The Development of an Intuitive Cognitive Style Process Model

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To Mum, Dad and Peter.

Abstract

Intuitive cognitive style has a long history describing the role of physical sensations (also known as gut feelings) as a dispositional preference within individual differences research. Traditionally, intuitive cognitive style has been taken as one pole of the bipolar intuition-analysis construct (Allinson & Hayes, 1996). Within the traditional approach, intuitive cognitive style research (Allinson & Hayes, 1996) has described individual differences in behaviour. However, recent mismatch between the theory and psychometric findings on the intuitive pole of intuition-analysis has led other researchers (Hodgkinson & Sadler-Smith, 2003) to question the bipolar nature of the construct. Furthermore, the new neuroscience of intuitive cognitive style's cousin, intuition, described intuitive constructs as consisting of the integration of cognitive, affective and somatic processes that yield physical sensations and has raised the important question about how the integration of seemingly disparate processes may occur (Hodgkinson, Langan-Fox, Sadler-Smith, 2008). In addition, intuitive physical sensations in the guise of somatic markers have come to the fore as central to understanding anti-social behaviours and obsessive compulsive disorders (e.g. Blair, 2001). Thus, knowing more about the process by which intuitive style, particularly from a dispositional individual differences perspective, not only may be valuable in research but also in clinical practice. To this end, the current thesis developed a psychoneurobiological-based self-report multidimensional process model of intuitive cognitive style based on the neuroscience of intuition for use in both research and practice. A new multidimensional scale was developed, the Intuitive Cognitive Style Scale (ICSS), to assess intuitive style as a multidimensional variable. The ICSS was administered in two separate data collections (total n= 509) to intuitive samples, together with a battery of occupational and personality instruments. The ICSS scale components were then submitted to process modelling and two main models were supported. In negative affective states, intuitives experience associative processing, that then focussed attention on observed non-verbal cues, which then triggered a physical feeling. In contrast, for positive affective states, intuitives experience associative processing, that then lead to the involvement of positive affect, which then triggered a physical feeling. Based on the results of the process modelling, the ICSS was modified and the physical feelings component examined together with occupational variables as a comparison with previous findings in which intuitive cognitive style was one pole of a bipolar construct. Further theoretical developments for intuitive cognitive style were then pursued for research and clinical practice according to the findings from the process modelling. Recommendations for future research include examining ICSS together with physiological measures, brain imaging and measures of psychopathologies to further clarify the role of a multidimensional process model of dispositional physical feelings.

Declaration

This is to certify that:

i) this thesis comprises only my own work,

ii) contains no material which has been accepted for the award of any other degree or diploma in any university or other institution,

iii) due acknowledgement has been made in the text to all other materials used,

iv) the thesis is less than 100,000 words in length, exclusive of tables, figures, references and appendices.

The work undertaken for this project was duly authorised by the Standing Committee on Ethics in Research Involving Humans of Monash University on 10th November, 2008, project number 2008001566.

Jennifer Otto

14th March 2013

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"The intuitive mind is a sacred gift and the rational mind is a faithful servant. We have created a society that honors the servant and has forgotten the gift."

Albert Einstein

Chapter 1

Introduction

This thesis considers intuition – often described in general by psychologists as a 'gut feeling' which embodies physical sensations – in its form as a stable, habitual preferential response to all information, called intuitive cognitive style. As a definition-in-progress, intuitive style is described as preferring a broad overview of information that operates below the level of effortful thinking and is affectively driven (Sadler-Smith, 2008). For ease of reading intuitive cognitive style will be referred to as *intuitive style* in this thesis. An exemplar of the experience of intuitive style would be when a mathematician usually trusts a 'gut feeling' intuitive physical sensation about changes to a particular formula and 'just knows', without being able to describe how they know, that the chosen option will provide the best outcome. Other examples of intuitive style include making decisions based on ‘gut feel’ or solving problems by gut feel where the intuitive relies on their physical sensations to come to a solution. The experience of intuitive style is often described as one that is a preference for non-conscious, holistic and rapid processing, where the person arrives at a particular understanding without any apparent effortful thought and cannot express the steps they have taken along the way. That is, the intuitive style process is not something that can be articulated. This non-conscious, holistic, rapid, non-verbal process has an affective component that is experienced as a degree of positive or negative emotion together with a physical sensation. Thus, intuitives are often said to be ‘following their heart’. For those who tend towards analysis, the intuitive style process may present as a frustration. This is because the intuitive style process is not amenable to scrutiny unlike the analytic, step-by-step process that is open to external scrutiny should the person share their thoughts. Further, the ‘I’m following my feelings’ nature of intuitive style may be experienced by non-intuitives as something non-logical, to be excluded from thought processes.

1.1 Background

This thesis is to be read from a psychological perspective and is not a business/management thesis. For clarity, examples from business management are presented to demonstrate the role of intuitive style, particularly in its original intuitive-analytic (Allinson & Hayes, 1996) form. Although the intuitive-analytic bipolar approach has been fruitful, recent psychometric and neuroscience findings (e.g. Hodgkinson & Sadler-Smith, 2003a) have raised questions about the appropriateness of the theory underpinning intuitive style as a bipolar opposite to analytic style, opening up opportunities to build on the existing knowledge created from the bipolar construct. In the process of questioning the bipolar approach, some apparently perennial questions about the nature of style and style research have arisen.

As a field of research, cognitive style has been criticised by other researchers (e.g. Tiedemann, 1989) for the multiplicity of style labels and their corresponding instruments, as well as for lacking in a substantive theoretical framework. It is notable that cognitive style is considered to be a construct bridging personality on one hand and cognitive abilities on the other (Messick, 1996) meaning that the operationalisation of cognitive style has been, and is currently (Rayner, 2011), an issue: This raises questions about the nature of cognitive style, is it best conceived as some form of cognitive ability or some form of personality, or perhaps it is something else entirely. This thesis will address these issues through taking a fresh approach to the theory of cognitive style by employing a psychoneurobiological-based multidimensional approach

Cognitive style is not the only area in which such questions arise. Intuition has been another area of research where getting to the nature of intuition has appeared to be very difficult. Not surprisingly then, bringing intuition and cognitive style together in the form of intuitive style presents a distinctly unique picture in terms of understanding the nature of the construct. Fortunately, research on intuition has progressed at a rapid pace with the maturing of technologies such as functional magnetic resonance imaging that have provided the landscape in which the rapidly evolving understanding of intuitive processes in humans has taken place over the past decade (Hodgkinson, Langan-Fox, & Sadler-Smith, 2008), using Einstein's faithful servant, the rational mind, to more fully understand intuition.

As a result of new technologies, there has been a shift in thinking about intuition from a somewhat mystical and gendered approach, and perhaps an attitude towards intuition as not amenable to scientific investigation, towards a rigorous neuroscience-based approach; theoretically and empirically detailing the specific characteristics of intuition as separate and distinct from analysis. Indeed, progress on understanding intuition from a neuroscience perspective is beginning to transfer to research in areas such as social cognition (e.g. Lieberman, 2000) that seem to be closely related to intuition.

Furthermore as new knowledge about intuition is emerging, particularly about the role of physical sensations, it is influencing understanding not only to do with individual differences, but also anti-social behaviours and obsessive compulsive disorders. In particular, being able to experience some form of physical sensation is of increasing importance in understanding the reasons why individuals behave in anti-social ways (Blair, 2001) and why individuals engage in obsessive-compulsive behaviours

(Lawrence, Wooderson, Mataix-Cols, David, Speckens, & Phillips, 2006). These kinds of influences for the family of intuition constructs across a wide variety of research fields are beginning to establish the importance of more fully developing a theoretically substantive framework, particularly in terms of intuitive style, because of what may be learned from the operation of intuition in its form as a preferential dispositional response. Yet, intuitive style has, to date, seemingly no links to the neuroscience informing intuition, perhaps due to conceptual issues.

As can be seen from the previous discussion, there was no mention of Jungian psychoanalytic formulations of intuition. Jung (1971) stated that intuition is about unconscious perceptions that are not sensations, feelings or intellect but something closer to instinct. Contrary to current thinking on intuition, Jung described intuition as being ‘given’ with a sense of mystery about how the intuition arises, contrasting it with processes that are a ‘product’ of thinking or feeling (p. 453), whereas, current definitions of intuition are about feeling and thinking. Moreover, the details of the unconscious perception of internal information and subliminal processing of information in Jung’s description of intuition may be easily explained nowadays in terms of processes such as interoception and implicit learning, respectively. A pragmatic approach to evolutionary psychology parallels Jung’s (1971) notion that aspects of intuition are phylogenically old, however, researchers are unlikely to hold to Jung’s notion that intuition is ‘a characteristic of infantile (or simple) … psychology’ (p. 454) given the evidence for intuition as a complex process. Rather, research in intuition has taken neuroscience evidence as a foundation for theoretical propositions about intuitive constructs finding that Jungian psychoanalytic formulations of intuitiveness, including intuitive style, lack correspondence between the psychometric evidence and the Jungian theoretical assumptions (Hodgkinson, et al., 2008). Indeed, neuroscience evidence may be said to have had such a significant impact on the way in which intuition constructs are conceived that it has been suggested that the many researchers in intuition hold neuroscience perspectives (Hodgkinson et al., 2008).

Indeed, the field has progressed so far in such a short period of time, relatively speaking, that researchers are now calling for different methods and approaches to understanding intuition constructs. According to Hodgkinson et al. (2008, p. 19)

> *" ...there is a need for further advancement of our understanding of intuition in terms of its underlying somatic, affective, and cognitive components. In particular, there is a pressing need to understand more fully how these various components are integrated. "*

1.2 Research Aim

Although there are extensive reviews concerning intuition written from differing fields of research, including social cognitive neuroscience, neuropsychology and cognitive neuroscience and written for a variety of audiences including researchers and employers, to date, no research work has comprehensively and explicitly sought to capture the key characteristics of intuitive style based on the new neuroscience of intuition. Moreover, to date there are no known instruments that have examined intuitive style from a perspective of a psychoneurobiological-based multidimensional process model or developed such an understanding into a testable, statistical process model integrating the somatic, affective and cognitive components.

> *Therefore, the aim of the current thesis is to develop a process model of intuitive style, within the context of the new neuroscience approach to intuition.*

To achieve this aim, the typical approach to researching cognitive style, including the assumption that styles are bipolar constructs, will be set aside to let the evidence from the neuroscience on intuition guide the development of a fresh, robust theory about the key characteristics that make up intuitive style integrating for the first time, to date, the cognitive, affective and somatic aspects of intuitive style.

1.3 Thesis Structure

There are a number of challenges and potentialities in cognitive style research, in general, that need to be brought to the fore in developing a psychoneurobiological-based multidimensional self-report process model of intuitive style, one of which is the apparent sameness of intuitive style to other cognitive style constructs. To this end, Chapter 2 presents a history of cognitive style that briefly charts the development of theories of cognitive style spanning many years and further explains some of the issues in researching style together with the main purpose of differentiating intuitive style from other similar cognitive styles. In this chapter, four groups of cognitive styles are examined: cognition-centred, personality-centred, dual-process, and super-ordinate approaches.

One of the key points to note in approaching cognitive style research is that the multiplicity of style labels and instruments has occurred perhaps because different researchers have noted different aspects of cognitive style through their own view of the world and as a result labels vary in conceptual content, and sometimes overlap. To manage these varied and differing style labels, in the past, researchers have distinguished them according to whether they employed style measures similar to those used in cognitive abilities or similar to those used in personality. Further, others have suggested over-arching labels under which previously developed styles may be classified. Intuition-Analysis, because of its seemingly super-ordinate qualities, has been dealt with in this thesis as an over-arching label.

Chapter 3 takes a closer look at the literature on the intuition pole of the bipolar intuition-analysis construct as conceived originally by Allinson and Hayes (1996) which is demonstrated in business settings. The progressive development of intuition-analysis revealed the usefulness of understanding the impact of individual differences in the workplace and demonstrated that intuitive style is associated with various job tasks, job roles and aspects of the work environment.

Although the results for intuitive style are informative for staff and companies alike, recent psychometric examination has resulted in a few researchers (e.g. Hodgkinson & Sadler-Smith, 2003a) questioning the bipolar structure and, therefore, the theoretical propositions underlying intuition-analysis. In particular, the intuitive pole of intuition-analysis has appeared not to stand up to such scrutiny suggesting that it may be better conceived as a multidimensional construct, separate from analysis. However, the first problem that arises from a multidimensional approach is that there is limited evidence describing possible dimensions of intuitive style.

As a result of other researchers questioning the nature of intuitive style as part of the bipolar intuition-analysis, the current thesis turns to other fields to find out more about the intuition family of constructs and to determine what components and dimensions may best represent intuitive style. To this end, Chapter 4 built on the evidence from the bipolar intuition-analysis construct and examined existing intuition definitions to see if there is any consistency across different fields of research. In addition, the body of work accumulated in the last ten years on the neuroscience of intuition pertinent to intuitive style was examined. While it may be argued that such developments have the potential to reduce intuition to activity among neurons, it in no way removes the need to understand the psychological processes associated with brain functionality. The neuroscience work on intuition has arisen in a number of different research areas from social cognition to decision making, bringing together the psychological experience and neural structure and function, and highlighting potential components of intuitive style. Chapter 4 then moves on to distinguish intuition from other closely related concepts that are often confused with intuition. The new knowledge about the neuroscience of intuition is applied to intuitive style and together with evidence gleaned from the bipolar intuition-analysis construct, intuitive style was re-conceptualised and a set of dimensions with their corresponding components was proposed.

Having formed a set of dimensions and components to be used in a psychoneurobiological-based multidimensional intuitive style process model, the next step was to develop and validate an instrument, the Intuitive Cognitive Style Scale (ICSS) in Chapter 5. However, along the way, an exciting new statistical development, ALPHAMAX (Hayes, 2005), in scale shortening procedures was used to inform the current work. This process was a great help in balancing the need for reliability against the need for parsimony. Furthermore, since replicability is one of the great tenets of science, it was decided to split the sample to allow for the factor structure to freely emerge from both samples during scale development, rather than impose the constraints of assuming factor structure for the purpose of confirmatory factor analysis, even though this resulted in a relatively small sample size for each factor analysis (Kline, 1986). However, there emerged a defined set of components and dimensions to support a process model of intuitive style that were subjected to scrutiny in terms of a number of aspects of validity and reliability.

No further scale development was pursued at this point because it was deemed likely that the statistical process modelling would reveal further information that would inform future scale development. Disappointingly, then, no longitudinal data was able to be collected for the new intuitive style scale. However, the purpose of the thesis was to develop a process model of a psychoneurobiological-based multidimensional intuitive style rather than to focus on the scale development alone as well as detailing the potential ways to integrate the dimensions of intuitive style turned out to be insightful work.

Chapter 6 returns to the literature to determine ways in which the dimensions of intuitive style may be integrated as process models (e.g. Somatic Marker Hypothesis: Damasio, 1999). A diverse set of literature was tackled in the search for any existing theories that may speak to the dynamic integration of the dimensions within intuitive style. To this end, Chapter 6 covers selected theoretical models that vary from neuroscience approaches to cognitive decision making, ranging from works seemingly forgotten to present day theories that were thought to provide a substantive theoretical foundation for the intuitive style process. Notably, none of the models dealt in detail with the ways in which information enters the intuitive style process. Stemming from this review were a set of potential process models that were deemed amenable to statistical analysis which may explain how the dimensions of intuitive style are integrated, from which, a series of hypotheses were formed.

An exciting new approach to indirect effects statistical modelling, PROCESS (Hayes & Preacher, 2011), was used in Chapter 7 to model the ways in which the dimensions of intuitive style may form process models. The new approach to indirect effects modelling allows for multiple models to be tested simultaneously, thus reducing the impact of error. One down side to this approach is however, that it only involves observed variables and as a result there is no data to indicate potential missing latent variables in the models or other error such as would be the case if structural equation modelling had been used. However, the small sample size was deemed to be more than suitable for the new approach to indirect effects modelling. The new approach to indirect effects modelling seeks to demonstrate the cascade effect of one variable through a set of intermediate variables, in a causal-like chain, to the outcome variable where a set of point-estimates, with corresponding standard error confidence intervals, are generated using bootstrap procedures. The result of PROCESS on the proposed intuitive style process models demonstrated support for two main models and the potential impact of the type of information on the triggering of various components of intuitive style. Moreover, the process modelling of the components of intuitive style were shown to yield the physical sensations component.

Since the intuitive pole from the bipolar intuition-analysis was examined in workplace settings, and evidence from the literature review of intuition-analysis suggested that intuitive style should be associated with specific jobs as well as broader occupational areas, the physical sensations component of the ICSS was further investigated. To this end, Chapter 8 presents the details of a re-examination of relationships between intuitive style and occupational variables noted in the literature review on intuition-analysis. Once again a fresh statistical approach to mediation was taken to model the relations among job satisfaction variables, personality traits and physical sensations moving the cognitive style literature one step forward from descriptive relationships. In this case, the mediation models were performed using new multiple mediation techniques, MEDIATE (Hayes & Preacher, 2012), that allow for all mediators to be modelled in parallel using bootstrapping procedures to generate point-estimates for the mediation and their corresponding standard error confidence intervals. Modelling mediators in parallel helps to control error associated with testing many models and can demonstrate the strongest mediator in a set of mediators. As noted previously, such modelling procedures only deal with observed variables and do not say anything about latent variables, nor can these procedures demonstrate the presence of other unobserved latent variables or error. However, given the relatively small sample size, multiple mediation modelling was deemed to be a suitable approach to analysing the data. The results of the parallel mediation modelling demonstrated that of the personality traits examined extraversion, perhaps not surprisingly, turned out to be the strongest mediator of the relationship between physical sensations and aspects of job satisfaction. Although the results of Chapter 8 were limited, it was important to understand any potential changes in the relationship of physical sensations with occupational variables due to the move from intuitive style as one pole of a bipolar construct to intuitive style as a psychoneurobiological-based multidimensional process model.

The ultimate chapter, Chapter 9, returns to reflect on and explore further the theoretical implications of intuitive style as a psychoneurobiological-based multidimensional process model in relation to cognitive style research. Further theoretical developments of the intuitive style process model together with the implications for clinical practice are presented. In the first section of Chapter 9, some long-standing issues in cognitive style research are reflected upon and discussed with respect to the evidence from the current thesis. These issues range from epistemology in the field of cognitive style to measurement concerns. The current thesis represents a departure from the typical ways in which research occurs in cognitive style and, therefore, it was pertinent to reflect on the implications for cognitive style as a field.

Furthermore, additional theories, particularly from neuroscience, were drawn together in Chapter 9 to further underpin intuitive style as a process model. While further neuroscience development lead to increased complexity, it is argued that the integration of the dimensions in intuitive style will always result in complexity and not parsimony. This is because the model involves the interaction of cognitive processes with affective processes and somatic processes from the neuronal level through to the psychological level.

In the course of researching potential process modelling options in Chapter 6, it came to light that one of the theories underpinning the process modelling examined in the current thesis was being operationalised using physiological measures to better understand areas as diverse as mental well-being, trauma and psychopathologies. The potential for the current intuitive style process model in its form as a psychometric instrument to inform work using current physiological measures in anti-social behaviours, obsessive compulsive disorders and what it means to be mentally healthy will, hopefully in the future, turn out to be a fruitful line of research.

Chapter 2

History of Cognitive Style

Introduction

This chapter reviews the history of cognitive style as a field of individual differences research and situates intuitive style within the broader context of cognitive style. The chapter aims to distinguish intuitive style from other similar cognitive style constructs.

Cognitive style, sometimes known as thinking style or information processing style, is the broad term applied to the stable, preferred ways in which an individual thinks that pervades all of life (Messick, 1976). From a narrower perspective, Allport (1937) described cognitive style as the typical patterns of thinking, problem solving, perceiving and remembering. As a field of research, cognitive style may be broken up into at least four main approaches to research (Sternberg, 1997; Rayner, 2000): cognition-centred cognitive style, personality-centred cognitive style, dual-process approaches and super-ordinate approaches. The focus of this chapter is on the dual-process and super-ordinate approaches to cognitive style, the recent approach to intuitive style and the original approach to intuitive style, respectively. The chapter begins with a foray into the historical background of cognitive style and aims to focus on cognitive styles that may help to inform a psychoneurobiological-based multidimensional self-report process model of intuitive style.

2.1 Historical Background of Cognitive Style

Although cognitive style came to the attention of researchers in the late 1800's (Galton, 1883) as part of individual differences, earlier descriptions of cognitive style date back to the ancient Greeks. In ancient Greek history two different ways of thinking, the rational and the irrational, were acknowledged (Dodds, 1964). The rational way of thinking was described by the ancient Greeks as logical, hypo-deductive thinking; whereas, the irrational way of thinking was described as feelings based intuitive thinking (Dodds, 1964). The distinction between logical-rational thinking and intuitive thinking persists to this day (e.g. Allinson & Hayes, 1996) and is a prominent theory describing individual differences in cognition. In addition to preferences for rational or intuitive thinking, early descriptions of cognitive style include preferences for visual and verbal cognitive styles (Galton, 1883).

Individual differences in visual and verbal cognitive style are applied in educational settings (e.g. Rayner, 2000) and pre-date Galton (1883). For example, Napoleon the First was apparently quoted as saying that:

> *"There are men who from some physical or moral peculiarity of character, make each thing a picture. No matter what knowledge, intellect, courage, or good qualities they may have, these men are unfit to command"* (p. 15, cited in Home, 1873)

Napoleon's quote appears to have pejorative overtones that are addressed by today's researchers in cognitive style (e.g. Sternberg, 1997). Indeed, one of the strongest claims for the development of cognitive style is that it does not seek to value one thinking preference above another. In cognitive style, each thinking preference is given equal worth (c.f. cognitive abilities where greater ability is considered better and to be highly valued). To this end, understanding thinking preferences in today's educational and business settings has led to the acknowledgement of the role individual differences play in areas such as learning (e.g. Riding, 2000), industrial/organisational psychology (e.g. Armstrong & Cools, 2009) and career management (e.g. Chang, Choi, & Kim, 2008). Thus, individual differences in thinking preferences have been acknowledged throughout history and continue to have impact in everyday life. Against this short historical backdrop of cognitive style the detail on the development of the constructs and research programs in cognitive style is presented.

2.2 Development of the Cognitive Style Construct

Although most researchers agree with these general definitions of cognitive style given by Allport (1937) and Messick (1976), researchers vary in the breadth of what they include in the construct, appearing to build definitions to suit their own purposes (Riding & Cheema, 1991) initially based on personality or cognition. Further evidence of the individualistic nature of cognitive style research was demonstrated in a recent Delphi study by Peterson, Rayner, and Armstrong (2008) who found that 31 of the original 110 researchers interested in cognitive and learning styles, contacted through the European Learning Styles Information Network (ELSIN), were able to come to some agreement on the following definition of cognitive style: cognitive style is defined by ELSIN as “individual differences in processing that are integrally linked to a person’s cognitive system, they are a person’s preferred way of processing, are partially fixed, relatively stable, and possibly innate preferences” (Evans, Cools & Charlesworth, 2010, p. 467). Evidence for the individualistic nature of cognitive style research appears not only in the definition of the construct, but also in the criteria for the construct.

The criteria for a construct to be considered a cognitive style (Riding, 2000; Sternberg, 1997) are:

- bipolar and stable, dimensions should be separate from one another
- independent of cognition and personality
- related to observed behaviours
- related to physiological measures

This discussion of epistemology is returned to in Chapter 9. These criteria for a cognitive style were used in the current history to exclude learning styles (e.g. Learning Style Indicator), learning strategies (depth of processing), cognitive strategies (e.g. mnemonics) and personality types (e.g. Jungian measures).

Some researchers have developed cognitive styles with unipolar dimensions (e.g. Conceptual Articulation) rather than bipolar dimensions and a few researchers relate their cognitive style constructs to physiological measures. As a result of such multiplicity, cognitive style has been criticised by others (e.g. Klien, 2003; Tiedemann, 1989) for its lack of unity in the field. Nonetheless, it may be that the cognitive style of the researcher influenced their perception of what style should be and therefore, the way in which cognitive style was conceived.

Two main paths of research appear to have grown in cognitive style: The experimental approach of the cognitive path (cognition-centred cognitive style) and the self-report approach of the personality path (personality-centred cognitive style). In addition, two theories fit into a dual-process approach to cognitive style, based on two different ways of thinking, and there is a fourth path, the super-ordinate approach, to do with integrating the many different dimensions within the cognitive style construct. A timeline (Figure 1) shows the many constructs developed in cognitive style according to the personality-centred and cognition-centred approaches.

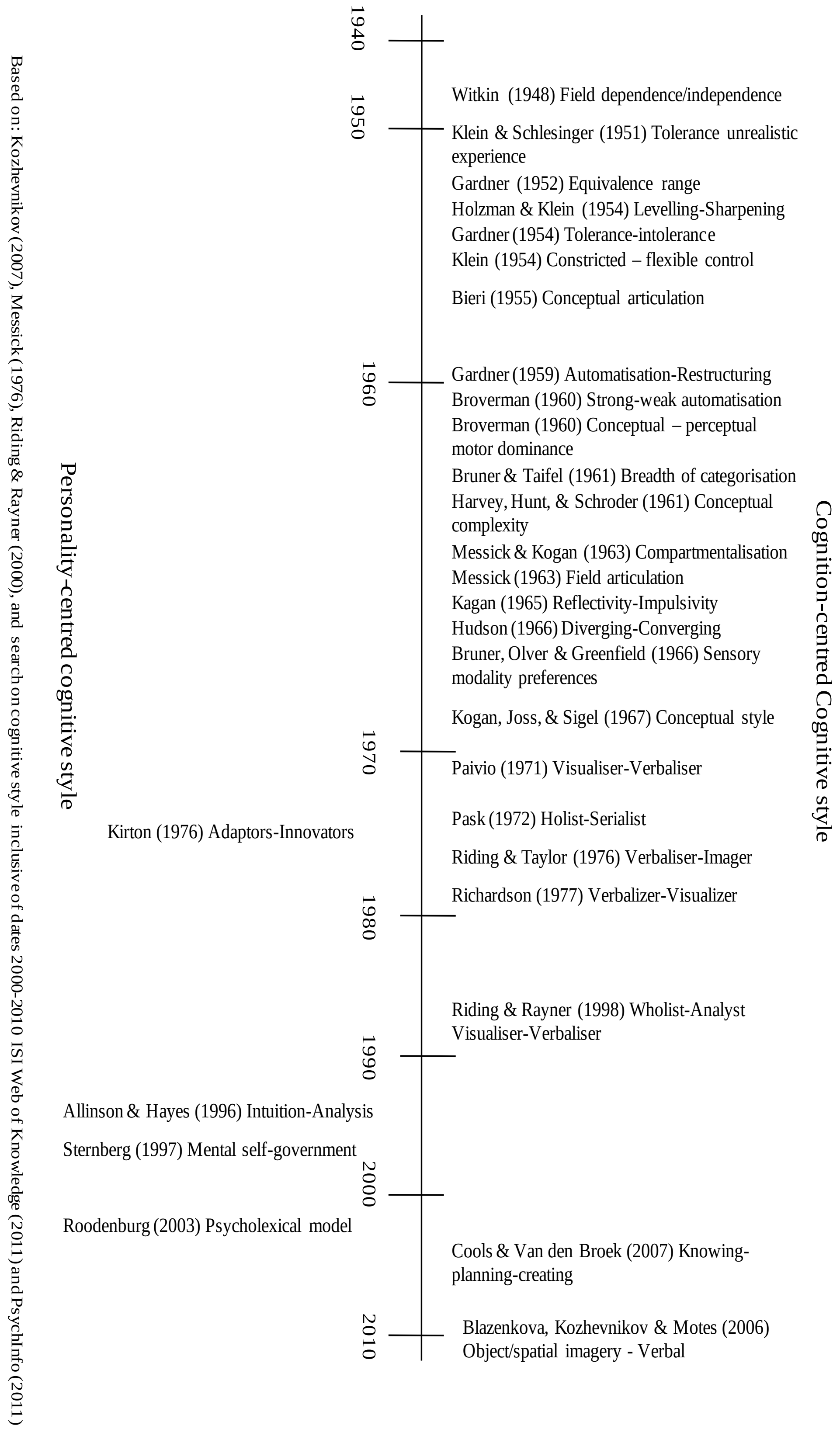


Figure 1. Timeline of Cognitive Style Research

2.2.1 Selection Criteria for Literature Search

A search of ISI Web of Knowledge (2011) and PsychInfo (2011) databases using each individual cognitive style label (e.g. Wholistic) and the term cognitive style, inclusive of dates from 2000 to 2011, for peer reviewed journal articles showed that the following theories, were used in more than one published study and have characteristics similar to intuitive style. Intuitive style being characterised as: *preferring a broad overview of information that operates below the level of effortful thinking and is affectively driven* (Sadler-Smith, 2008).

To be considered to be similar to intuitive style a cognitive style must have one or more of the following in common: a preference for a broad overview of information, open-ended approach to problem solving, a random approach to exploration and to rely on gut feelings (Allinson & Hayes, 1996). Based on these criteria the literature search yielded the following cognitive styles:

Cognition-centred cognitive styles

- Field dependence/independence (Witkin & Goodenough, 1981)
- Wholistic-Analytic Visual-Verbal (Riding & Rayner, 1998)
- Knowing-Planning-Creating (Cools & Van den Broeck, 2007b)

Personality-centred cognitive styles

- Adaptors-Innovators (Kirton, 1989)
- Mental Self-Government (Sternberg, 1997)

Dual-process approach

- Cognitive-Experiential Self-Theory (Epstein, 1996)
- Intuition-Deliberation (Betsch, 2004)

Super-ordinate approach

- Intuition-Analysis (Allinson & Hayes, 1996)
- Wholistic-Analytic-Visual-Verbal (Riding & Rayner, 1998)

Because many of the theories in cognitive style are no longer in use, the focus of this history is on cognitive style theories similar to intuitive style in use from the year 2000.

2.3 History of Cognition-Centred Cognitive Styles Similar To Intuitive Style

Much of the early history of cognitive style has come from the cognition-centred path of cognitive style and is demonstrated in educational settings. The cognition-centred path of cognitive style continues to be the most prolific in terms of research activity (Kozhevnikov, 2007), in general. The list shown in Figure 1 is indicative of the volume of theories and instruments created in the cognition-centred path of cognitive style. The early cognition-centred cognitive style research (e.g. Witkin, & Ash, 1948) was driven by the individual differences in people's responses on ability and aptitude tests. To this end, much of the research in the cognition-centred path of cognitive style draws heavily on cognitive psychology in terms of its theories and methodology and is considered by some (Richter, 1992; Sternberg, 1997) to be mechanistic and confounded with cognitive abilities. Perhaps as a result of such challenges to methodology, a lull in research occurred between the late 1970's to the late 1990's.

A resurgence of interest in cognition-centred cognitive style came in the late 1990's led by Riding and Rayner (1998) following a period in which cognitive style, in general, seemed to fall into obscurity (Miller, 1987). Riding and Rayner (1998), Miller (1987) and Sternberg (1997) make the point that the plethora of cognitive styles in the literature, challenges of measuring style and individualistic research programs may have contributed to the apparent hiatus of around 20 years.

2.3.1 Cognition-Centred Cognitive Style Theories In Current Use Similar to Intuitive Style

Literature search revealed three cognition-centred cognitive style theories with active research programs in current published studies. Field Dependence/Independence (Witkin & Goodenough, 1981) and Wholistic-Analytic Visual-Verbal (Riding & Rayner, 1998) theories have well-established research programs. One new theory in this category has been developed called Knowing-Planning-Creating (Cools & Van den Broeck, 2007a, 2007b). These theories will be presented in chronological order, beginning with Field Dependence/Independence. However, the research in cognition-centred cognitive style will be covered here briefly because the focus of this thesis is on intuitive style as originally presented in super-ordinate approaches and dual-process approaches.

2.3.2.1 Field Dependence/Independence

Unlike the majority of early cognition-centred cognitive styles, Field Dependence/Independence developed extensively, possibly because it became a more inclusive theory than other cognition-centred cognitive style theories (Witkin & Goodenough, 1981). Field Dependence/Independence (FD/FI) (Witkin, 1950) began with individual differences in the cognitive aspects of visual perception then broadened to include aspects of affect and personality (Witkin & Goodenough, 1981). Field Dependent individuals were thought to rely on information from the environment that directs their cognition, whereas, field independent individuals have a preference for determining their own responses and thoughts.

To understand more about individual differences in pilot's perception of instruments and visual horizon, Witkin and Ash (1948) and Witkin (1950) began testing individual differences in visual perception using the Rod-and-Frame test[1]. Over the years, FD/FI grew to include social, personality and affective aspects in the theory. Through this development FD began to look like intuitive style, having the similar preference for a broad overview, being social and the involvement of affect in decision making. The expansion of FD/FI to include non-cognitive aspects was due to evidence that field independence seemed to be related to perceptual and non-perceptual activities (Witkin & Goodenough, 1981). The inclusion of non-perceptual aspects of the person in FD/FI may be reflective of the breadth of the definition of cognitive style (Messick, 1976) perhaps making it difficult to delineate FD/FI from other constructs.

Today, FD/FI remains an active research program continuing through the apparent lull in research activity between the late 1970's to late 1990's. A search of ISI Web of Knowledge (2011) on FD/FI yielded 82 peer reviewed journal articles (see Table 1), of which two articles included FD/FI in literature reviews related to cognitive style (Kozhevnikov, 2007) and working memory (Solaz-Portoles & Sanjose-Lopez, 2009).

[1] The Rod-and-Frame test is performed in a darkened room where individuals were to determine whether or not the rod, placed inside a frame, was in an upright position. Witkin and Ash (1948) found that some people were not influenced by the position of the frame when determining if the rod was upright, whereas others saw the rod as upright only in relation to the orientation of the frame.

Table 1. Research in Field Dependence/Independence 2000-2010

Area of research	Articles found in database search, for reference only (full details not listed)
Cognitive psychology	Alamolhodaei (2009), Angeli & Valanides (2004), Angeli, Valanides & Kirschner (2009), Bernardi (2003), Chao, Huang & Li (2003), Chapman & Calhoun (2006), Chou (2001), Cristea (2004), Ford & Chen (2001), Gibbs (2000), Guisande, Paramo, Tinajero & Almeida (2007),Hecht & Reiner (2007), Hicks, Bagg, Doyle & Young (2007), Hodgson, Christian & McMorris (2010), Janing (2001), Kang, Scharmann, Noh & Koh (2005), Kang, Scharmann & Noh (2004), Maes, Vich & Eling (2006), McMorris, Sproule & MacGillivary (2002), Miyahara & Goshiki (2004), Miyake, Witzki & Emerson (2001), Morra (2002), Morra (2008), Musch (2003), Niaz, De Nunez & De Pineda (2000), Pithers (2000), Ratanova & Likhacheva (2009), Rittschof (2010), Rothermund & Wentura (2001), Rothkopf, Dashen & Teft (2002), Salbod (2001), Saracho (2001), Si & Xu (2008), Smith (2002), Song (2004), Stamovlasis (2010), Stash & De Bra (2004), Stoesz, Jakobson, Kilgour & Lewycky (2007), Tallir, Musch, Valcke & Lenoir (2005), Tsakanikos (2006), Tsitsipis,Stamovlasis & Papageorgiou (2010), Vincent-Morin & Lafont (2005), Yan (2010), Yao (2008), Zhang (2002), Zhang (2004), Zheng, Yang, Garcia, & McCadden (2008).
Psychopathology	Calamari, Pini & Puleggio (2000), Glicksohn, Naftuliev, & Golan-Smooha (2007), Tokley & Kemps (2007)
Personality	Endler (2000), Glicksohn & Golan (2001), Murray (2007), Rehulkova (2007), Tsakanikos & Reed (2003), Ustarroz, Sayes, Calvo & Mata (2005)
Physical Skills	Burge, Fowlkes & Banks (2010), Glicksohn, J., & Kinberg, Z. (2009), Guillot & Collet (2004), Hecht & Reiner (2007), Liu (2005), Liu & Chepyator-Thomson (2004), Liu & Chepyator-Thomson (2003), Luyat, Moroni & Gentaz (2005)
Cognitive style	Li, Sun, Fu, Zhang & Xu (2004)
Social psychology	Gibson (2003)
Vocational psychology	Guisande, Paramo, Soares & Almeida (2007)

Research of FD/FI in cognitive psychology generally took place in educational settings. Exemplars of studies in contemporary educational settings include Tsitsipis, Stamovlasis, and Papageorgiou (2010) and Angeli, Valanides, and Kirschner (2009).

In a study of 329 students aged 14-15 situated in Greece, Tsitsipis, Stamovlasis, and Papageorgiou (2010) found that students who are field independent were more likely to achieve better results in science subjects than field dependent students. When learning about the different states of matter, field independence predicted better understanding of changes of state and structure of matter than field dependence. Similarly, in a study of learning performance and computer modelling software, Angeli, Valanides, and Kirschner (2009) found that student teachers who were field independent learners benefitted from an instructional format that included both text and diagram, whereas, field dependent students tended to experience an increase in their cognitive load (having to work harder) and decreased performance compared to the field independent students.

Although FD/FI is an active research program, some researchers (e.g. Richter, 1991) have questioned the validity of measures of FD/FI because of the strong association with cognitive abilities. Indeed, Tinajero and Paramo (1997) demonstrated an association of around 40% between field independence and Cattell's Culture Fair Intelligence Test. Furthermore, the way in which FD/FI is measured is of concern because instruments such as Embedded Figures Test measure field independence are thought to infer field dependence rather than measuring a preference for field independence or field dependence (Richter, 1991; Rittschof, 2010). In addition, researchers have re-conceptualised FD/FI as a cognitive control (Jonassen & Grabowski, 1993), a spatial ability (Sternberg, 1997) and as a perceptual ability (Zhang, 2004). The notion that FD/FI is an ability is strongly supported by evidence from McLeod, Jackson and Palmer (1986) who found no difference between FD/FI and spatial ability, and further evidence that FD/FI appears to include the cognitive abilities of the visuospatial sketch pad and central executive functioning (Miyake, Witzki, & Emerson, 2001). Having briefly examined FD/FI, the next cognition-centred cognitive style of Wholistic-Analytic together with Visual-Verbal cognitive styles will be presented helping to clarify the differences between cognition-centred cognitive styles and intuitive style.

2.3.2.2 Wholistic-Analytic Visual-Verbal Cognitive Style

Riding and Cheema (1991) began to address the plethora of cognition-centred cognitive styles by looking at the associations among early cognition-centred cognitive styles, subsuming them into super-ordinate categories of Visual-Verbal and Wholistic-Analytic styles, of which, the Wholistic pole is considered very similar to intuitive style but does not take into account affective and somatic components. The Wholistic-Analytic label is thought to describe a person's preferred way of organising information (Riding & Rayner, 1998) and subsumes Holist-Serialist (Pask, 1972), Field Dependence/Independence (Witkin, 1950), and Levelling-Sharpening (Holzman & Klein, 1954) labels, while the Visual-Verbal label is thought to describe preferences in mental representation and subsumes Visualiser-Verbalizer (Richardson, 1977), Verbaliser-Imager (Riding & Taylor, 1976) and Visualizer-Verbalizer (Paivio, 1971) labels.

Similar to intuitive style, Wholistic cognitive style is described as preferring a broad overview of information, compared to Analytic which is a narrow step-by-step approach to information. The Visual component is considered a preference for representing and processing information visually and the Verbal component is considered as representing information verbally. Riding and Rayner posited that the Wholistic-Analytic and Visual-Verbal styles would interact in some way to influence a person's learning outcomes. The research concerning the interaction of Wholistic-Analytic and Visual-Verbal styles is presented in Section 4 of this chapter on the Super-ordinate Theories of Cognitive Style. What follows in this section concerns evidence pertaining to the separate Wholistic-Analytic dimension of cognitive style.

To facilitate research on Wholistic-Analytic Visual-Verbal cognitive style, a computerised test was developed, the Cognitive Styles Analysis (CSA) (Riding, 1991) which measured individual's ratio of response times to visually-presented figure-ground shapes (Wholistic-Analytic) and text-based questions using abstract categorisation (verbal) or visually-rich text descriptors (visual). The way in which Wholistic-Analytic cognitive style is operationalised by the CSA demonstrates the conceptualisation of Wholistic-Analytic cognitive style to be cognition-centred and focused on lower-order cognitive processes. Although the Wholistic dimension looks like intuitive style, when juxtaposed, the Wholistic dimension does not include the affective or physical sensations aspects of intuitive style. What follows is a brief overview of research findings demonstrating the value of understanding about Wholistic-Analytic cognitive styles.

Wholistic-Analytic. Riding and his colleagues successfully used Wholistic-Analytic cognitive style to understand more about the impact of individual differences on educational outcomes. School performance, measured as recall of information, for Wholistic students was improved when a title was given at the beginning of the passage for 11 year olds (Douglas & Riding, 1993) and when sub-headings were included for 10-15 year old Wholistic students (Riding & Al-Sanabani, 1998). On the other hand, the recall performance of analytic students was not changed with the addition of a title (Douglas & Riding, 1993) or sub-headings (Riding & Al-Sanabani, 1998) in these age groups, with the exception of male analytics, whose performance improved markedly with the inclusion of sub-headings (Riding & Al-Sanabani, 1998) suggesting an interaction of gender with Wholistic-Analytic cognitive style.

However, in a different study of 11 year olds (Riding & Grimley, 1999), the limited amount of information displayed to students at any one time (termed viewing window size) in computer based learning negatively impacted the performance of analytic students compared to Wholistic students suggesting an alternative explanation for the previous findings on school performance. Riding & Grimley (1999) suggested that computer presented information has a narrow viewing window – only a specific amount of data can be seen at any one time – which hampers the analytics need to see all the information all at once to gain an overview (p. 52), contrary to the description of analytic cognitive style and similar to the description of Wholistics. Wholistics, were claimed to have a tendency to generate the whole from the parts and do not need to see the overview of the information, which is also contrary to the description of Wholistics preferring a broad overview. Additional research (Adams, 2001) suggested that Wholistic students are more likely to make decisions faster than analytics when the information was inferred rather than explicit and perhaps the tendency to infer information may have an impact on the findings of the study on computer-based learning as Wholistics may have been inferring information from the limited viewing window.

Although evidence from Riding and his colleagues suggested that understanding Wholistic-Analytic cognitive style benefited learners and educators, others (Peterson, Deary & Austin, 2005a) have questioned the way in which Wholistic-Analytic cognitive style is measured. Peterson, Deary and Austin (2005a) question the use of the CSA (computerised figure-ground) test because good performance on embedded figures tests is known to be strongly associated with high cognitive abilities. In addition, the presentation of word descriptions rather than pictorial images for the Visualiser component may have influenced test results (Peterson, Deary & Austin, 2005a) in favour of Verbalisers.

As a result of operationalisation issues of the Wholisitic-Analytic Visualiser-Verbaliser constructs and the CSA test, Peterson and Deary (2006) and Peterson, Deary and Austin (2005a) sought to improve the assessment of Wholistic-Analytic Visual-Verbal cognitive style by further developing the Wholistic-Analytic and Visual-Verbal operationalisations. In further developing the computerised testing of Wholistic-Analytic dimensions, Peterson and Deary (2006) took a reductionist approach in changing the Wholistic-Analytic section of the test to measure the ratio of inspection times for Navon-type stimuli. Navon-type stimuli are visual images in which a number may be made up of letters, or visa verse, and are similar to figure-ground images. For example, many letter L's may be placed together to form the number 2. Participants are asked to report on the number/letter and length of participant response time is taken to be an indication of cognitive style. In addition, Peterson, Deary and Austin (2005b) sought to improve the visual-verbal test.

Because Peterson, Deary and Austin (2005b) found the content of the CSA visual-verbal test to be biased towards verbalisers, they altered the test to include pictures in place of visually-descriptive text. For example, where the words 'red apple' appeared in the CSA, Peterson and her colleagues substituted a picture of a red apple. Substituting pictures for words in the visual-verbal in items designed to tap preferences for visual dimension of cognitive style providing a more balanced assessment. However, it may be argued that the operationalisation of Wholistic-Analytic and Visual-Verbal cognitive style measure cognitive abilities, such as processing speed, rather than style (Peterson, et al., 2005b).

2.3.2.3 Knowing-Planning-Creating

Knowing-Planning-Creating was developed by Cools and Van den Broeck (2007a) to address the multidimensional nature of cognitive style. Individuals who prefer knowing styles are described as having preferences for facts and details are analytic and logical. Planners are described as having preferences for order and structure, control, planning and preparation. In contrast to Knowers and Planners, Creatives are described as having preferences for uncertainty and freedom, unconventional and flexible ways of dealing with information. Knowing and Planning appear to be very similar to analytic cognitive style and Creating appear to be somewhat similar to intuitive style without affective or somatic components. However, creativity may be considered as a field distinct from that of intuitive style (Mumford, 2003). Knowing-Planning-Creating is operationalised by an 18 item self-report. In this new research program, Cools and Van den Broeck (2007b) began by using two large data sets, 24,267 and 2,182 respectively, from an online career survey tool. Their first study found differences in cognitive style between specific occupational groups. In particular, information technology occupations were found to have a knowing cognitive style, administrative/technical/production occupations were found to have a planning cognitive style. Marketing/sales/personnel/research and development/general management were found to have a creating cognitive style. To facilitate further understanding of knowing-planning-creating cognitive style, the second study by Cools and Van den Broeck (2007b), looked at the association of Knowing-Planning-Creating with job satisfaction, intent to leave and job search behaviours. Cools and Van den Broeck (2007b) found no evidence for greater job satisfaction when an individual's cognitive style fits well with the cognitive style of the occupation. However, people with a creating cognitive style were more likely to engage in job search behaviour and intent to leave compared to knowing and planning cognitive styles, regardless of fit.

2.4 Summary of Cognition-Centred Cognitive Style Theories Similar to Intuitive Style

Of the cognition-centred cognitive style theories that are in current usage, the Wholistic-Analytic Visual-Verbal and Field Dependence/Independence theories have established research programs providing ecologically relevant outcomes.

Nevertheless, cognition-centred cognitive style research is criticised by others (Tiedmann, 1989) for measuring cognitive abilities. Most criticism aimed at cognition-centred cognitive style concerns measurement and methodology. Measurement of cognition-centred cognitive style relies on techniques developed to measure cognitive abilities and tends to elicit maximum performance from participants rather than preference. For example, research evidence shows a large association between high levels of cognitive abilities and Field Independence (Tiedmann, 1989) leading to confounded results. This ends a brief look at the history of cognition-centred cognitive style for the purposes of completeness. Instead of taking the cognition-centred path, a few researchers have looked at cognitive style from the perspective of personality where much of the research on intuitive style can be found.

2.5 History of Personality-Centred Cognitive Styles Similar To Intuitive Style

Personality-centred cognitive style developed in parallel to the cognition-centred path. However, research in personality-centred cognitive style has not developed with the same exuberance as the cognition-centred path as indicated in Figure 1. Many of the personality-centred theories have only single studies or do not have current research programs.

2.5.1 Personality-Centred Cognitive Style Theories In Current Use Similar to Intuitive Style

There are two theories of personality-centred cognitive style that have similar aspects to that of intuitive style:

- Adaptor-Innovator (Kirton, 1976; 1989)
- Mental self-government (Sternberg, 1997)

The Innovation pole of Adaptor-Innovator is partially defined as non-conformist and random similar to intuitive style. Mental self-government is a complex set of thinking styles where global, liberal, legislative and judicial styles all display aspects of non-conformity and random approaches to problem solving.

Researchers sometimes include Jungian typology as developed by Briggs-Myers and Briggs (1976). Although Jungian typology is sometimes included as a cognitive style (Richter, 1992), it is excluded from this thesis as Jungian types are not considered to be cognitive style according to the definition given by Messick (1976) and as noted by Hodgkinson et al. (2008) research on the family of intuition constructs has moved to a neuroscience focus. In addition, Jungian types are considered to be dynamic and developing across the lifespan (Jung, 1971), whereas, cognitive style is considered to be a stable characteristic (Messick, 1976; Riding & Rayner, 1998). The earliest of the personality-based cognitive style theories and instruments is Kirton's (1976) Adaptors-Innovators.

2.5.1.1 Adaptor-Innovator

Adaptors are described as conforming to current organisational paradigms, are dependable, tend to experience high levels of self-doubt, work methodically with details, and address problem-solving within the organisations way of doing things. On the other hand, innovators are described as breaking free from the current paradigm, are often seen as tangential and impractical, undisciplined, good in crises and act as catalysts by challenging the organisations usual way of problem-solving (Kirton, 1989, p. 10) somewhat similar to intuitive style. In trying to better understand organisational change, Kirton (1989) found that managers and other personnel can be described according to the approach they take to solving-problems at work, either as adaptors or as innovators. The non-conformity of innovators is similar to some conceptualisations of intuitive style as well as being somewhat different from Adaptor-Innovator in that Adaptor-Innovator does not explicitly describe the affective or somatic components usually attributed to intuitives.

Kirton (1989) stated that the theory of adaptors-innovators may be classed as a cognitive style because it holds to the assumptions of cognitive style construct - stable preferences, value-free, and bipolar. To measure adaptors-innovators, Kirton (1989) developed a 32 item instrument the Kirton Adaptor Innovator (KAI) with three subscales (Sufficiency of Originality, Efficiency and Rule/Group Conformity) measuring adaption-innovation. Participants are asked how easy (or difficult) it is to present themselves as a certain type of person over a long period of time.

The initial research on KAI described individual differences in people's organisational behaviour cross-culturally in the general population in the UK (Kirton, 1976), USA (Goldsmith, 1985) and Italy (Previde, 1991) as well as for senior high school students in New Zealand (Mulligan & Martin, 1980) and Ireland (Hammond, 1986). Kirton (1976), in an initial study of 532 participants from companies in England, found that the Adaptor-Innovator description divided managers according to their style where female managers displayed preferences for adaption, male managers' preferences for innovation and older managers' preferences for adaption. Kirton (1976) went on to replicate the factor structure (found in the initial study of 532 participants) in an independent sample of 286 participants as well as demonstrating the independence of adaptors-innovators from dogmatism, intolerance of ambiguity, inflexibility, conservatism, extraversion and neuroticism. Further research found that managers (De Ciantis, 1987), teachers (Kirton, Bailey & Glendinning, 1991), and research and development employees (Keller & Holland, 1978) can be described as adaptors or innovators. Additional research suggested that the KAI concept is useful in detailing the fit between the person and the work environment for engineering employees in manufacturing (Puccio, Joniak, & Talbot, 1995) and software developers (Chilton, Hardgrave, & Armstrong, 2005).

Although Kirton's (1989) theory of Adaptors-Innovators is beneficial for looking at the ways in which organisations make change, it has been re-cast by others (e.g. Isaksen, Lauer, & Wilson, 2003) as a theory of creativity suggesting that some researchers view Adaptors-Innovators as a theory that describes styles of creativity rather than cognitive styles. Moreover, Kirton (1989) presents creativity as central to the notion of Adaptors-Innovators and labels innovators as creative and different from that of intuitive style. Moreover, creativity may be considered to be a field of research separate from that of cognitive style (e.g. Mumford, 2003).

Furthermore, Kirton's (1989) theory seems to include aspects usually associated with personality, such as conformity (adaptors) and sensation seeking (innovators). While Messick's (1976) definition of cognitive style is broad in the sense that it specifies that cognitive style impacts all areas of life, the definition of cognitive style does not appear to lead to describing people (innovators) as being seen to be “abrasive, creating dissonance” (Kirton, 1989, p. 10) that may be considered to be personality descriptors rather than cognitive styles. Indeed, factor analysis shows some overlap of the Adaptor-Innovator Inventory with personality measures such as Cattell's 16 Personality Factors, the Jackson Personality Inventory and the General Sensation Seeking Scale (Kirton, 1989). Thus, perhaps constraining cognitive style theory by drawing more on existing theoretical perspectives from other fields may help to build a multidimensional intuitive style process model, and perhaps, may address the issue of confounding cognitive style with personality traits and/or types.

2.5.1.2 Mental Self-Government

Sternberg's (1997) model of Mental Self-Government (MSG) is based on the metaphor of different types of government. Sternberg (1997, p. 19) states that the various types of government world-wide are reflections of different ways in which people think because governments are created by people and are not simply an occurrence of nature. Thus, individuals are described by the MSG in terms of 13 different thinking styles that are organised in five dimensions. There are three functions (legislative, executive, and judicial), four forms of government (monarchic, hierarchic, oligarchic and anarchic), two levels of government (global and local), two scopes (internal and external) and two leanings (liberal and conservative). Mental self-government is a complex set of thinking styles where global, liberal, legislative and judicial styles all display aspects of non-conformity and random approaches to problem solving similar to intuitive style with the absence of affective and somatic components.

The measurement of this style is by self-report. Therefore, when the theory and measurement of Mental Self-Government are taken together, one may argue that this style can be classed as a personality-centred style (i.e measurement is by self-report and theory is grounded in personality-based style).

Research using MSG provides a completely different take on cognitive style in comparison to previous work. In one study (Sternberg, 1997), teachers of lower primary school grades were found to be more legislative or liberal than teachers in upper primary who were found to be more executive. In addition, when the relationship of mental self-government with Holland's (1997) six occupational interests was tested by Zhang (2000) who found support for the hypothesised relationships of Holland's (1997) social and enterprising occupational interests with external thinking and judicial styles; negative relationship of artistic occupational interests with executive, local and conservative thinking styles.

Further work on MSG (Sternberg & Zhang, 2005) has grouped together the 13 thinking styles in terms of creativity and higher cognitive complexity (legislative, judicial, hierarchical, global, and liberal styles) and decreased cognitive complexity (executive, local, conservative). These groupings are reminiscent of earlier cognitive style labels such as Conceptual Complexity (Messick, 1976) — the degree of discrimination of categories within a concept — and similar to Adaptors-Innovators (Kirton, 1989) in terms of conformity and thinking within existing paradigms as adaptors (executive, local, conservative) or developing alternatives and divergent thinking as innovators (legislative, judicial, hierarchical, global and liberal styles) and similar to some descriptors of intuitive style.

2.5.2 Summary of Personality-Centred Cognitive Styles Similar To Intuitive Style

Personality-centred cognitive style theories have highlighted individual differences in business and educational settings. While personality-centred cognitive style research has not been as prolific as cognition-centred cognitive style and suffers from some confounding with personality theories, personality-centred cognitive style researchers have worked to develop ecologically valid theories and measures of cognitive style. The next section describes the dual-process approach to cognitive styles.

2.6 Dual-process Approaches Similar To Intuitive Style

2.6.1 Cognitive-Experiential Self-Theory

Epstein (1990) proposed a dual-process model of personality-centred cognitive style that has since received some support from the neurology of social cognition (Lieberman, 2007). Epstein suggested that people have two different systems of processing information that operate in parallel termed the Cognitive (rational style)-Experiential (intuitive style) Self-Theory (CEST). In contrast to the prevailing view of cognitive style dimensions as polar opposites (e.g. adaptors-innovators or intuition-analysis), Epstein proposed that the experiential and rational systems are independent of one another, operating in consort. The CEST suggested that people have a preference for relying on one dual-process system more than the other. Epstein's (1990) theory proposes three conceptual systems, the rational (conscious level, abstract, logical, verbal), the experiential (preconscious and associationistic unconscious) forming part of the personality structure. These experiential parts of the theory are similar to that of intuitive style where individuals describe their style as something that goes on below the level of their consciousness. Epstein proposed that rational system tends to dominate the experiential system (this assumption is applicable to Western cultures).

The CEST is operationalised as the Rational-Experiential Inventory (REI) – a 31 item self-report questionnaire. Research using the REI shows strong association of the rational system with literacy and numeracy achievement and personality dominance, while the experiential system appears to be related to state-trait anxiety, self-esteem, dominance and depression (in men) (Epstein, et al., 1996). According to Epstein et al. (1996), attachment styles in romantic relationships and attachment working models of parents are associated with rational and experiential systems where the experiential system is associated with secure romantic attachment for males and females; and for men, a secure working model of mother. The relational system is associated with dismissive romantic attachment for women and negatively associated with a secure working model of father for men (Epstein et al., 1996). Based on these findings of the association between rational-experiential systems and adult attachment, it may be suggested that cognitive styles, perhaps including intuitive style, may help to underpin interpersonal relationships.

The CEST was further developed by Pacini and Epstein (1999) by adding ability and engagement subsections to the rational and experiential systems to address limitations of non-parallel content, the lack of social items in the rational scale, the slightly lower reliability of the experiential scale and uneven number of negatively worded items of the previous version of the REI. Studies with the revised REI show that rational thinking is a predictor of neuroticism (five factor model), ego strength and belief in a predictable, controllable world (Epstein, et al. 1996) and a significant predictor of authoritarianism (Kemmelmeier, 2010). The psychometric structure of the REI scale and associations with the five factor model of personality were replicated in a Swedish sample of undergraduate social science students (Björklund & Bäckström, 2008).

Witteman et al. (2009) compared the REI to an instrument measuring Intuition-Deliberation in a sample of Dutch and Spanish students (Betsch, 2008). Witteman et al. (2009) found a high degree of association between the experiential scale and the preference for intuition suggesting that the two scales are substitutable measures whereas the rational scale and the deliberation scale were weakly associated. The finding that the experiential and intuition scales are interchangeable also suggests that intuition is likely to be associated with interpersonal relationships.

Moreover, Witteman et al. (2009) piloted two experimental studies relating the REI to task behaviours. In the first pilot study, special school teachers were asked to perform tasks that included the Wason selection task, vignettes taken from Epstein et al. (1996), diagnostic classification tasks and mathematical tasks (Witteman, et al. 2009). Witteman et al. (2009) found rational thinking was associated with rational tasks and experiential thinking was negatively associated with rational tasks. The second pilot study looked at the length of time needed to make a decision and found no association between rational thinking and decision time (c.f Wholistic-Analytic cognitive style where analytics were presumed to take more time in making decisions than Wholistics). However, degree of preference for experiential thinking was found to be related to decreased decision-making time where people high on experiential thinking took less time to make decisions (Witteman, et al. 2009). The evidence that experiential cognitive style is related to decreased decision time parallels that of thinking about intuition where intuitive decision making is thought to require less time than analytical decision making (Dane & Pratt, 2007), being rapid and non-conscious.

In a set of three studies, Norris and Epstein (2011) revised the REI structure and examined its relationship with a number of variables. In line with other work (Hodgkinson & Sadler-Smith, 2003b) on the REI and Intuition-Analysis (Allinson & Hayes, 1996), Norris and Epstein (2011) found according to factor analysis (varimax rotation) that the Experiential aspect of the REI yielded three factors, intuition, emotionality and imagination in a university student sample of 2,245 participants, contrary to earlier conceptualisations. The Experiential intuition factor appears to be similar to intuitive style, whereas, the Experiential emotionality (emotional intensity) and imagination (aesthetics/visual imagery) factors seem to be very different from intuitive style. In terms of relationships with other variables, the Experiential intuition subscale demonstrated the strongest association with measures of personal growth ($r = .34$, $p < .001$) and empathy ($r = .33$, $p < .001$). While Experiential intuition looks similar to intuitive style there are distinct differences with many conceptualisations of intuitive style including affective and somatic components. A second dual-process approach to intuition is presented next.

2.6.2 Preference for Intuition or Deliberation

A recent addition to the study of dual process models of cognitive style, similar in theoretical base to Epstein’s (1990) CEST, focused on preferences for deliberative-analytic, effortful thinking and affective-intuitive thinking based on implicit learning (Betsch, 2008). In a similar vein to that of intuitive style, the intuition construct here reflects the emotional aspects of intuitive style and the types of characteristics that may come together to form intuition.

In a study on making a choice between coffee pots and then estimating the cost of the chosen pot, Betsch and Kunz (2008) demonstrated that 64 students in social sciences have distinct preferences for intuition or deliberation in decision-making and judgements. Preferences for intuition or deliberation were manifest in the explicit strategies (spontaneous and reflective, respectively) used by the participants to make choices and that use of (non) preferred style that lead to (decrease) increase in monetary value of the chosen coffee pot. A follow-up study (Betsch & Kunz, 2008) demonstrated that when people use their preferred style in decision making about an item, positive affect occurs towards the item and the item has an increase in perceived value. In addition, Betsch (2004) found that people's preferences for intuition or deliberation are not governed by the context in which the thinking occurs consistent with the notion that cognitive style is an innate, stable characteristic (Messick, 1976; Rayner, 2000). These findings, when taken together with the CEST research, continue to support the distinction between two preferential ways of thinking (Dodds, 1964).

2.6.3 Summary of Dual-Process Approaches

Because dual-process approaches to cognitive style are not reliant on personality or cognition, it is interesting to note that both the CEST and the PID reflect the distinctions between analytic and intuitive ways of processing information.

2.7 Super-ordinate Theories Similar To Intuitive Style

One of the strongest criticisms levelled at cognitive style throughout its history is to do with the proliferation of cognitive style constructs (Klein, 2003; Lewis, 1976). Many researchers have developed their own versions of cognitive style along with their own theories and instruments (e.g Figure 1) throughout the past 70 years. On the other hand, a number of researchers have sought to bring order to the available styles by defining over-arching theories that subsume previously developed constructs. There are two integrative theories to be considered in this section:

- Wholistic-Analytic Visualiser-Verbaliser (Riding & Rayner, 1998)
- Intuition-Analysis (Allinson & Hayes, 1996)

2.7.1 Wholistic-Analytic Visual-Verbal

Following the criticisms of Lewis (1976) concerning the fragmented state of cognitive style research, and to facilitate research of cognitive style in educational and training settings, Riding and Cheema (1991) sought to provide a useful way of integrating cognition-centred cognitive style dimensions existing in the literature at that point in time. Finding more than 30 dimensions in the literature, Riding and Cheema (1991) used the well-established notion that there are "two qualitatively different types of thinking" (Nickerson et al, 1985, p.50) being analytic and wholistic cognitive style. It is interesting to note that once again, scholars have returned to the original ancient Greek distinction of rational and irrational (intuitive) ways of thinking.

In addition, Riding and Cheema (1991) differentiated learning strategies from cognitive style as well as a second group of cognitive style dimensions labelled visualiser-verbaliser cognitive style. This integrative model of cognitive style has been operationalised in the form of computerised testing (Cognitive Styles Analysis: Riding, 1991) and used extensively in primary school education (e.g. Douglas & Riding, 1993), secondary education (e.g. Riding & Al-Hajji, 2000), and undergraduate studies (e.g. Riding & Staley, 1998) to investigate individual differences in learning (see Table 2).

Some aspects of the wholistic-analytic super-ordinate dimensions are reflected in the intuition-analysis dimensions. That is, the associative processing of the Wholistic dimensions is also used to describe intuitive style. Similarly, the rational, logical, step-by-step processing of the Analytic dimension is reflected in the analysis pole of intuition-analysis.

Nonetheless, other researchers (Blajenkova & Kozhevnikov, 2009) have criticised the operationalisation of Riding and Rayner's (1998) model because it may be testing performance (cognitive ability) rather than preference (cognitive style: see Section 2.3.1 this chapter for further discussion). Riding and Rayner's (1998) computerised test times the participant’s responses and participants are aware of this which may lead the participants to respond according to their cognitive abilities rather than their cognitive style.

Table 2. Research in Wholistic-Analytic Visual-Verbal Cognitive Style

Outcomes	Articles found in database search for reference only (full details not listed)
School achievement	Riding & Agrell (1997), Riding & Caine (1993), Riding & Douglas (1993), Riding & Grimley (1999), Riding & Mathias (1991), Riding & Sadler-Smith (1992), Riding & Staley (1998)
Physiological measures	Riding, Glass, Butler, & Pleydell-Pearce (1997)
Intelligence	Riding & Pearson (1994)
Comprehension	Douglas & Riding (1993)
Personality	Riding, Burton, Rees & Sharratt (1995), Riding & Wigley (1997), Riding & Wright (1995)
School refusal	Rayner & Riding (1996)
Behaviour	Riding & Al-Hajji (2000), Riding & Burton (1998), Riding & Craig (1998)
Teacher stress	Borg & Riding (1993)
Memory	Douglas & Riding (1994), Riding & Al-Sanabani (1998),
Motor skills	Riding & Al-Salih (2000)
Instructional format	Riding & Read (1996), Riding & Sadler-Smith (1997), Riding & Watts (1997), Sadler-Smith & Riding (1999)
Occupational stress	Riding & Wheeler (1995)

One way around the issue of measuring cognitive abilities instead of cognitive style is to take a different route to measuring the two qualitatively different types of thinking. In 1996, Allinson and Hayes developed a theory of cognitive style based on the two distinctive ways of thinking which was operationalised by self-report, avoiding the potentiality of measuring cognitive abilities and leaving open the potential for confounds with personality traits.

2.7.2 Intuition-Analysis

Allinson and Hayes' (1996) model of cognitive style is sometimes taken to be a personality-centred approach to cognitive style because of the way in which they measure cognitive style. However, it may be re-conceptualised as a super-ordinate approach to cognitive style in line with similar constructs such as wholistic-analytic (Riding & Cheema, 1991) because it includes material from other cognitive style constructs. The intuition-analysis model of cognitive style (Allinson & Hayes, 1996) includes the affective aspect – "immediate judgement based on feeling and the adoption of a global perspective" (p. 122, Allinson & Hayes, 1996) and mirrors the long established two distinctive ways of thinking, the rational and irrational (intuitive) described by the ancient Greeks (Dodds, 1964).

Table 3 displays the research on Intuition-Analysis. Exemplars of findings in adult samples include: undergraduate business students' preference for intuition or analysis influences their learning (Zhang, Allinson, & Hayes, 2006), entrepreneurs and owner-managers are more intuitive than other managers (Allinson, Chell, & Hayes, 2000), mixed results for eastern cultures and western cultures (Allinson & Hayes, 2000; Sadler-Smith & Tsang, 1998), and preferences for intuition or analysis influence the relationship between supervisors and students (Armstrong, Allinson, & Hayes, 2004).

Table 3. Research in Intuition-Analysis

Area of Research	Articles found in database search for reference only (full details not listed)
Education (business)	Allinson, Hayes & Davis (1994), Backhaus & Liff (2007), Chang (2005), Doucette, Kelleher, Murphy & Young (1998), Evans, Fiorina, Antonietti, Colombo & Bartolomeo (2007), Fitzgerald & Young (2002), Graff (2002), Graff (2003), Graff (2005), Graff & Davies (2005), Graff, Davies & McNorton (2004), Laight (2004), Leung, Wang & Chan (2007), MacGillivary (1999), Moore, O'Maidin & McElligott (2003), Murphy, MacGillivary, Reid & Young (1999), Neupauer & Dennis (2010), Sadler-Smith (1999a), Sadler-smith (1999b), Sadler-Smith & Smith (2004), Sadler-Smith & Tsang (1998), Sarmany-Schuller, & Simuth (2006), Savvas, El-Kot & Sadler-Smith (2001), Shaw & Southey (1999), Tanova (2003), Taylor (2003), Zhang, Allinson & Hayes (2006)
Business/Management	Allinson, Chell & Hayes (2000), Allinson & Hayes (1996), Allinson & Hayes (2000), Allinson, Armstrong & Hayes (2001), Allinson, Armstrong & Hayes (2006), Armstrong (2000), Armstrong, Allison & Hayes (2002), Hayes & Allinson (1994), Hayes & Allinson (1998), Hayes, Allinson, & Armstrong (2004), Murphy, Doucette, Kelleher, Reid & Young (2001), Sadler-Smith (2004),
Work groups	Armstrong & Priola (2001), Priola, Smith & Armstrong (2004)
Research Supervision	Armstrong (2004), Armstrong, Allinson & Hayes (2004)
Theory (business/management)	Hayes & Allinson (1994), Hayes, Allinson, Hudson & Keasey (2003), Hodgkinson, Langan-Fox & Sadler-Smith (2008), Hodgkinson & Sadler-Smith (2003a), Hodgkinson & Sadler-Smith (2003b), Hodgkinson, Sadler-Smith,Burke, Claxton & Sparrow (2009), Hodgkinson, Sadler-Smith, Sinclair & Ashkanasy (2009), Murphy, Kelleher, Doucette & Young (1998), Sadler-Smith, Spicer & Tsang (2000), Sadler-Smith, Allinson & Hayes (2001)
Entrepreneurs	Armstrong & Hird (2009), Barbosa, Gerhardt, & Kickul, (2007), Hmieleski & Corbett (2006), La Pira & Gillin (2006), Young, Doyle & Fisher (2002)
Social	Hill, Puurual, Sitko-Lutek, Rokowska (2000)

The research on intuition-analysis is elaborated on in the following chapter (Chapter 3) that takes a closer look at intuitive-analytic cognitive style for the purpose of examining intuitive style in depth including its psychometric properties.

2.8 Summary of Integrative Theories Similar To Intuitive Style

In sum, super-ordinate theories of cognitive style are a means of organising theories and labels in cognitive style. Perhaps intuition-analysis represents the best way of conceptualising the two different ways of thinking in cognitive style research that have persisted as notable over an extensive period of time. The persistence of these two different thinking preferences seems to suggest some underlying neurological or, perhaps, biological pattern that may turn out to be formative to a psychoneurobiological-based multidimensional process model of intuitive style.

Conclusion

Research in cognitive style began around 70 years ago and stable individual differences in thinking are noted as far back in time as ancient Greece. Research on the stable individual differences in thinking has grown in three ways: research that is cognition-centred, research that is personality-centred, recent research that comes from a dual-processing approach and the super-ordinate approach. This chapter demonstrated that many of the cognitive styles similar to intuitive style lack the affective and somatic aspects of intuitive style considered to be essential to intuitive style. Of the super-ordinate theories of cognitive style, intuition-analysis seems to best represent the conceptual differences between the two different ways of thinking noted by the ancient Greeks – the rational and the irrational (feelings-based) ways of thinking and includes affect as an aspect of intuitive style in-line with the current definition-in-progress (Sadler-Smith, 2008). The next chapter takes a closer look at intuitive-analytic cognitive style.

"Style is the substance of the subject called unceasingly to the surface."
Victor Hugo (1802-1885)

Chapter 3

Intuitive-Analytic Cognitive Style

Introduction

The previous chapter situated intuitive-analytic cognitive style in relation to the historical development of cognitive style research. The current chapter takes a closer look at intuitive-analytic cognitive style, as conceptualized by Allinson and Hayes (1996), and seeks to highlight the key characteristics of intuitive style. Much of the work in intuitive-analytic cognitive style is associative, detailing relationships between intuition-analysis and occupation, job tasks and job roles as well as cross-cultural, gender and interpersonal differences from the perspective of intuitive style as a 'gut feel'. In addition, two articles take a mixed methods and qualitative approach to developing intuitive style where Priola, Smith and Armstrong (2004) and Armstrong and Priola (2001) begin to detail the experiential aspects of intuitive and analytic styles and look at the influence of intuition-analysis on team work. In this chapter, the terms intuition and analysis will be used in conjunction with intuitive style and analytic style representing each side of the bipolar intuitive-analytic construct. Similarly, the terms analytic and intuitive will reflect the labelling of people who describe themselves as preferring intuitive or analytic cognitive style.

This chapter begins with the theory of intuition-analysis, detailing Allinson and Hayes (1996) foundational work, followed by the development of intuition-analysis with a view to bringing to the fore components of intuitive style that may turn out to be central to a psychoneurobiological-based multidimensional process model. Lastly, challenges to the psychometric adequacy and theoretical underpinnings of intuition-analysis are presented that pave the way for the development of a new approach to intuitive style.

3.1 Development of Intuitive-Analytic Cognitive Style and the Cognitive Style Index (CSI)

3.1.1 Theory of Intuition-Analytic Cognitive Style

Allinson and Hayes' (1996) theory of intuitive-analytic cognitive style brought together the literature available at the time on cerebral hemispheric processing, the well-established notion of two different ways of thinking (Dodds, 1964) and existing theories and measures similar to intuitive-analytic cognitive style. At the time of writing the initial paper on intuitive-analytic cognitive style (i.e. Allinson & Hayes, 1996), differences in cerebral hemispheric processing were commonly labelled as right-brain and left-brain where the right hemisphere functionality included emotional, spatial, and wholistic processes, and the left hemisphere functionality included verbal, logical and analytical processes (e.g. Springer & Deutsch, 1998). In addition, based on what was known about brain functionality and the multiplicity of labels describing intuitive and analytic style, Allinson and Hayes (1996) formed the intuition-analysis construct to act as a super-ordinate dimension of the classic dichotomous ways of thinking (p. 124).

Table 4. A Portrait of Intuitive and Analytic Cognitive Styles

A portrait of Intuitive style	A portrait of Analytic style
Intuitives prefer to be guided by their gut feelings. They tend to respond to all types of information according to how they feel about the information. In everyday life, their decisions and responses are rapid, often without any effortful thought. Intuitives are attentive to social cues and enjoy relationships. In addition, they prefer to have a broad overview of information rather than the detail. Intuitives may be described as people who follow their hearts.	Analytics prefer to be guided by logic. They tend to respond to all types of information in a rational manner. In everyday life, their decisions and responses are deliberative and detail oriented. Analytics are attentive to data and things more than relationships. In addition, they prefer to have a step-by-step, detailed approach to information. Analytics may be described as people who follow their heads.

Analytic style is described as the preferential use of left brain processes that involve "judgement based on mental reasoning and a focus on detail" (Allinson & Hayes, 1996, p. 122). Allinson and Hayes (1996) detail analytic cognitive style as:

- a structured approach to problem solving
- tendency to be verbal
- tendency to conform
- take a detailed approach to ideas
- take a step-by-step approach to exploration

Analytics tend to focus on things and data, routine and structure, have rules and boundaries and are relatively impersonal. A portrait of analytics and intuitives can be found in

At the other end of the continuum, intuitive style is described as the preferential use of right brain processes that involve "immediate judgement based on feeling and the adoption of a global perspective" (p. 122). Allinson and Hayes (1996) go on to detail intuitive style as:

- taking an open-ended approach to problem solving
- tendency to be spatial and visual
- tendency to be non-conformists

- take a global approach to ideas
- take a random approach to exploration
- rely on gut feelings

Allinson and Hayes (1996) suggested that intuitives tend to prefer a focus on interpersonal relations, are flexible, open to change, provide new experiences, are relatively free from rules and close commitment and are activity-based. The descriptors for intuitive style listed here will be examined by reviewing the literature on the intuition-analysis construct in adult samples to determine their suitability as potential key components in a psychoneurobiological based multidimensional process model of intuitive style.

Another aspect to note in relation to looking at the ways in which a multidimensional process model of intuitive style may perform is the implicit assumption in Allinson and Hayes' (1996) description of the characteristics of intuition-analysis that the style of the person will, in some way, be reflected in both their choice of job and their degree of satisfaction with their job. That is, there appears to be an underlying assumption that individuals will experience greater job satisfaction than when aspects of the job are a good fit with their style. To this end, particular note was made during the literature review of associations between intuitive style, from the bipolar intuition-analysis model perspective, occupations and job satisfaction.

While the descriptors of the bipolar intuitive style are very useful, it is also necessary to examine the way in which the bipolar construct is operationalised. The operationalisation of the intuitive-analytic bipolar construct may reveal more about the key components of intuitive style.

3.2 Measurement of Intuitive-Analytic Cognitive Style

Allinson and Hayes (1996) stated that the instruments available at the time for measuring aspects of intuition-analysis in business settings were somewhat cumbersome to administer (e.g. Group Embedded Figures) or too lengthy (e.g. Myers-Briggs Type Indicator). Sadler-Smith (1999a) stated that Allinson and Hayes (1996) Cognitive Style Index appears to be based on other instruments measuring the same, or if not, similar dichotomous ways of thinking present in the literature at that point in time.

Allinson and Hayes (1996) operationalised the bipolar construct of intuitive-analytic cognitive style as the Cognitive Style Index (CSI), a 38 item self-report instrument of which, 18 items are worded as intuitive items and 20 worded as analytic items. Copyright permission precludes the publishing of the total scale in this thesis.

Example items are:

I am inclined to scan through reports rather than read them in detail (Intuition item)

Response: True Uncertain False

I always pay attention to details before I reach a conclusion (Analysis item)

Response: True Uncertain False

The response format for this instrument is trichotomous true-uncertain-false with a theoretical maximum score of 76, mean of 38.5 and minimum of zero. Allinson and Hayes (1996) state that they chose the trichotomous format to overcome response bias in extreme responses, the avoidance of extremes and provide for genuine uncertainty. Items are scored in the positive towards analytic cognitive style so that the higher the score, the more analytic the individual (Allinson & Hayes, 1996). By default, however, the lower the score the more intuitive the individual and thus it may be argued that the CSI is an indirect measure of intuitive style rather than a direct measure of intuitive style. The apparent indirect nature of the measure of intuitive style may make it difficult to determine which components may turn out to be central to a process model of intuitive style. While at times it may be difficult to fully clarify which components may be key to a process model of intuitive style, the initial scale development and validation study for the CSI achieved the stated aim of developing a self-report measure suitable for business settings.

3.2.1 Intuition-Analysis Development Study

In their initial study using the CSI, Allinson and Hayes (1996) used a sample of 66 construction managers (all men), 225 undergraduate students (80 women), 226 brewery supervisors and managers (105 women), 74 primary school teachers (59 women), 202 business and economics undergraduates (68 women), 130 managers from a range of occupations (miscellaneous managers: 41 women) and 22 human relations professionals (13 women). Intuition-analysis was examined in relation to the similar constructs of learning style (Learning Styles Questionnaire) and personality type (Myers-Briggs Type Indicator) as well as examining the relationship of intuition-analysis to personality (Cattell’s 16 PF Questionnaire), ability (Critical Thinking Appraisal) and preferences in the work environment (Work Environment Preference Schedule).

In addition, Allinson and Hayes (1996) hypothesised that the CSI should differentiate among groups of people thought to differ on intuitive-analytic cognitive style. To this end, intuition-analysis was examined in relation to gender, job level (senior, middle and junior), occupation, job function (tasks), age, job satisfaction and job climate with the aim of differentiating people in each group. In brief, junior managers, financial tasks and younger employees were hypothesised to be analytical and senior managers, personnel tasks and older employees were hypothesised to be intuitive. No predictions about gender and intuitive-analytic cognitive style were made due to the mixed findings in the literature at the time.

3.2.2 Results

In assessing the relationship of intuition-analysis with similar constructs, Allinson and Hayes (1996) found that higher (more analytic) scores were negatively associated with the learning style of action (-.81) and positively associated with the learning style of analysis (.33). Similarly, higher (more analytic) scores were positively associated with the Myers-Briggs Type Indicator constructs of extroversion-introversion (.57) and feeling-thinking (.57) and negatively associated with sensing-intuitive (-.45) and judgement-perceiving (-.41). The strength of these associations may be due, in part, to the wording of some of the questions. The wording of some questions in the CSI is very close to those of the Myers-Briggs Type Indicator suggesting it may measure personality type rather than cognitive style. Some examples are:

(MBTI) Do you prefer to do things a) on the spur of the moment, or b) according to your plans?
(CSI-Analyis) I rarely make 'off the top of my head' decisions

(MBTI) Does following a schedule a) appeal to you, or b) cramp you?
(CSI-Anaysis) I try to keep a regular routine in my work
(CSI-Intuition) Formal plans are more of a hindrance than a help in my work

In terms of relationship with the 16 PF personality measure, Allinson and Hayes (1996) found that higher (more analytic) scores on the CSI were positively associated with expedient-conscientious (.39), forthright-shrewd (.30), undisciplined self conflict-following self image (.45) and negatively associated with submissive-dominant (-.34), introversion-extroversion (-.22) and subduedness-independence (-.31). In addition, the CSI was negatively associated with all aspects of the Critical Thinking Appraisal (ranging from -0.6 to -.28) and positively associated with work environment (.27). Although, none of these associations are particularly large suggesting the CSI is measuring something different from either personality or cognitive ability. Moreover, not only was the CSI shown to have validity in relation to other constructs, but also the CSI was found to differentiate groups of people.

To further understand the intuitive-analytic cognitive style construct, Allinson and Hayes (1996) used Duncan multiple-range tests and found that intuitive-analytic cognitive style was associated with gender, seniority, occupation, work environment, job roles and tasks, and job satisfaction. Duncan multiple range tests to separate out the association of intuition and analysis with the stated variables. Duncan multiple range tests are sometimes used when researchers wish to investigate differences between group means. However, Duncan multiple range tests have been criticised for being too lenient on type 1 errors (Petrinovich & Hardyck, 1969: a critique of the use of Duncan multiple range tests is presented in Section 3 of this chapter) suggesting there may be challenges to the psychometrics of the scale.

In regard to gender, Allinson and Hayes (1996) found that women management students, brewery managers, teachers and business/economics students were more analytical than their male counterparts. No difference for gender on intuition-analysis was found in the miscellaneous managers group. In regard to the other groups, senior managers were found to be more intuitive than junior managers in construction and brewing (seniority); construction and miscellaneous managers were found to be more intuitive than other managers (occupation); undergraduate students low on intuitive style preferred structured, impersonal work environments; personnel managers were more intuitive than managers in finance or production (job roles); and, junior managers low on intuitive style rated themselves high on job satisfaction. These results provide initial evidence for the linkages between intuitive style and occupational variables. This initial study demonstrates some association of intuitive style with the work place variables of gender, seniority, job tasks and roles.

Subsequent research builds on Allinson and Hayes' (1996) findings in the samples of undergraduate students in business management, law, hospitality as well as employed managers in a variety of occupations. The search of ISI Web of Knowledge (2011) and PsychInfo (2011), performed for the previous chapter on the history of cognitive style, yielded 53 peer reviewed journal articles using Allinson and Hayes' (1996) intuitive-analytic cognitive style, of which, 29 articles directly relate to adult samples.

The following section traces the development of the bipolar intuitive-analytic cognitive style and synthesises key findings from the literature beginning with the quantitative studies (see Table 5) for the purposes of noting components of intuitive style that may turn out to be key to a multidimensional process model of intuitive style.

Table 5. Development of Intuitive-Analytic Cognitive Style (Adult Samples)

		Intuition-Analysis in relationship to:									
Date	Author	Seniority	Gender	Tasks	Work Environment	Culture	Relations	Self-efficacy	Occupation	Job Satisfaction	Psychometrics
1996	Allinson & Hayes (1996)	X	X	X	X				X	X	
1998	Doucette, Kelleher, Murphy & Young (1998)		X			X			X		
	Murphy et al. (1998)								X		X
1999	MacGillivary (1999)		X						X		
	Phelps & Krabuanrat (1999)					X					
2000	Allinson & Hayes (2000)	X				X					
	Allinson, Chell & Hayes (2000)	X	X						X		
	Hill, Puurual, Sitko-Lutek, Rokowska (2000)	X	X			X					
	Sadler-Smith, Spicer & Tsang (2000)	X	X			X					
2001	Allinson, Armstrong & Hayes (2001)	X					X				
	Armstrong & Priola (2001) *mixed methods			X			X				
	Murphy, et al. (2001)										X
	Savvas, El-Kot, Sadler-Smith (2001)		X			X					
2003	Hayes, Allinson & Hudson & Keasey (2003)										X
	Hodgkinson & Sadler-Smith (2003a)	X	X								X
	Hodgkinson & Sadler-Smith (2003b)										X
	Tanova (2003)	X	X			X					
2004	Hayes, Allinson & Armstrong (2004)	X	X						X		
	Priola, Smith & Armstrong (2004) *qualitative						X				
	Taylor (2004)	X							X		
2006	Downey, Papageorgio & Stough (2006)	X					X				
	Adeco & Florin (2006)								X		
2007	Adeco & Florin (2007)								X		
	Brigham, De Castro & Shepherd (2007)				X				X	X	
	Backhaus & Liff (2007)										X
2008	Loftstrom (2008)	X			X						
	Meric & Cappen (2008)	X	X								
2009	Hodgkinson, et al. (2009)										X
	Kickul, Gundry, Barbosa & Whitcanack (2009)										X
2010	Brigham et al. (2010)								X	X	

3.3 Research on Intuitive-Analytic Cognitive Style

Having examined the original Allinson and Hayes study in the previous section, the literature review begins with the next chronological study using the CSI with a view to drawing out key characteristics of intuitive style. From the initial study using intuition-analysis, other researchers have reported findings with respect to variables similar to those in the Allinson and Hayes' (see Table 3) article. The main approach to this section is an historical perspective because of changes derived from further psychometric analyses of the intuition-analysis construct that occurred in 2003.

It is assumed that the components of intuition as listed on pages 46-47 are evidenced in all the studies. Specific note will be made of any evidence that does not support these components and any evidence for additional components or further clarification of existing components will be detailed.

3.3.1 Quantitative Studies

In a study of law students, Doucette, Kelleher, Murphy and Young (1998) sought to add to the literature on the self-development of law students by better understanding individual differences in student's cognitive processes. Based on findings from Field Dependence/Independence literature and Allinson and Hayes (1996), Doucette et al. (1998) hypothesised that senior law students would be less analytical than junior law students; female law students would be more analytical than male law students and specific professional practice preferences would be associated with differences in intuition-analysis. Using the CSI, Doucette et al. (1998) examined the cognitive style of 284 Canadian law students. Analysis of variance (ANOVA) showed differences in intuition-analysis related to seniority in study. Post hoc least-squares demonstrated that first year students were significantly more analytical than third year students (Doucette et al., 1998). In addition, ANOVA using gender as the grouping variable showed that female law students were significantly more analytical than male law students (Doucette et al., 1998). These findings support those of Allinson and Hayes that senior individuals tend to be more intuitive than juniors and females more analytic than males. Moreover, students with a preference for a specific area of practice were more intuitive than those who had no preference (Doucette et al., 1998).

To analyse between-group differences on practice preferences, Doucette et al. (1998) appropriately formed three groups (litigation, corporate/commercial, administration/public law) due to the small sample size for some of the professional practice preferences (e.g. poverty n=1). Differences between means for litigation and corporate/commercial groups were found, with the litigation group being significantly more analytical than the corporate/commercial group. The difference between corporate/commercial and administration/public law groups was non-significant. No results were reported for the difference between litigation and administration/public law groups. No effect sizes were reported for the results of this study. Doucette et al. (1998) concluded that understanding differences in intuition-analysis was a valid aspect to consider in terms of self-development, particularly in relation to getting the most out of the learning environment and communicating with others. Doucette et al. (1998) findings add to the generalisability of Allinson and Hayes (1996) work by demonstrating that law students, similar to business management students (Allinson & Hayes, 1996), report a range of preferences for intuition or analysis and that these preferences may be linked to specific occupational niches within the law profession.

In a similar vein to Doucette et al. (1998), MacGillivary (1999) studied intuition-analysis in 109 tourism development and hospitality management students from Canada. MacGillivary's (1999) article is short and does not contain a great deal of detail. MacGillivary (1999) hypothesised that female students would be more analytical than male students, that hospitality management students (n=30) would be more analytical than tourism development students (n=38) and general students (n=41) given that the hospitality course was considered to focus on highly procedural and systematic thinking compared to the broad approach of tourism development taken in the general degree. Contrary to expectations based on the results of other studies (e.g. Doucette et al., 1998), ANOVA demonstrated no significant difference in intuition-analysis associated with gender or course. MacGillivary (1999) did not speculate on the reasons for these non-significant findings. However, it is possible that small sample sizes contributed to MacGillivary's (1999) results. In addition, it is not clear from the article if the group of general students was included the analyses. If the group of general students were included in the analysis then it may be that mixing the samples has resulted in a lack of clarity, perhaps due to having both intuitives and analytics in the same group, leading to the non-significant findings. Although, both Doucette et al. (1998)

and MacGillivary (1999) findings are limited to student samples, they demonstrate that the CSI may be used in cultures (Canadian) different from the UK sample used in the original study (Allinson & Hayes, 1996).

Further cross-cultural evidence for the idea of intuition-analysis comes from part of a larger study where Phelps and Krabuanrat (1999) investigated intuition-analysis in Thai managers. Phelps and Krabuanrat (1999) administered the CSI to 466 top level managers from Thai companies. Phelps and Krabuanrat (1999) focused on the qualitative aspects of their data such that no statistical detail is provided in the article concerning the results from the use of the CSI. Phelps and Karbuanrat (1999) found that the Thai manager's average score on the CSI was higher than those of Western managers from previous research (it is unclear which research they refer to). They also state that their results do not fit with other studies that have, in the past, suggested that Asian cultures are more intuitive and note that the focus tends to be on extreme examples of non-rational decision making such as the use of fortune-tellers. This raises the issue, once more, of the best way to define intuitive style. It is most likely that the research suggesting that Asian cultures are more intuitive does not interpret intuition in the same way as Phelps and Krabuanrat, appearing to take the mystical approach to defining intuition rather than a psychological approach.

The differences in intuition and analysis are highlighted again by Allinson and Hayes (2000) following on from their original work. Allinson and Hayes (2000) sought to understand more about managers' cultural and gender variations on intuition-analysis in a large study of 394 managers from six countries (Britain, India, Jordan, Nepal, Russia, Singapore) and 360 management students from five countries (Australia, France, Germany, Britain, Hong Kong). In this exploratory study, predictions about the association of intuition-analysis with culture were not made other than to test the stereotypic notion of Western countries being analytical and Eastern countries being intuitive. Following significant ANOVA for the management group, Allinson and Hayes (2000) applied Duncan multiple range tests to determine whether intuition or analysis were responsible for the significant findings. Allinson and Hayes (2000) found that British managers were more intuitive than managers from other countries and Singaporean managers were more intuitive than Jordanean and Nepalese managers. These results also support the assumption that intuitive and analytic cognitive style are individual differences that may be shaped to some extent by cultural contexts but are more likely to be influenced by other individual differences (see student managers section below). Although Allinson and Hayes tested for gender differences in each country, it may be that the small sample sizes have yielded non-significant results.

Allinson and Hayes (2000) went on to apply Hickson and Pugh's[2] (1995) classification of cultures to explain the reasons why Singapore, usually considered an Eastern country, was apparently more intuitive than its counterparts of Nepal and Jordan. Allinson and Hayes (2000) hypothesised that Singapore was strongly influenced and westernised through industrialisation compared to Jordan or Nepal, and therefore, more intuitive. Allinson and Hayes (2000) concluded that the stereotype of the analytic West and intuitive East was not supported for managers.

In the student managers group, German male management students were found to be more intuitive than student managers (either sex) from other countries and British female students were found to be more intuitive than Australian and French female managers. Moreover, in comparing managers and students from Britain, Allinson and Hayes (2000) found a significant difference in intuition-analysis between students and managers for women, with female students significantly more analytical than female managers. Allinson and Hayes (2000) add to previous evidence (Allinson & Hayes, 1996; Doucette et al., 1998) suggesting cultural and gender differences in intuition-analysis. Notably, Allinson and Hayes (2000) illustrate differences in intuition-analysis between students and managers suggesting that student samples may not be representative of managers in employment. This is important because intuitive style may turn out to be an outcome of some sort of implicit learning process that requires knowledge of a field be developed, meaning that students should be more analytical than managers who have gained knowledge and experience of the job role and have formed intuitiveness.

[2] Hickson and Pugh (1995) proposed seven categories of nations: East-Central European, Arab, Developing Countries, Asia, Latin, Anglo and Northern European. The countries used in Allinson and Hayes' (2000) research represent each of these categories.

The research examined (Allinson & Hayes, 2000; Doucette et al., 1998; MacGillivary, (1999); Phelps & Krabuanrat, 1999) so far has provided evidence in support of the listed components of intuitive style and no new information regarding the components of intuitive style was found.

A slight change in the direction of the intuition-analysis literature occurs at this point in time as researchers begin to ask questions about the usefulness of intuition-analysis in understanding entrepreneurial behaviour because entrepreneurs are often assumed to be intuitive based on their behaviour of relying on their gut feelings to make business decisions.

As part of a larger study into entrepreneurial behaviour, Allinson, Chell and Hayes (2000) looked at seniority and intuition-analysis. Allinson, et al. (2000) built on the literature distinguishing 156 entrepreneurs (19 women) from business owner managers (64 construction managers, 225 brewery managers, and 257 various managers enrolled in study and their colleagues) by using the CSI to differentiate among groups of individuals. Allinson, et al. (2000) hypothesised that entrepreneurs would be more intuitive than other managers, that there would be no difference between entrepreneurs and senior managers in intuitive-analytic preferences and that entrepreneurs would be more intuitive than junior or middle managers. Allinson, et al. (2000) conducted two-way ANOVA and found that entrepreneurs were significantly more intuitive than various managers involved in short courses, as intuitive as senior construction and brewing company managers and significantly more intuitive than female junior and middle managers (construction and brewing). No significant results for gender were found when comparing entrepreneurs with other managers. The non-significant finding for gender adds to the previous evidence (MacGillivary, 1999) where no difference in intuition-analysis was found. However, in contrast to Allinson, et al. (2000) findings, previous work (Allinson & Hayes, 1996, 2000; Doucette et al., 1998) suggests that gender differences are associated with intuition-analysis. No explanation was given as to the reasons why Allinson et al. (2000) found no difference in intuition-analysis for men and women and they concluded that entrepreneurs were similar to senior managers in their preference for intuitive style and different from middle and junior managers. While Allison et al.'s (2000) evidence has added to the literature, it is surprising that they did not calculate effect sizes for their results. However, what is evident from this study is that in this sample of entrepreneurs, intuitive style plays an important role in business decisions.

Returning to developing the evidence for the relationship between intuition-analysis and occupational variables, Hill, Puurula, Sitko-Lutek, and Rokowska (2000) further investigated culture, seniority and gender using the CSI as part of a larger study looking at the socialisation of cognitive style. Hill et al. (2000) took a slightly different stance towards the theoretical aspects of cognitive style in their study of 108 managers (Poland=30, Finland=35 and UK=43), 92 senior personnel (Poland=36, Finland=49, UK=7) and 79 students (Poland=75, Finland=4, UK=0) proposing that intuition-analysis may be socially learned through cultural differences in schooling. The theory that cognitive style is socially learned is not well supported in the literature because early physiological evidence (e.g. Riding, Glass, Butler, & Pleydell-Pearce, 1997) indicates that cognitive style is trait-like rather than learned. Hill et al. (2000) used respondent's retrospective memories of schooling as a way of operationalising socialised behaviours in cultures where the UK is seen as highly individualistic and more intuitive, Poland more totalitarianism and analytic with Finland occupying the middle ground between the two extremes. Hill et al. (2000) hypothesised that individuals who had experienced the fostering of independence in early school socialisation experiences would correlate positively with intuitive style (contrary to evidence cited earlier that style is physiologically based); older individuals would prefer intuitive style; the UK sample would be more intuitive than other cultures and the Polish sample would be more analytic reflecting cultural differences in intuition-analysis. The CSI was translated and re-translated into Polish and Finnish and ANOVA (one and two-way) used to analyse part of the data (Hill et al., 2000). Hill et al. (2000) found that the UK and Finnish managers were more intuitive than their corresponding non-managers with no significant difference between managers and non-managers in the Polish sample. No significant differences were found for gender or age within each sample and no significant difference between cultures for socialisation and intuition-analysis (Hill et al., 2000) were found. Hill et al. (2000) concluded that their results support cultural differences in intuition-analysis. Since Hill et al. (2000) state that the relationship between culture and socialisation through schooling needs further clarity, it is important to note that the lack of clarity in the theoretical assumptions about intuition-analysis mean that their results need to be interpreted with caution. In comparison to Hill et al. (2000), Sadler-Smith, Spicer and Tsang (2000) provided clearer evidence on the association of intuition-analysis with culture, seniority and job level.

Although Sadler-Smith et al. (2000) primary aim was to provide replication and validation of the CSI, they contributed further evidence to the nature of the relationships between intuition-analysis and culture, seniority and job level using a sample consisting of 501 (senior, middle, line managers) UK local government employees, 201 UK personnel practitioners, 101 UK business management students, 104 UK owner-managers and 98 Hong Kong owner-managers. The statistical aspects of Sadler-Smith et al. (2000) study will be discussed in Section 3 on the psychometric challenges to intuition-analysis at the end of this chapter. Using analyses different from Allinson and Hayes (1996) in their application of factor analysis, Sadler-Smith et al. (2000) found significant differences for culture in that owner-managers from the UK were more intuitive than their Hong Kong counterparts. The finding that managers in UK were significantly more intuitive than Hong Kong managers is similar to the findings of Allinson and Hayes (2000) where individuals from Eastern cultures were shown to be more analytical than individuals from Western cultures.

However, the findings of Sadler-Smith et al. (2000) contradict Allinson and Hayes (2000) westernisation explanation of Eastern cultures. Because in applying Allinson and Hayes (2000) explanation of the westernisation of Eastern cultures, Hong Kong may be considered to be similar to Singapore in that Hong Kong may be westernised due to the influence of British culture, and therefore may be expected to be more intuitive than analytic. Thus, there may be some explanation, such as individual differences or seniority, other than that proposed by Allinson and Hayes (2000) that may account for the variation of intuition-analysis across cultures.

With regard to the relationship of intuition-analysis gender and seniority, Sadler-Smith, Spicer and Tsang (2000) looked at the potential of an interactive effect of gender and seniority on intuition-analysis and found no significant interaction between gender and seniority (job level) for local government managers in the UK. However, Sadler-Smith, Spicer and Tsang (2000) did find a main effect for seniority where senior managers were more intuitive than junior managers. Therefore, although it appears that men are more intuitive than women in earlier studies (e.g. Allinson & Hayes, 1996), when the findings of Sadler-Smith et al. (2000) are taken together with previous evidence (e.g. Doucette et al., 1998), perhaps the apparent gender differences in intuitive style are better attributed to seniority and, possibly, length of tenure on the assumption that senior staff have generally spent more time in the job than junior staff. The association of intuition with seniority is argued for in intuition research outside of the field of cognitive style in management literature (e.g. Dane & Pratt, 2007).

The theory behind the relationship of intuition with seniority states that seniority (or length of time in a specific area of work) provides individuals with opportunity to build their fund of work-specific knowledge from which they may then make generalised patterns and associations among information that are used to form the feelings-based global-approach of intuitive style (Sadler-Smith, 2008). Moreover, junior managers are in the early stages of work-specific knowledge attainment and are more likely to take the step-by-step approach because they have not yet gained a broad fund of knowledge needed for developing the generalised patterns and associations used in a feelings-based global-approach.

However, it is the contention of cognitive style theorists (Messick, 1976) that individuals have stable preferences for either intuitive or analytic approaches, and therefore, it may be that senior managers gain their role because they are individuals whose preference is for intuition rather than analysis and are better suited to the tasks (e.g. taking a global approach) of senior management than individuals whose preference is for analysis. This notion of intuition-analysis being a stable characteristic gains further support from the results of a later study (Hodgkinson & Sadler-Smith, 2003a) focusing on further improving the psychometrics of the CSI (see Section 3 Psychometric Challenges to Intuition-Analysis).

At this point in the development of the literature on intuitive-analytic cognitive style there is mixed evidence for the association between intuitive style and culture, and strong evidence for the association of intuitive style with senior management.

Notably, the next study investigated (Allinson, Armstrong & Hayes, 2001) provided the first explicit evidence of a potential social component to intuitive style, whereas, results of previous studies are only indicative of a social component based on the idea that some occupational roles (e.g. management) which may be classed as social perhaps reflecting a people verses data/things separation (Prediger, 1982).

In a slightly different take on the relationship of intuition-analysis with management, Allinson, Armstrong and Hayes (2001) investigated the relationship between intuition-analysis, seniority and interpersonal relations using leader-member exchange theory as the theoretical framework. Although the current thesis is not concerned with leader-member exchange theory, Allinson et al. (2001) has relevance in terms of describing the influence of intuition-analysis on the social aspects of work. Allinson et al. (2001) received responses from 142 managers working at senior or middle level and their subordinates in electronics (n= 64) and engineering (n=78) companies. Allinson et al. (2001) hypothesised that greater similarity between manager and subordinate cognitive style would result in lower dominance, a more nurturing relationship, a more productive relationship and the subordinate would report greater liking of and respect for the manager. In addition, Allinson et al. (2001) hypothesised that in meetings, intuitive managers with analytic subordinates would talk more than other configurations of intuitive-analytic dyads. In their statistical analysis, Allinson et al. (2001) tested the interdependence of scores for leaders and subordinates and found that all scores were independent. To investigate (mis)match of intuition-analysis in dyads, Allinson et al. (2001) calculated difference scores. In addition, because instrument reliability was demonstrated, Allinson et al. (2001) posited that difference scores were easier to interpret than hierarchical multiple regression with (quadratic) cross-products. Unlike previous studies (Allinson & Hayes, 1996), Allinson et al. (2001) set the median score on the CSI at 43 with intuitives < 43 and analytics ≥ 43 for both managers and subordinates based on scores from a previous sample (p. 209).

Using ANOVA, Allinson et al. (2001) found that analytic managers with intuitive or analytic subordinates perceived themselves as more dominant and there was a difference for intuition-analysis when the cognitive style of the manager matched that of the cognitive style of the subordinate with intuitive subordinates perceiving themselves as more dominant in their dyad than analytic subordinates.

Intuitive managers were found to be significantly more nurturing (regardless of cognitive style of subordinate) than analytic managers and were more liked and respected by their analytic subordinates than analytic managers with intuitive subordinates. Notably, these findings provide some evidence that intuitives seem to understand analytic style even though it is not their preference and that analytics struggle to understand intuitives. Unlike other studies, effect sizes (Allinson et al, 2001, p. 213) were calculated for significant group comparisons and ranged from .53 for nurturance (analytic dyad verses intuitive manager-analytic subordinate) to .98 for subordinates liking of manager (analytic manager-intuitive subordinate verses intuitive manager-analytic subordinate). Additional analyses revealed that intuitive leaders with more analytic subordinates were found to talk less than analytic leaders (Allinson et al., 2001). Allinson et al. (2001) concluded that match between the cognitive style of the manager and the subordinate is not always the best outcome and that dissimilarity between cognitive style of the manager and the subordinate may lead to better outcomes in relationships at work.

Furthermore, contrary to previous evidence (e.g. Allinson & Hayes, 1996; Doucette et al, 1998) on the relationship between senior management and intuitive style, Allinson et al.'s (2001) study suggests that not all senior managers may be intuitive perhaps lending weight to physiological differences as a foundation for intuitive style rather than behaviours learned in the workplace. In addition, Allinson et al.'s (2001) thorough study is the first to use effect sizes helping to clarify the applicability of intuition-analysis to business settings. The next study returns to the issue of cultural differences in intuition-analysis, where Savvas, El-Kot and Sadler-Smith (2001) sought to understand more about the relationship between cultural differences and intuition-analysis.

Savvas et al. (2001) studied intuition-analysis in two separate samples with the first sample consisting of undergraduate students: 48 Greek students, 45 Egyptian students and 52 UK students. Savvas et al. (2001) matched the groups in the first sample as closely as possible on gender, age, program of study and educational background. The second sample consisted of 20 Egyptian business students, 38 psychology/counselling and 18 management students from Hong Kong, 21 masters business students, 28 certificate business students and 27 diploma business students from the UK. Savvas et al. (2001)

hypothesised differences between scores for each cultural group of students in each sample. Cultural groups were based on Hofstede's[3] (1991) cultural groupings. Savvas et al. (2001) tested their hypothesis in the undergraduate sample using two-way ANOVA and found no significant differences for intuition-analysis. However, in the postgraduate sample, the two-way ANOVA demonstrated significant differences between groups by culture. Duncan multiple range tests showed that UK postgraduates were more intuitive than Hong Kong or Egyptian postgraduates. No statistical difference was found between Hong Kong and Egyptian postgraduate groups. Savvas et al.'s (2001) findings are similar to those of Allinson and Hayes (2000) who also demonstrated significant cultural differences between groups of students. Following in the footsteps of Savvas et al. (2001) and Allinson and Hayes (2000), Tanova (2003) applied the CSI to Turkish students.

Tanova (2003) studied the relationship of intuition-analysis with seniority, gender and culture in 127 Turkish business students as part of investigating the factor structure of the CSI in a Turkish sample. However, this study is lacking in detail and appears to be somewhat theoretically confused. Tanova hypothesised that students from Turkey would be more analytical than students from Western countries based on Savvas, et al. (2001) findings that Turkey is similar to other Eastern student samples in that Turkish students tend to prefer analytic cognitive style even though Turkey may not be considered an Eastern country. In addition, Tanova (2003) hypothesised that analysis will increase with course seniority (contrary to previous studies, although this may be an error in translation) and that female students would be more analytical than males. In this research, the CSI was administered in Turkish following translation (including reverse translation by a bilingual specialist). A t-test showed significantly higher mean scores on the CSI for Turkish students compared to data from British students in Allinson and Hayes (2000). In addition, Tanova found greater seniority in course was significantly associated with analytical cognitive style when investigated by ANOVA. The difference between men and women students on the CSI was non-significant.

[3] Hofstede (1991) proposed four cultural dimensions of power distance (willingness to accept unequal power distribution), collectivism-individualism, uncertainty avoidance (feeling of being threatened by ambiguous situations) and masculinity-femininity (distribution of roles). For example, power distance is perceived as high in Arab-speaking nations and low in the UK.

Tanova's (2003) study presented theory that is inconsistent, possibly due to translation. Tanova (2003) correctly states that "...in samples for eastern cultures [taken from Savvas, et al., 2001] the graduate students have higher (i.e. more analytical) Cognitive style index [sic] scores than the undergraduates." and in contradiction to a statement made previously in the paper that, "… suggests that in eastern cultures individuals with higher status may score more intuitive (i.e. lower scores) on Cognitive Style Index." (p. 1151). Indeed, it appears that Tanova (2003) meant to state that some eastern cultures tend to be more analytical than some western cultures because data from Savvas et al, (2001) clearly shows a significant difference between UK post graduates and Egypt and Hong Kong post graduates. This study may be considered to be a weak study and is lacking in detail.

Similar to the findings of Allinson, Chell and Hayes (2000) and contrary to the gender differences found by Allinson and Hayes (2000), Hayes, Allinson and Armstrong (2004) in a large sample of 1,621 (922 women) participants demonstrated no significant difference between men and women managers on intuitive style and significant difference for management type. Hayes et al. (2004) drew their sample from 364 UK managers (food & beverage, manager development program and owner-managers) and 747 UK non-managers (undergraduate students, local council and utility workers). Based on a review of the previous literature, Hayes et al. (2004) hypothesised significant gender differences with female managers being no different from female non-managers and more intuitive than male managers and non-managers. Testing the independence of female and male managerial samples showed no significant difference between the two groups. However, a significant ANOVA finding for type of manager followed by Duncan multiple range test demonstrated that owner-managers were significantly more intuitive than food and beverage managers. In the non-management sample, t-test showed that females were more analytic than males. Hayes et al. (2004) found significant difference in intuition-analysis between female managers and female non-managers where female managers were more analytic than female non-mangers. However, for males, Hayes et al. (2004) found no significant difference between managers and non-managers.

> *Thus far, the components of intuitive style proposed by Allinson and Hayes appear to be supported by the studies reviewed with the exception of a tendency to be spatial and visual (not examined in any of the reviewed studies). In addition, there is evidence for a social component and evidence to support the further examination of associative processing component.*

In relation to associated variables, the evidence for gender differences in intuition-analysis *continues to be problematic* with studies yielding contrary results. However, it appears that clear evidence is beginning to emerge for relationships between intuitive style and seniority, social occupations and, perhaps, culture.

Instead of taking a broader perspective on occupational roles, such as management, Taylor (2004) shifts the focus of intuition-analysis away from the relationship to management and towards job tasks with his study on the ways in which intuition-analysis influences the use of knowledge management systems. 212 software developers from a single European company reported on their cognitive style and their use and perception of knowledge management systems (email, data mining, knowledge repository, Lotus notes, Yellow Pages). Taylor (2004) hypothesised that individual's usage and perception of knowledge management systems would be associated with their cognitive style and their gender, that there would be an interaction of gender and cognitive style and that degree of usage of knowledge management systems would determine perceptions about the systems. Taylor (2004) used two-way ANOVA to test the posited relationships between intuition-analysis, gender, usage and perception. Taylor (2004) found a main effect for gender on email usage where females use email more than males; a significant interaction for gender and intuition-analysis on data mining where female analytics use data mining less than males or female intuitives; both gender and intuition-analysis were found to be associated with the use of knowledge repository where analytics and males were found to use the knowledge repository more than intuitives and females; and, males were found to use the yellow pages and Lotus notes more than females. In addition, Taylor (2004) found that usage of knowledge management systems predicts an individual's perceptions about the knowledge management system. That is, greater usage leads to positive perceptions about knowledge management systems perhaps biasing the results of his study.

Although Taylor's (2004) research is specific to a single occupation, software development, it lends some foundation for further understanding the relationship of intuition-analysis with job satisfaction, where a good fit between the individual and the job is thought to lead to job satisfaction (Holland, 1997). In the next study by Downey, Papageorgiou and Stough (2006) the focus is on women managers.

Downey et al.'s (2006) findings support the notion that intuitive style involves affect in some way and indicates that affect may be a key component of a psychoneurobiological-based multidimensional process model of intuitive style. Downey et al. (2006) in a study of 176 Australian women managers, from a variety of industries, explored the relationship between the intuitive style pole of the CSI, emotional intelligence (EI: workplace and trait measures) and leadership style (transactional, transformational, & laissez-faire). As part of their study, Downey et al. (2006) hypothesised that transformational leaders would be more intuitive and report higher levels of emotional intelligence than transactional leaders or laissez-faire leaders. Initial correlations demonstrated that intuition-analysis was significantly negatively associated (i.e. intuitive style is associated) with emotional recognition and expression (workplace EI), emotions directing cognitions (workplace EI), and attention to feelings (trait EI). Intuition-analysis was positively associated (i.e. analytic cognitive style is associated) with transactional leadership and management by exception. The correlation between transformational leadership and intuitive style was not significant (Downey et al., 2006). However, multiple regression demonstrated that emotions directing cognitions (workplace EI) accounting for 32% of the variance in intuitive style and explained a further 10% of variance in transformational leadership after EI. Downey et al. (2006) concluded that intuitive style was associated with emotional expressiveness and recognition of emotions (self and others), taking account of emotions in decision making and the negative association with transactional leadership style.

Although Downey et al. (2006) concentrated on associations of intuitive style with emotional intelligence and leadership styles, their work demonstrates two important features of intuition-analysis not discussed in their paper. Firstly, Downey et al. (2006) findings show that women managers vary in their preference for intuition-analysis contrary to previous evidence (e.g. Allinson & Hayes, 1996) that suggests that women are analytical. However, preferences for intuition-analysis may be reflected in the type of job tasks done by managers at different levels of seniority. Since degree of seniority was not taken into account, Downey et al. (2006) results may be confounded by management level. Secondly, Downey et al. (2006) clearly demonstrated the link between emotions and intuitive style.

Demonstrating the link between emotions and intuitive style is foundational to the next chapter of this thesis that seeks to provide a better theoretical understanding of, and further develop, the measurement of intuitive style. In addition, Downey et al. (2006) demonstrated that variables correlating with intuitive style, and not with analytic cognitive style, may be best measured using independent scales for intuition and analysis. In a departure from Downey et al. (2006), the next study (Acedo & Florin, 2006) looks at entrepreneurial behaviour and returns, again, to the association of seniority with intuition and junior management with analysis.

Acedo and Florin (2006) investigated the relationships between entrepreneurial individual international posture (intuition-analysis, pro-activity, tolerance for ambiguity, international orientation and risk-perception), the profile of the entrepreneur's company (number of employees, age and scope of operations) and the degree to which the entrepreneur's company was committed to international markets in a sample of 222 Spanish entrepreneurs of small to medium-sized companies. To assess their proposed model Acedo and Florin (2006) used partial-least squares (PLS) structural equation modelling. Standard procedures for assessing reliability and validity of the measurement model were used and then the structural model was assessed (Adeco & Florin, 2006). Because intuition-analysis was part of a second order latent construct (individual international posture), Adeco and Florin (2006) did not state separate findings for intuition-analysis. Adeco and Florin (2006) found that intuition-analysis played a minor role in forming the larger construct of individual international posture. However, Adeco and Florin (2006) did demonstrate that there was opportunity for further research in understanding the role of intuition-analysis in entrepreneurial behaviour.

Following on from their work in 2006, Adeco and Florin (2007) took a closer look at the role of intuition-analysis in entrepreneur's risk perception. Adeco and Florin (2007) proposed that rational (analytic) entrepreneurs would be more proactive in taking strategic business opportunities than intuitives and rational (analytic) entrepreneurs and would have higher levels of risk perception when implementing business opportunities. A random sample of 218 Spanish chief executive officers of small to medium sized enterprises reported on their cognitive style, tolerance for ambiguity, pro-activity, risk perception and experience. Adeco and Florin (2007) demonstrated that analysis was significantly associated with higher pro-activity and lower tolerance of ambiguity. In a PLS structural equation model, Adeco and Florin (2007) demonstrated a significant positive relationship between intuition-analysis and pro-activity on risk perception. They did not find any support for the hypothesised relationship between analysis and higher levels of risk perception. Adeco and Florin (2007) correctly stated that pro-activity was found to act as a mediator in the relationship between intuition-analysis and risk perception. The implications of these findings are that entrepreneurs, similar to other groups of individuals, vary in their preferences for intuition-analysis contrary to the notion that entrepreneurs, as a group, are intuitive.

Brigham, De Castro and Shepherd (2007) demonstrated the importance of associative processing as a component of intuitive style in a study of 159 owner-managers from small high-tech companies in the US on the influence of intuition-analysis on work context (owners perceptions of information processing demands of the work environment), job satisfaction, intent to exit and turnover. As part of their path model, Brigham et al. (2007) hypothesised that: intuitive owner-managers would be more satisfied in less structured work contexts than analytic owners and analytic owners would be more satisfied in structured work contexts than intuitive owners; intuitive owners in less structured work contexts would have lower intent to exit and higher intent to exit from structured work contexts than analytic owners. Following non-significant results on tests for multicollinearity, Brigham et al. (2007) employed hierarchical regression to test their hypotheses. Brigham et al. (2007) found significant interactions for intuition-analysis by work context and intuition-analysis by intent to exit. Their results demonstrated support for the hypotheses where intuitive owners were more satisfied in less structured work contexts and less satisfied in structured work contexts than analytic owners; and, intuitive owners have less intent to exit in less-structured work contexts and greater intent to exit in structured work contexts than analytic owners. Brigham et al. (2007) demonstrated the fit between uncertain information processing demands in unstructured, complex work environments and intuitive style. The fit with uncertain information processing demands may draw on the preference for associative processing, building on previous evidence be associative processing should be considered a key aspect of a multidimensional process model of intuitive style.

Further to the relationship of intuition-analysis with perceived work environment and tenure, Loftstrom (2008) translated the CSI into Finnish and applied changes to the CSI recommended by Hodgkinson and Sadler-Smith (2003b) where intuition and analysis are measured as separate items rather than as each end of a bipolar item (the changes recommended by Hodgkinson and Sadler-Smith will be discussed in the section on psychometric challenges to intuition-analysis this chapter). Loftstrom (2008) hypothesised that women would be more analytic than men, leaders would be more intuitive than other employees, older workers would be more analytic, intuitive style would be associated with higher levels of education and that the work environment partially consists of cognitive style. Managers and employees from small to medium sized production companies (n=126) and from the service sector (n=102) provided self-reports of their preference for intuition or analysis and their perception of the work environment. Loftstrom (2008) used regression analyses to look at the relationships among variables. Loftstrom (2008) found that women were more analytical than men and younger workers were more analytic than older workers, who were more intuitive, demonstrating a small effect size (η =.12). In addition, Loftstrom (2008) demonstrated that higher levels of analytic cognitive style were related to lower levels of education (η=.08) and length of time in work (30+ years) was associated with intuitive style (η=.06), whereas, shorter periods of work was associated with analytic cognitive style. No difference was found for intuitive style between the production industry and service sector. However, Loftstrom (2008) found that a supportive work environment was significantly associated with intuitive style and a prejudiced work environment with analytic cognitive style. Loftstrom's (2008) findings of a supportive work environment are consistent with Downey et al.'s (2006) evidence of an association of intuitive style with affect and a focus on social relationships at work.

Although Lofstrom (2008) demonstrated significant associations with gender, education, age and tenure for intuitive and analytic cognitive style as separate items, the effect sizes for relationships with education level, length of time in work and age are very small providing opportunity for further research on these relationships. Since Lofstrom (2008) used the scale structure proposed by Hodgkinson and Sadler-Smith (2003), this study cannot be compared to other studies using the original version of the CSI. Furthermore, the association of intuitive style factor with perceived supportive work environment suggests that intuitives have a tendency to focus on and prefer the interpersonal aspects of work adding to the notion that social and affect are likely to be key components in a multidimensional process model of intuitive style.

Unlike Loftstrom (2008), Meric and Cappen (2008) used the original CSI format for their research into sex stereotypes, work experience and intuition-analysis. Meric and Cappen's (2008) paper is somewhat lacking in detail and does not review many articles in cognitive style that look at gender and intuition-analysis. Meric and Cappen (2008) administered the CSI to 286 students (126 women) from a university in the US. Meric and Cappen (2008) hypothesised that males would be more analytical than females and students with work experience related to the area of study would be more analytical than students not working. ANOVA demonstrated differences in intuition-analysis for sex and for work experience (Meric & Cappen, 2008). They found that females were more analytic than males, consistent with the results of previous research (e.g. Allinson & Hayes, 2000). Meric and Cappen (2008) found that students with work experience related to their area of study were significantly more intuitive than students without work experience. This suggests that the development of a fund of work related knowledge is important for the functioning of intuitive style in business settings.

The final evidence to be examined came from a larger study by Brigham, Mitchell and De Castro (2010) who examined the interaction between intuition-analysis, as both a bipolar construct and as separate unipolar variables together with the degree of formalization in 121 small to medium technology based enterprises. In this exploratory approach using the bipolar intuition-analysis construct they found that for intuitive managers, increasing formalization of the business yielded an increased growth rate (measured by percentage change in number of employees in a five year period). Because of questions raised by other researchers (these will be addressed in section 2.3), Brigham et al. (2010) performed their analyses again using the unipolar version of the CSI to separate out intuition from analysis which then highlighted differences between the bipolar and unipolar constructs where intuitive style remained the significant variable in the study.

In sum, the review of the quantitative studies has demonstrated that there was support for many of the components of intuitive style as proposed by Allinson & Hayes (1996) with the exception of the tendency to be spatial and visual. Furthermore, additional details were garnered for the affect (Downey, et al. 2006; Lofstrom, 2008) and associative processing components (Brigham, et al., 2007; Sadler-Smith et al., 2000) and surprisingly, evidence for a new social component was found (Allinson et al., 2001; Downey et al., 2006; Lofstrom, 2008, Sadler-Smith et al., 2000). This social component requires theoretical foundation in psychoneurobiological evidence and needs to be taken into consideration when developing a psychoneurobiological-based multidimensional process model of intuitive style. In addition to examining the quantitative studies, further evidence will be drawn from the qualitative studies in the next section.

3.3.2 Mixed Method and Qualitative Studies

One mixed method study (Armstrong & Priola, 2001) highlighted the importance of the affect component and added further support to the proposed social component of intuitive style through the explicit examination of socio-emotional acts as part of a team interaction. Armstrong and Priola (2001) suggested that preferences for intuitive or analytic cognitive style may have positive and negative benefits for group processes in self-managed work teams. Armstrong and Priola (2001) videotaped 11 teams (100 participants) of final-year undergraduates from an information systems course at a university in England over a 4 month period, where each team put together practice tenders for the supply of computer systems. This task was considered to be more of an intuitive task given that students needed to have an overall view of the project (Armstrong & Priola, 2001). Armstrong and Priola (2001) hypothesised that analytic team members and predominantly analytic teams would initiate more task-oriented acts compared to intuitive team members and predominantly intuitive teams. In addition, Armstrong and Priola (2001) hypothesised that intuitive team members and predominantly intuitive teams would initiate more socio-emotional acts than analytic team members and predominantly analytic teams.

Teams were organised by academic staff and were then administered the CSI to determine each team's cognitive style. Armstrong and Priola (2001) used the 12 categories of Bales Interaction Process Analysis (IPA) to code data transcribed from videotape of each session teams held in the practice tender process. Inter-rater reliability for the IPA coding was reported at .95 (p. 295, Armstrong & Priola, 2001). T-tests were used to analyse the relationships between IPA categories and intuition-analysis and Armstrong and Priola (2001) reported that team leaders were significantly more intuitive than team members for all teams regardless of the dominant cognitive style of the team. Contrary to expectations, intuitive team members initiated more acts in every IPA category than analytic members and this difference was found to be statistically significant (Armstrong & Priola, 2001). Moreover, intuitive team members did initiate more socio-emotional acts than analytic team members. Since these results may be biased by the fact that team leaders were intuitive, Armstrong and Priola (2001) revised their data to exclude team leaders. Armstrong and Priola (2001) demonstrated significant findings for intuitive team members who initiated more socio-emotional acts than analytic members. On the other hand, Armstrong and Priola (2001) found no significant difference for intuition-analysis on task-oriented acts.

In terms of the different types of teams, 3 teams were homogeneous analytic, 2 teams homogeneous intuitive and 6 teams were heterogeneous (Armstrong & Priola, 2001). Armstrong and Priola (2001) found significant one-way ANOVA for socio-emotional acts with no significant findings for task-oriented acts. Duncan multiple range tests demonstrated that intuitive teams initiated more socio-emotional acts than other teams (Armstrong & Priola, 2001). Further analysis via Analysis of Covariance on combined team data for each cognitive style group (analytic, intuitive and heterogeneous) demonstrated a significant finding for social-emotional acts (Armstrong & Priola, 2001). Duncan multiple range tests showed that the intuitive teams initiated more social-emotional and more total acts than analytic or heterogeneous groups (Armstrong & Priola, 2001). Armstrong and Priola (2001) concluded that contrary to expectations, intuitive teams are more likely to get the work done than analytics and analytic teams. Armstrong and Priola (2001) suggested that intuitive teams may get more work done because they can deal more effectively with interpersonal issues than analytics. Their findings support the notion that social and affective components are important parts of intuitive style.

The second study in this section highlighted the validity of self-report as a method of measurement in examining intuitive style. In a follow-up study, Priola, Smith and Armstrong (2004) administered a mechanistic task (logical, step-by-step task) to 18 undergraduate students who were placed in three teams. Priola et al. (2004) chose a mechanistic task for this study because the previous study (Armstrong & Priola, 2001) used an intuitive type task which was thought to place analytic teams at a disadvantage. In this exploratory study, the cognitive style of each team was measured and teams designated as analytic, intuitive, and heterogeneous. Qualitative data were collected and analysed through discourse analysis. Priola, Smith and Armstrong (2004) used discourse analysis for the purposes of uncovering stylistic preferences in language and the ways in which students understand their own behaviours (p. 573). Stylistic preferences in language refer to the ways in which cognitive style can be observed in the spoken word, that is, the person speaking will automatically use words that are indicative of their cognitive style.

Similarly, the words used by people to explain their behaviour indicate their cognitive style preference. The quote attributed to Victor Hugo at the beginning of the chapter very neatly captures the essence of Priola et al.’s (2004) study in that they are examining the data for the “… substance of the subject called unceasingly to the surface.”

Using the criteria of stylistic preferences in language and behaviour to examine the data, Priola et al. (2004) found strong evidence for stylistic differences in both language preferences and explanations of behaviour. For example, students in the intuitive group made no attempt to complete the task using rational thinking and could not explain why they thought their answers were correct even making comments like 'we could guess' and 'we are never going to find it logically' (p. 575). Further, when the intuitive group were asked to explain what happened during the task they stated that the task was 'biased for people who are analytical' and 'more logical' (p.578). The statements of the intuitive student’s clearly show that they recognise that the task is not a good match for their style.

The heterogeneous team exhibited dissent and continually questioned and negotiated their way through the task making statements like 'the only way would be if we exclude the other two alternatives' and 'not really' in working towards consensus. The positive aspects of working in a heterogeneous team were discussed by team members who made statements similar to 'we have all thought of different answers and then we worked the whole out after a while' (p. 586). The importance of this article is in the explicit demonstration of the types of words and cognitive actions that are labelled intuition and analysis. Indeed, Priola et al. (2004) have successfully demonstrated Messick's (1976) statement that cognitive style is the “consistent individual differences in preferred ways of organizing and processing information and experience” (p. 4) through the use of methodology different from the usual quantitative self-report.

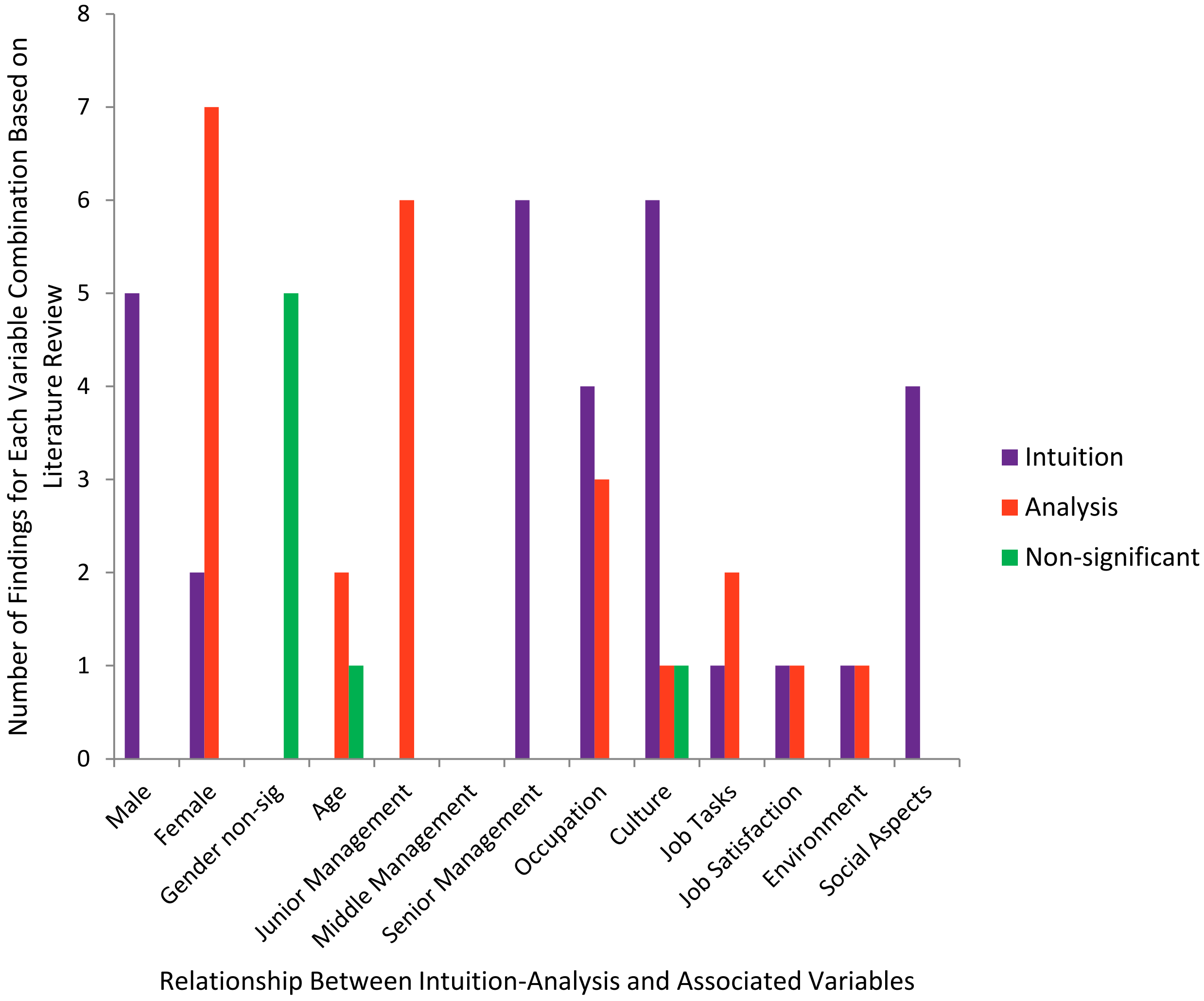
3.3.3 Intuition-Analysis Research Summary

To conclude the review of the findings in the literature, it was found that many of the components of intuitive style proposed by Allinson and Hayes were supported with the exception of a tendency to be spatial and visual which were not examined in any of the studies. This indicates that taking a global approach (or broad overview), open-ended approach to problem solving, relying on physical sensations were supported. A flexible work place and activity-based work environments as preferential outcomes of intuitive style were supported.

Furthermore, additional evidence was found for affect and associative processing as key components of intuitive style. A social component emerged as a new aspect to be further investigated as part of building a psychoneurobiological-based model of intuitive style.

In addition, the following graph (Figure 2) provides a visual summary of the mixed findings between intuitive style and associated variables from the articles presented in this chapter. As can be seen from Figure 2, the association between intuition- analysis and gender, seniority, culture and interpersonal relations are mixed indicating a need to separate out intuition from analysis to gain further clarity. An example is the association between intuition-analysis and gender (Figure 2) where males appear to be intuitive, females appear to be both intuitive and analytic perhaps these findings are due to the bipolar nature of the construct, forcing an artificial outcome. A number of associated variables (e.g. job satisfaction) may benefit from further investigation. The next section places the psychometrics and theory of intuition-analysis in the spotlight.

Figure 2. Summary of Associated Variables for the Bipolar Intuition-Analysis Based on the Literature Review.



3.4 Psychometric Challenges to Intuition-Analysis

The purpose of this section is to present the psychometric evidence for the bipolar intuition-analysis construct with a view to examining the potential for intuitive style to be multidimensional. In spite of excellent reviews of the CSI (e.g Coffield et al., 2004), demonstrably good internal (Doucette et al., 1998; MacGillivary, 1999, Sadler-Smith et al., 2000) and test-retest (Allinson & Hayes, 1996; Armstrong, Allinson & Hayes, 1997) reliability and the significant associations with occupational and social variables, it is fair to say that vigorous debate continues (e.g. Hodgkinson, Sadler-Smith, Sinclair & Ashkanasy, 2009) over the nature of intuition-analysis driven by the inconsistent psychometric findings in the literature as well as questions concerning the theoretical foundations of the intuition-analysis construct. The initial part of this section reviews the psychometric aspects of intuition-analysis (Allinson & Hayes, 1996) and is followed by evidence supporting the bipolar position and evidence contrary to the same. A few studies take a structural equation modelling approach to understanding intuition-analysis that helps to better account for error and potential unmeasured latent variables in the model (Kline, 2011). In addition, the psychometric evidence challenging the structure of intuition-analysis suggests ways in which to further develop intuitive style.

3.4.1 General Psychometric Issues

Since an a priori decision was made in development that the intuition-analysis construct (Allinson & Hayes, 1996) should be unifactorial, maximum likelihood confirmatory factor analysis with item parcelling was used to test goodness-of-fit of the model. Item parcelling procedures are sometimes used to improve the psychometric properties of a scale before factor analysis. In particular, parcelling together items is thought to increase variance and improve the stability of subscales (Cattell, 1973). This approach yielded evidence for a single bipolar construct in five of their seven samples (p. 125). Furthermore, although it was stated that confirmatory factor analysis was used, the way in which the statistical analysis was depicted suggested to researchers (Hodgkinson & Sadler-Smith, 2003) that confirmatory factor analysis was used in an exploratory manner (p. 124) because the analyses were run in parallel, rather than as exploratory analysis, followed by a confirmatory factor analysis using separate samples.

Another aspect of Allinson and Hayes (1996) research that has been criticised (e.g. Hodgkinson & Sadler-Smith, 2003b; Hodgkinson et al., 2008) is the way in which the items are worded. Hodgkinson et al. (2008) cogently argued that a number of items in the CSI scale should be interpreted as representing strategies rather than stylist preferences. For example, the item "To solve a problem, I have to study each part in detail" does not indicate preference.

In addition, Duncan multiple range tests were used to explore differences within group means (Allinson & Hayes, 1996). Duncan multiple range test is proposed as a way to control the familywise error rate when undertaking many post hoc pairwise comparisons in small samples (Duncan, 1955). However, Petrinovich and Hardyck (1969), in their study of error rates for multiple comparisons under different sample conditions, demonstrated that Duncan multiple range tests produces higher Type 1 error rates than other multiple comparison tests such as Tukey's Honestly Significant Difference or Scheffé except under the conditions of true-null hypothesis. That is, Duncan multiple range tests produce similar Type 1 error rates when it is assumed that all samples come from populations with identical variances and means (Petrinovich & Hardyck, 1969). The true-null hypothesis cannot be applied to the intuition-analysis data because the samples used for comparison originated from different populations such as brewery managers and management students (p. 129). Thus, the results of the intuition-analysis study may be influenced by increased Type 1 error rates.

3.4.2 Psychometric Evidence Supporting a Unitary Intuition-Analysis Construct

In a study related to the educational aspects of professional development, Sadler-Smith, Allinson and Hayes (2000a) administered the CSI to 127 UK managers and non-managers. Sadler-Smith, Allinson and Hayes (2000) reported Cronbach's alpha of .89 for the scale and they were able to replicate the factor structure of Allinson and Hayes (1996) using exploratory factor analysis following the item parcelling procedure used by Allinson and Hayes (1996). Although Sadler-Smith et al. (2000) were able to replicate the findings of Allinson and Hayes (1996), in a later study Sadler-Smith, Spicer and Tsang (2000) were not able to reproduce these findings.

Further to Allinson and Hayes (1996) request for other researchers to examine the factor structure of the CSI, Murphy, Doucette, Kelleher, Reid & Young (2001) administered the CSI to 615 members (387 males) of the legal profession in Nova Scotia. Murphy et al. (2001) followed Allinson and Hayes (1996) item parcelling procedure before applying exploratory principle components factor analysis. In this short article, Murphy et al. (2001) demonstrated a single factor solution commensurate with the findings of Allinson and Hayes (1996). However, like Sadler-Smith et al. (2000), Murphy et al. (2001) replicated the same item parcelling procedures, perhaps increasing bias in the results.

One criticism (Sadler-Smith, Spicer, & Tsang, 2000) of the work on intuition-analysis is that the sample sizes used for the maximum likelihood factor analysis were smaller ($n < 100$) than that usually recommended (Kline, 2011). Because maximum likelihood procedures infer population characteristics from the sample (Tabachnick & Fidell, 2001, p. 613), sample sizes need to be large enough to avoid biasing (underestimating) the population variance (Kline, 2011, p. 155). In addition, maximum likelihood requires that the model defined by the researcher be correctly specified (i.e. takes into account all latent variables forming the factors) otherwise there will be discrepancy between the researcher's predicted model and the model produced from the sample (Kline, 2011). Moreover, maximum likelihood procedures assume that the variables are continuous. Since the CSI has trichotomous responses (may not be representative of continuous variables), item parcelling was necessary not only to overcome restricted variance of single items but also to transform the categorical variables into continuous variables. The use of item parcelling to transform categorical variables into continuous variables was not discussed in the original intuition-analysis paper. Furthermore, to thoroughly test maximum likelihood models it is necessary to specify alternative models and no statement was made concerning whether alternative models to the single factor structure were tested. To address the need for larger sample sizes, Sadler-Smith et al. (2000) used sample sizes ranging from 101 to 309 and applied the same item parcelling procedures (p. 177) as the original intuition-analysis study (Allinson & Hayes, 1996) and found that they were able to replicate the factor structure presented in the original study (Allinson & Hayes, 1996). Although there is evidence for a bipolar intuition-analysis construct, there is also evidence that it may turn out to be better to separate intuitive style from analytic cognitive style.

3.4.3 Psychometric Evidence Supporting Separate Intuition and Analysis Constructs

Sadler-Smith et al. (2000) in their replication and validation of the CSI used multiple procedures to assess the psychometric structure of the scale. Sadler-Smith et al. (2000) reported Cronbach's alpha for internal reliability of the scale ranging from α =.79 to α = .89 across different samples. These Cronbach's alphas were similar to those reported by Allinson & Hayes (1996) of .84 to .92. In addition, Sadler-Smith et al. (2000) noted that two items failed to correlate sufficiently (Spearman's $r < .30$) with the overall CSI scale. Item-total correlations for the final version of the CSI were not reported in the original study.

In four out of five models Sadler-Smith et al. (2000) were able to replicate the single factor structure of intuition-analysis proposed by Allinson and Hayes (1996). Model fit in the sample of 192 local government senior and middle managers was found to be borderline (χ^2=16.96, $p<.05$: Sadler-Smith et al. 2000). Since Sadler-Smith et al. (2000) have used the same factor analysis procedures as the original study it is likely that the lack of fit of the fifth model may be due to underestimating the true variance in the model, or the structure of the intuitive-analytic cognitive style construct may be different from that assumed by researchers.

Furthermore, Hodgkinson and Sadler-Smith (2003a) question the methodology presented in the original intuition-analysis study (Allinson & Hayes, 1996). In particular, Hodgkinson and Sadler-Smith (2003a) state that the item parcels used in the original analysis contained both intuition and analysis items, resulting in bias towards a single factor structure and rightly discuss the use of confirmatory factor analysis in an exploratory manner, as well as the lack of separate data sets for each analysis. In addition, while these fundamentals of factor analysis noted by Hodgkinson and Sadler-Smith (2003a) are important, violating the assumptions of maximum likelihood (as noted in the discussion above) may have had greater impact on the final results.

To address possible psychometric challenges and an incomplete theoretical framework of intuitive-analytic cognitive style, Hodgkinson and Sadler-Smith (2003b) argued that the concept of intuition-analysis was too simplistic and did not take into account evidence from other fields such as neuroscience (Lieberman, 2007), management (Dane & Pratt, 2007) and healthcare (Benner & Tanner, 1987) showing that intuition, and therefore intuitive style, is most likely to be a complex construct possibly formed from the dynamic integration of cognition, affect and somatic components (Hodgkinson, Langan-Fox, & Sadler-Smith, 2008). In particular, Hodgkinson and Sadler-Smith (2003b) draw on research evidence from experimental psychology and social cognition demonstrating two functionally different and independent modes of processing described as automatic, rapid, wholistic (intuition) and controlled, detailed, analytic (analytic). These functionally different models are termed dual-process models (e.g. Epstein, 1990; Hodgkinson & Maule, 2002).

Therefore, Hodgkinson and Sadler-Smith (2003b) proposed three models for investigation: a unifactorial model representing the bipolar intuition-analysis approach, a two-factor model designating intuition and analysis as orthogonal unipolar constructs and a third model with intuition and analysis as correlated unipolar constructs. Hodgkinson and Sadler-Smith (2003b) used the sample data from Sadler-Smith et al.'s (2000) previous study so that comparisons of item parcelling procedures could be made for this part of their study. To test the unifactorial model, a 9 x 4 matrix of separate intuitive and analytic parcel scores was derived for each participant and, following scrutiny of the data for normality, they applied principal components analysis. Principal components analysis yielded two components, rejecting the unifactoral construct posited in the original study with an oblique (Direct Oblimin) rotation to achieve the best fitting model. Subsequent confirmatory factor analysis using structural equation modelling (sample of 438 postgraduate and professionals studying at a UK business school) with the use of a number of goodness-of-fit indices verified that the best fitting model consisted of correlated unipolar intuition and analysis constructs. Although Hodgkinson and Sadler-Smith (2003b) addressed the issues to do with item parcelling and factor structure, the issue of the forced-trichotomous response remained and may have contributed to error in the model. Hodgkinson and Sadler-Smith (2003b) suggested that changes be made to the way in which intuition and analysis are: a) conceptualised moving from unidimensional to multidimensional, b) the way in which the CSI is scored from forced-trichotomous to Likert-scale responses, and c) item wording based on the strong psychometric evidence from their study.

Furthermore, in the third part of their study, Hodgkinson and Sadler-Smith (2003b) used the correlated two-factor model in a new sample to take another look at the relationship between intuition and analysis with gender and seniority. Two-way ANOVA produced slightly different results from previous research due to treating intuition and analysis as separate constructs. For the analysis construct, a significant main effect for gender and seniority was found (interaction was non-significant), where females reported higher levels of analytic cognitive style than males, and lower levels of analytic cognitive style were associated with greater seniority. In comparison, higher levels of intuitive style were associated with increased seniority and relationship with gender was non-significant as was the gender seniority interaction. However, age may play a role in explaining the relationship between seniority and intuition and the effect of age was not investigated in their study. On the whole, the evidence from Hodgkinson & Sadler-Smith (2003b) supports the notion that underlying intuitive style is the development of funds of knowledge that may then be accessed by some form of associative process.

Hodgkinson and Sadler-Smith's (2003b) results suggest an explanation for the mixed results from previous studies on the relationship between gender and intuition and analysis. The mixed results on gender and intuition-analysis may be due to assuming that the construct underlying the CSI was bipolar. When the construct is taken to be bipolar it means that scores are constrained to either analysis or intuition by virtue of the subjective cut point, presenting a misleading picture of the relationship with other constructs. For example, a number of studies (Allinson & Hayes, 1996, 2000; Doucette et al., 1998) support the finding of Hodgkinson and Sadler-Smith (2003b) that women are more analytical than men, by default, placing men as more intuitive than women because of the bipolar nature of the construct. Hodgkinson and Sadler-Smith (2003b) concluded that understanding intuition and analysis as theoretically separate constructs implies that intuition and analysis, in consort, are needed to develop cognitive flexibility to minimise cognitive bias. Furthermore, and perhaps of greatest importance in understanding the nature of intuitive style, is that measurement of intuition-analysis using the CSI meant that individuals were categorised as biased towards either intuition or analysis due to the enforced cut-point procedure.

The debate about the underlying structure of Intuition-Analysis gained momentum following the publishing of Hodgkinson and Sadler-Smith's (2003b) work. Hayes, Allinson, Hudson and Keasey (2003) critiqued Hodgkinson and Sadler-Smith's (2003b) article; arguing in favour of a bipolar view of intuition-analysis citing evidence from the bipolar conceptualisation of Myers-Briggs Type Inventory dimensions as supporting such an approach. In addition, Hayes et al. (2003) claim that evidence, such as that relating to Epstein et al. (1996) dual-process model, does not relate to cognitive style because models of cognitive style should be 'governed by a common set of principles, rather than separate dimensions based on different cognitive systems' (p. 271). Moreover, Hayes et al. (2003) provide theoretical explanations about conditional probabilistic associations to further strengthen their argument for a bipolar intuition-analysis construct. Conditional probabilistic associations describe a single continuum of information processing with automatic processing of weak associations representing intuition at one end and conscious effortful associations representing analysis at the other end (Hayes, et al., 2003). However, contrary to Hayes et al.'s (2003) assertions, a substantial body of research into dual-process theories of cognition has recently been further supported by evidence from neuroscience (Lieberman, 2008). Therefore, the application of conditional probabilistic associations to intuition-analysis will not be discussed any further.

Hayes et al. (2003) go on to critique Hodgkinson and Sadler-Smith's (2003b) conclusion that the CSI precludes the development of cognitive flexibility. Hayes et al. (2003) maintained that individual's vary somewhat along the bipolar construct even though their preference is for either intuition or analysis. While it is acknowledged that no instrument can take action to preclude anything, Hodgkinson and Sadler-Smith (2003b) were clear in their explanation that the use of the CSI for staff development in business settings may misrepresent an individual's cognitive capacity to flexibly apply various styles to different contexts.

In terms of the methodological issues raised by Hodgkinson and Sadler-Smith (2003b), Hayes et al. (2003) refute the position that parcelling items of intuition and analysis together leads to bias in favour of a single factor by arguing that Allinson and Hayes (1996) item parcelling procedure was based correctly on empirical correlations among items. However, the usual advice of parcelling together homogeneous items for stability (Kline, 1986) appears to have gone un-noticed by Hayes et al. (2003). They then reverse Hodgkinson and Sadler-Smith's (2003b) argument for parcelling intuition and analysis items separately by claiming that parcelling according to either intuition or analysis biases Hodgkinson and Sadler-Smith's (2003b) results in favour of a two factor solution. Furthermore, Hayes et al. (2003) state that choice of factor rotation by Hodgkinson and Sadler-Smith (2003b) was guided by their judgement rather than empirical evidence and that Hodgkinson and Sadler-Smith (2003b) did not test other factor rotations. While this reasoning appears cogent at first glance, the argument neglected to mention the procedure in using a structural equation modelling approach to confirmatory factor analysis requires that the researchers theoretically specify correlations between factors as part of model specification before data collection begins (Kline, 2011), imposing a model onto the data. However, Hodgkinson and Sadler-Smith (2003b) followed the appropriate procedures in the structural equation modelling approach to factor analysis and cannot be criticised for doing so. Moreover, Hodgkinson and Sadler-Smith (2003b) followed suggested procedures (Tabachnick & Fidell, 2001) for choosing between orthogonal and oblique rotations. They noted that orthogonal relationships will not be obscured or changed by the use of oblique rotations and, therefore, oblique rotations were a justified use of data analysis techniques.

In reply to Hayes et al. (2003), Hogkinson and Sadler-Smith (2003b) uphold their positions on item parcelling and factor rotation. Hodgkinson and Sadler-Smith's (2003b) approach to parcelling together similar items separately for each construct leads to improved reliability and variance in the correlation matrix on which factor analysis is based. Similarly, Hodgkinson and Sadler-Smith (2003a) stated that using oblique rotations in factor analysis means that no assumptions about the degree of correlation between factors are made thereby avoiding bias. In addition, Hodgkinson and Sadler-Smith (2003a) note the lack of comment made by Hayes et al. (2003) on the evidence provided by confirmatory factor analysis in testing competing models. The debate continues with further evidence in support of Hodgkinson and Sadler-Smith's (2003b) position developed by other researchers.

Backhaus and Liff (2007) and Loftstrom (2002) have not been able to replicate the claimed unifactoral structure of the CSI. Following in the footsteps of Hodgkinson and Sadler-Smith (2003b), Backhaus and Liff (2007) studied the factor structure of the CSI using a sample of 222 American business students.

Backhaus and Liff (2007) presented five models to be tested: a single-factor model using individual CSI items, a single factor model with Allinson and Hayes' (1996) item parcelling procedure, a single factor model with Hodgkinson and Smith's (2003b) item parcelling procedure, a correlated two factor model using Hodgkinson and Sadler-Smith's (2003) procedure and an uncorrelated two factor model using Hodgkinson and Sadler-Smith's (2003b) procedure. Like Hodgkinson and Sadler-Smith (2003b), Backhaus and Liff (2007) took a structural equation modelling approach to confirmatory factor analysis for all models. Taking into consideration a number of model fit indices (i.e. $\chi 2$, goodness-of-fit, adjusted goodness-of-fit, normed fit index, relative fit index and parsimony normed fit index) Backhaus and Liff (2007) demonstrated that the single factor model using individual CSI items, and the single factor model with Allinson and Hayes (1996) item parcelling procedures, did not support the proposed single factor solution. Similarly, Hodgkinson and Sadler-Smith's (2003b) item parcelling single factor model did not fit the data. Again, fit indices for Hodgkinson and Sadler-Smith's (2003b) correlated two factor model and the uncorrelated two factor model did not support the proposed solutions. However, Backhaus and Liff (2007) state that the model with the best fit, out of the five models proposed, is Hodgkinson and Sadler-Smith's (2003b) correlated two factor model. Backhaus and Liff's (2007) results support neither Hodgkinson and Sadler-Smith's (2003b) conceptualisation nor Allinson and Hayes' (1996) conceptualisation of intuitive and analytic cognitive style.

Since Backhaus and Liff (2007) were not able to fit Allinson and Hayes' (1996) model to the data, they proceeded to conduct exploratory factor analysis using maximum likelihood of the single factor model with individual items, and the single factor model using Allinson and Hayes (1996) parcelling technique, with the aim of clarifying the relationships among CSI items. The single factor model using individual items resulted in 13 factors where intuitive and analytic items did not group together in any meaningful way to form factors. On the other hand, the single factor model with Allinson and Hayes' (1996) item parcelling resulted in a two factor solution, contrary to Allinson and Hayes' (1996) results. In conclusion, Backhaus and Liff (2007) suggest that their results may be due to intuition and analysis being best represented by multiple factors rather than single factor models, the different methods of constructing item parcels, cultural differences in language and the student sample used by Backhaus and Liff (2007) may have lead to variation in results from those of Allinson and Hayes (1996) and Hodgkinson and Sadler-Smith (2003). In sum, there is some support for the psychometric structure of two separate unidimensional intuitive and analytic cognitive style constructs as suggested by Hodgkinson and Sadler-Smith (2003) that may be better underpinned by substantive dual-process theory.

Further evidence for a two factor solution for intuitive and analytic cognitive style comes from a large study concerning the relationship between self-efficacy and intuition-analysis in 138 student entrepreneurs in the United States. Kickul, Gundy, Barbosa, and Whitcanack (2009) took the advice of Hodgkinson and Sadler-Smith (2003) to treat intuition-analysis as two separate scales. Principle components factor analysis using the scale items with an oblique rotation demonstrated two separate factors. Kickul et al. (2009) reported Cronbach's alphas of .89 for the intuition scale and .79 for the analytic scale indicating good reliability for each scale.

Recently, Hodgkinson, Sadler-Smith, Sinclair and Ashkanasy (2009) compared the factor structure of the CSI to the Rational-Experiential Inventory (REI: Epstein, Pacini, Denes-Raj & Heier, 1996) for the purpose of addressing a number of psychometric and theoretical issues highlighted earlier in this section. The REI is very similar to the CSI in that the Experiential component is described in the same way as intuition and the Rational component is described in the same way as analysis. Unlike the CSI, the REI is based on dual-process theory that has gained support from neuroscience (Lieberman, 2007) and the REI operationalises dual-process theory as two interdependent and interacting factors. Hodgkinson et al.

(2009) empirically tested the theoretical claim of Allinson and Hayes (1996) of a bipolar single factor intuition-analysis construct against the dual-process independent factors of the REI by using factor analysis to investigate these instruments at the item and scale levels.

Item level analysis of the CSI and the REI was performed using responses from 408 undergraduate management students from an Australian university (Hodgkinson et al., 2009). In this study, Hodgkinson et al. (2009) changed the response format of the CSI to a 5-point Likert scale to overcome restriction of variance and the need for item parcelling. Exploratory factor analysis (principal components) was used to assess both scales to accommodate the change in response format, and a lack of theoretical base on which to build a confirmatory factor analysis for the CSI, as well as testing the revised version of the REI (Pacini & Epstein, 1999). Hodgkinson et al. (2009) reported that appropriate checks for normality were performed before applying factor extraction techniques. For the REI, rational items loaded on the first component with experiential items loading on the second (positively worded items) and third (negatively worded items) components (Hodgkinson et al. 2009). Components of the REI were found to be orthogonal. Hodgkinson et al. (2009) summarize their findings as being similar to that of Epstein et al.'s (1996) work and suggest that the split of experiential factor across two components is reflective of a method factor rather than a substantive factor. However, researchers (Sadler-Smith, 2008) have found that negative affect plays a role in intuition and perhaps Hodgkinson et al.'s (2009) findings of three factors may be supported by a multidimensional explanation of intuitive style.

The CSI presented a mixed picture with 19 analysis items loading on component one, with five of these items cross-loading on component two. The intuition items loaded on components two and three with the exception of three items that failed to load adequately. All components were correlated and Hodgkinson et al. (2009) labelled the components as systematic processing (unipolar component) reflecting analytic cognitive style, spontaneous-cautious (bipolar component) spanning analysis and intuition, and heuristic processing (unipolar component) reflecting aspects of intuitive style. In summary, Hodgkinson et al. (2009) state that the REI reflected the theoretical underpinnings of dual-process theory and the CSI did not reflect the bipolar unidimensional construct posited by Allinson and Hayes (1996).

For the second part of their study, Hodgkinson et al. (2009) deleted items from the REI and CSI with factor loadings less than .32 based on their findings from study 1 and administered the revised instruments to a separate sample of 300 undergraduate management students from an Australian university. Cronbach's alphas for each revised instrument subscales ranged from .73 to .86 indicating good reliability for both instruments (Hodgkinson et al, 2009). Hodgkinson et al. (2009) compared the structures of CSI and the REI using exploratory factor analysis (principal components) with direct Oblimin rotation. The results of the factor analysis confirm the structure of the REI as having independent components (no correlations between subscales), one rational and two experiential – positively worded items and negatively worded items. The experiential (negatively worded items) component was significantly associated with the experiential (positively worded items) component and showed characteristics very similar to experiential (positively worded items) in relation to the rational component (Hodgkinson et al., 2009). The experiential (negatively worded items) component displayed relationships similar to the experiential (positively worded items) component with respect to the CSI subscales, strongly indicating that the experiential (negatively worded items) component was a method factor (Hodgkinson et al., 2009). Again, the CSI presented a mixed picture with analysis, intuition (heuristic processing factor) and intuition (spontaneous-cautious factor) significantly loading on component one and intuition (spontaneous-cautious factor) cross-loading on component three. In summarizing their findings, Hodgkinson et al. (2009) stated that their work clearly demonstrates that the CSI response format should be changed to a Likert-like scale and that the items in the CSI may benefit from revision. In addition, Hodgkinson et al.'s (2009) work clearly demonstrates two theoretical dimensions of cognitive style: one rational-analytic and one experiential-intuitive and therefore, they call for researchers to abandon the unidimensional conceptualisation of intuition-analysis.

In sum, the intuition-analysis operationalised as the CSI has contributed substantially to understanding the influence of individual differences. However, psychometric evidence (Backhaus & Liff, 2007; Hodgkinson et al. 2009; Hodgkinson & Sadler-Smith, 2003b) demonstrates that it is no longer possible to maintain a conceptualisation of intuition-analysis as a single, bipolar construct. Notably, although the CSI has demonstrably good reliability this does not mean that the CSI is a valid measure of intuition and analysis; that is, that it measures what it claims to measure.

Furthermore, Backhaus and Liff (2007), Hodgkinson et al. (2009) and Hodgkinson and Sadler-Smith (2003b) have provided strong psychometric evidence to support a unidimensional analytic cognitive style factor and a multidimensional intuitive style factor. Thus, when the evidence for a unitary construct is taken together with the evidence for a multidimensional intuitive style construct, it seems likely that intuitive style is multidimensional. These initial findings of multidimensionality should be further explored.

Resulting from the emerging understanding of intuitive style as multidimensional, the theoretical underpinnings of intuitive and analytic cognitive style may be best understood in terms of evidence available in other areas of research such as neuroscience. Moreover, there appears to be an exciting opportunity to further develop the conceptualisation and measurement of the intuitive style construct based on recent findings from neuroscience (Lieberman, 2007; Hodgkinson, et al., 2008).

Conclusion

In conclusion, a review of the literature has demonstrated that the bipolar intuition-analysis supported the general description of intuitive style as taking a global perspective based on affective judgement. In relation to the components of intuitive style described by Allinson and Hayes (1996) detailed at the beginning of this chapter, research evidence supports:

- taking a global or broad overview approach to ideas (e.g. Armstrong & Priola, 2001)
- taking an open-ended approach to problem-solving (e.g. Priola et al., 2004)
- relying on gut feelings/physical sensations (e.g. Armstrong & Priola, 2001)
- preference for interpersonal relations/socially supportive workplaces (e.g. Downey et al., 2006)

Moreover, addition detailed evidence was found in support of:

- affect as a key component (e.g. Downey et al., 2006)
- associative processing as a key component (e.g.

New evidence was found in support of a social component:

- social aspect as a key component (e.g. Allinson, Armstrong & Hayes, 2001)

However, the initial conceptualisation that intuition-analysis should be a bipolar construct may be misleading, limiting the interpretation of associations with other constructs. Furthermore, there is evidence (e.g. Downey et al., 2006) that some variables are discretely associated with either intuition or analysis indicating that separate intuition and analysis scales may be required to further clarify individual differences.

Further to the notion that intuition and analysis may be better described as separate entities, the psychometrics and theoretical underpinnings of the bipolar intuition-analysis construct operationalised as the Cognitive Style Index (Allinson & Hayes, 1996) have been called into question by researchers (Hodgkinson & Sadler-Smith, 2003; Hodgkinson et al., 2009). In particular, mounting psychometric evidence indicates that intuition-analysis may be better conceived as two separate items rather than a unitary construct. In addition, intuitive style may be best viewed as a multidimensional construct and as such, the theory behind intuitive style may benefit from revision. Thus, there is potential to further explore the nature of intuitive cognitive style as a psychoneurobiological-based multidimensional process model.

Chapter 4

Re-conceptualising Intuitive Style

Introduction

This chapter provides an overview of the recent developments on the study of intuition that are then used to re-conceptualise components of intuitive style from a psychoneurobiological-based approach in light of the evidence presented in the previous chapter. The purpose of this chapter is to examine the current theoretical contributions from intuition research with the idea that intuition research should shed further light on the components, particularly the associative processing, non-conscious, affective and social, that may turn out to be suitable in building a fresh, well substantiated model of intuitive style. Additional neuroscience evidence is presented to work towards substantive theory, addressing the vagueness of the non-conscious and associative components.

As presented in Chapter 3, intuitive style was conceptualised by Allinson and Hayes (1996) as one end of a bipolar construct known as intuition-analysis and it was noted that future developments of intuitive style as a construct should consider it as multidimensional as well as separate from that of analytical cognitive style. The need for a fresh approach to intuitive style was shown to be initiated by other researchers querying the psychometric structure of the bipolar intuition-analysis construct bringing to the fore the need to address its theoretical foundation.

To this end, the current chapter begins with a brief look at the history of intuition and is followed by the different definitions and conceptualisations of intuition and a list of the major components of intuition. The section on the ways in which intuition and intuitive style differ from other closely associated concepts precedes a basic overview of the neuroscience of intuition. This chapter closes with a section re-conceptualising components of intuitive style in light of findings on intuition.

4.1 Historical Perspectives

In the past, intuition has had many meanings and debate is beginning to converge over the most appropriate way in which to define intuition. Intuition has been thought of as a myth, something that is mystical or spiritual, and unknowable by scientific methods. Intuition has meaning in philosophy (Kant in translation, Haywood, 1848), healthcare (Braude, 2009; Benner & Tanner, 1987), business environments (Allinson & Hayes, 1996) and it is often considered to be gender specific (Hayes, Allinson & Armstrong, 2004). In popular psychology, intuition is often represented in many different ways from the spiritual to brain hemispheric dominance. Furthermore, in the popular press, intuition is usually described as a ‘gut feeling’ or ‘sense of something’ and is referred to in any number of ways from the mystical in relation to spirituality, such as that in blogs and social networking, to the ‘intuitive’ expertise of commentators on Australian Rules Football!

Similarly, the degree of acceptance of intuition in the scientific community varies depending on the field in which intuition research is performed. For instance, debate continues in medical circles over the role of intuition in the practice of healthcare (Braude, 2009), whereas, in the business world, intuition is currently a major focus in understanding individual differences in managerial functioning and business eduation

(Dane & Pratt, 2007). In addition, intuition is associated with scientific discovery (Hadamard, 1945) and is the subject of a number of recent popular publications, Blink (Gladwell, 2005) for example. Typically, the term intuition is used loosely, not only in everyday life but also in research and getting to the core understanding of what makes up intuition appears to have been heavily reliant on technological developments in brain functioning studies.

In recent times, intuition appears to have become a significant area of research in the fields of management and neuropsychology (Hodgkinson et al., 2008; Lieberman, 2000) and is perhaps best known as a Jungian type in the guise of Myers-Briggs Type Inventory (Briggs-Myers & Myers, 1976). Notably, research on intuition currently includes approaches from dual-process theory of thinking (e.g. Glöckner & Witteman, 2010), automatic (non-conscious) mental processes (e.g. Betsch, 2008), having a strong basis in the neuroscience of mental processes. Indeed, Hodgkinson, et al. (2008) state that

> *"… there is a notable absence of modern authors who define the concept [Intuition] in Jungian terms"* (p. 4).

Certainly, the current thinking (e.g. Hodgkinson, et al., 2008) on intuition draws heavily on dual-process theories that are grounded in evidence from cognitive psychology (Glöckner, 2008), social cognition (Lieberman, 2007), and neuropsychology (Damasio, 1999) buoyed by accessible neuroimaging techniques. What follows is a brief look at the current definitions and conceptualisations of intuition for the purposes of identifying evidence of key components in intuition that will help to further develop the theoretical base for components of intuitive style.

4.2 Current Definitions and Conceptualisations of Intuition

There are a wide variety of definitions and conceptualisations of intuition. Some examples of the variety of notions about intuition present in the literature since 2000 are:

“[intuition is] the subjective experience of a mostly non-conscious process that is fast, a-logical, and inaccessible to consciousness” (Lieberman, 2000, p. 111)

“intuition refers to a family of ‘ways of knowing’ that have in common a lack of clearly articulated comprehension or rationale, but which differ in a variety of other ways” (Claxton, 2000, p. 40)

“knowing without being able to explain how we know.” (drawn from Vaughan’s, 1979 definition in Langan-Fox & Shirley, 2003)

‘‘Intuition is the way we translate our experiences into judgments and decisions. It’s [sic] the ability to make decisions using patterns to recognize what’s going on in a situation and to recognize the typical action scripts with which to react. Once experienced intuitive decision makers see a pattern, any decision makers see a pattern, any decision they have to make is usually obvious.’’ (Klein, 2003, p. 13).

“a capacity for attaining direct knowledge or understanding without the apparent intrusion of rational thought or logical inference. (Sadler-Smith & Shefy, 2004, p. 77)

“[intuitions are] … affectively charged judgments that arise through rapid, nonconscious, and holistic associations.” (Dane & Pratt, 2007, p. 40)

“[intuition is]... a process of thinking. The input to this process is mostly provided by knowledge stored in long-term memory that has been primarily acquired via associative learning. The input is processed automatically and without conscious awareness. The output of the process is a feeling that can serve as a basis for judgments and decisions.” (Betsch, 2008, p. 4)

“Intuition is an involuntary, difficult-to-articulate, affect-laden recognition or judgment, based upon prior learning and experiences, which is arrived at rapidly, through holistic associations and without deliberative or conscious rational thought’’ (Sadler-Smith, 2008, p. 31).

"Intuition is based on automatic processes that rely on knowledge structures that are acquired by (different kinds of) learning. They operate at least partially without people's awareness and result in feelings, signals, or interpretations." (Glöckner & Witteman, 2010, p. 5-6)

These definitions differ from earlier conceptualisations of intuition as 'gut feeling' or 'hunch' in one important way: most of the recent definitions of intuition are specific, detailed and less global than older definitions. As can be seen from the variety of definitions, researchers continue to vary in the way in which they conceptualise the breadth and depth of intuition. However, there appears to be agreement on a number of components and these are:

- automatic/fast processing
- acts at a level that is non-conscious
- possibly dependent on experience/prior learning
- does not involve any form of logical or rational thought

Half of the definitions listed above include affect as a component of intuition; others include detail about the kinds of cognitive processes involved in intuition providing a great starting point for re-conceptualising components in a psychoneurobiological-based multidimensional intuitive style process model.

Furthermore, two qualitative studies (McCutcheon & Pincombe, 2001, Rogers & Wiseman, 2006) reveal more about the role of social components in intuitive processing. In an occupationally driven study, McCutcheon and Pincombe (2001), used grounded theory of 262 nurses from a variety of nursing settings, used a Delphi survey and focus groups to find out about nurse's beliefs about and practice of using intuition in the workplace. McCutcheon and Pincombe (2001) found that for their sample of nurses, intuition "is a result of a complex interaction of attributes, including experience, expertise and knowledge, along with personality, environment, and acceptance of intuition as a valid 'behaviour' and the presence or absence of a nurse/client relationship." (p. 345).

Another notable study selectively focused on those who describe themselves as intuitive (Rogers & Wiseman, 2006). Rogers and Wiseman (2006) used structured qualitative interviewing of 50 individuals who described themselves as highly intuitive. Participants were asked to provide their own definition of intuition that were then analysed using content analysis. Notably, the majority of participants labelled intuition as a gut instinct, closely followed by describing intuition as a non-conscious rapid processing of information (Rogers & Wiseman, 2006). The majority of participants in their study associated intuition with personal relationships, career, business and foreknowledge of events (Rogers & Wiseman, 2006). The association of intuition with relationships, career and business is consistent with the findings of Allinson and Hayes' (1996) intuition-analysis presented in the previous chapter. In addition, recently published fine-grained reviews (Hodgkinson et al., 2008; Lieberman, 2007) on intuition make strong suggestions about defining and conceptualising intuition.

In their extensive up-to-date review on the research of intuition, Hodgkinson, Langan-Fox and Sadler-Smith (2008) adopt Dane and Pratt's (2007, p. 40) definition of intuition: "… affectively charged judgements that arise through rapid, non-conscious, and holistic associations".

They reason that this definition concisely captures intuition as a process as well as reflecting something of what is known about intuition from the field of neuroscience.

However, this definition does not appear to include physical sensations that is central to the definition of intuitive style. In seeking to further clarify the nature of intuition as a foundation for re-conceptualise components of intuitive style, intuition needs to be distinguished from other constructs that are often taken to be intuition.

4.3 Distinguishing Intuition from Other Constructs

Intuition may be mistaken for other processes that sometimes accompany it such as: heuristics, insight, instinct, implicit knowledge, guessing and tacit knowing processes (Sadler-Smith, 2008). Since intuition is sometimes confused with other constructs with which it may have some association, it is likely that intuitive style may also be misconstrued. To this end, the following details the difference between intuition and other similar constructs.

4.3.1 Heuristics

Intuition is distinctly different from the use of heuristics (Glöckner, 2008). Glöckner (2008) states that heuristics of the 'fast and frugal' type are different from intuition in that heuristics are 'rules of thumb' or serial strategies that take into account a limited amount of information, whereas, intuition uses a parallel approach taking into account large quantities of information. In a study of the differences between heuristics and intuition, 89 individuals performed a decision task in which they chose the largest city, based on inferred population size, from a number of cities when presented with cues and then performed a complex decision task where the number of cues was increased (Glöckner, 2008). Glöckner (2008) demonstrated that decision-making time for those using intuition was much quicker than other forms of decision-making and distinct patterns of choices were analysed by maximum likelihood to show that those using heuristics were different to those using intuition. Furthermore, Glöckner and Betsch (2008) involved groups of 15 university students in three experiments designed to demonstrate the role of intuitive processes in decision making. In the first experiment, students role played managers of a company and were required to select the best of three products based on a matrix of information cues (i.e. ratings by others, validity of product ratings) presented on computer under time constraint. This procedure is known as Mouselab. Glöckner and Betsch pointed out that the typical Mouselab set-up forces participants to use deliberative (analytical, step-by-step) strategies in decision making and does not allow for the demonstration of intuitive processes. Students indicated their choice of product based on presented cues by pressing one of a selection of keys on the computer keyboard. Choices made by each student were classified into strategies (lexicographic rule, equal weight rule, weighted additive rule, or take-the-best). The weighted additive rule was taken as a form of intuitive processing, where different pieces of information are taken together and processed non-consciously. Increased time constraints did not influence the type of strategy used. These 11 students were thought to use weighted additive rule (complex strategy) in making their decision, contrary to previous research where lexicographic and equal weight rule are thought to be strategies of choice when making decisions under time pressure because they are simple strategies. In addition, Glöckner and Betsch (2008) tested the possibility that students were analytical in their integration of cue information rather than intuitive. To test analysis verses intuition, they instructed students to use weighted additive rule and timed the student's responses. Glöckner and Betsch (2008) found that response times varied significantly with the pattern of the cues and that response times decreased with increased number of repetitions of different cue patterns. Given the complexity of the cue information, time pressure and decision speed (median=1.1 sec), Glöckner and Betsch (2008) concluded that students responses were too quick to be using heuristics and that the students were using the rapid, non-conscious, holistic approach of intuitive processing.

In their second study, Glöckner and Betsch (2008) used increasing time constraints to determine if individuals do use heuristics under increasing time constraints. A second group of 15 students were administered the same scenario as study 1, however, each square in the information matrix was blacked-out and the information in each square was revealed when the mouse was positioned on top of the square. Students continued to use weighted additive rule in the lenient time conditions where they were able to view more cues/review previously chosen cues and some students switched to simple deliberative heuristics in the most severe time constraint where they were able to view a very limited number of cues (Glöckner & Betsch, 2008). Glöckner and Betsch (2008) found a statistically significant difference between lenient time constraints and the most severe time constraints and concluded that changes in decision strategy were due to the decreased amount of information able to be viewed in the severe time constraint category. Their findings help to demonstrate that intuitive processes require some quantity of information, also indicating the presence of associative processing because the time taken to process the information in a deliberative manner would be visible to the experimenters and to the participants. Glöckner and Betch's (2008) findings from the second study have provided further evidence for the difference between heuristics and intuitive processes.

In Glöckner and Betsch's (2008) studies, they note that their results may have been confounded by individuals responding through the use of pattern recognition. To address this possible confound, Glöckner and Betsch (2008) reported a third study in which they changed the validity of the information but not the order of presentation. 63 students were administered the same scenario as study 1 using Mouselab and were asked to indicate the degree of certainty in their decision making. Decision making was found to vary with cue pattern indicating that students did not rely on the most valid cue to make their decisions and they tended to use weighted additive rule rather than simple heuristics (Glöckner & Betsch, 2008, p. 27). Glöckner and Betsch (2008) found that decision times decreased with increasing validity of the first cue and there were learning effects that may account for decreased decision times. Degree of certainty increased with increased validity of the first cue (Glöckner & Betsch, 2008). Glöckner and Betsch (2008) used difference scores to test for an association of significant change in certainty with differences between cue validity. Analysis of data supported the positive association between cue validities and degree of certainty indicating that students used weighted additive processes rather than simple heuristics. All in all, Glöckner and Betsch (2008) were able to cogently distinguish between heuristics and intuitive processes. Similar to heuristics, insight may be mistaken for intuition.

4.3.2 Insight

Researchers (e.g. Hadamar, 1945; Sadler-Smith, 2008) across the decades have suggested that intuition is something different from insight which is often known as the Aha! or Eureka! experience. Insight is the experience in which an individual moves from not knowing a solution to knowing a solution often in a novel way. Insight is best seen in, and often researched in, problem-solving and creativity (Hadamar, 1945). Perhaps the most well-known example of insight is provided by the story of Archemedes discovery of displacement where he is said to have jumped out of the bath and ran round shouting 'Eureka, I've got it' having suddenly solved the problem of how to determine whether or not the crown made for the King was constructed of solid gold by noticing that the level of the bath water increased when he got in the bath.

In an overview of insight, Mayer (1995) focuses on five well-researched conceptualisations of insight. Insight may be thought of in many ways including as completing a structure, re-organising or restructuring information, changing the way in which a problem is formulated or taking a different perspective, overcoming mental blocks or sets that restrict thinking about the function of objects and thinking by analogy. The steps of insight may make insight appear somewhat similar to intuition in that insight is said to occur without conscious awareness of the thought process and contain some level of positive affect (Gick & Lockhart, 2000). Unlike intuition, insight is characterised by a person arriving at an impasse in their thinking about a solution. The impasse is usually followed by a period of incubation in which the person is not actively thinking about a problem that they are working on, in contrast to the immediacy of intuition. Moreover, in insight the solution tends to come at unexpected moments, which may be when the person is doing something other than working on the solution, unlike the rapid response of intuition. In addition, the logical steps taken to get to an answer provided by insight can be articulated, whereas, the steps to intuitive conclusions are not able to be verbalised (Lieberman, 2000; Sadler-Smith, 2008). Not only is intuition different from insight in startling ways, but also intuition is different from instinct.

4.3.3 Instinct

Although intuition may be thought of as developing from instinct (e.g. Sadler-Smith, 2008), instincts are defined by researchers (e.g Cappon, 1993) as biological reflex behaviours necessary for the survival of the human species. Indeed, Lieberman's (2007) research on intuition places intuition as a thinking process involving the phylogenetically older parts of the brain (limbic system) similar to that of Damasio's evidence from acquired brain injury (Section 4.3 this chapter).

4.3.4 Tacit Knowing and Tacit Knowledge

Intuition is different from tacit knowing as described by Polanyi (1967). Polanyi (1967) defines tacit knowing as the process of unconscious acquisition of knowledge that is personal and cannot be expressed. An example may help to clarify what is meant by tacit knowing. A child learning his or her native language may also unconsciously acquire (tacit knowing) knowledge (tacit knowledge) about grammatical structure or cultural structures. According to Polanyi (1967), the tacit knowing of tacit knowledge is not open to introspection because it is an unconscious process. Therefore, tacit knowing appears to be similar to intuition in that the intuitive process may turn out not to be open to introspection. However, unlike tacit knowing, the outcomes of the intuitive process are consciously known and able to be expressed.

Polanyi (1967) describes tacit knowledge as knowledge that is acquired unconsciously in the process of doing something else. Polanyi (1967) uses the description of facial recognition to illustrate learned knowledge – for example, the characteristics of someone's face – that is not explicit. Sternberg, et al. (2000), following on from the work of Polanyi (1967), have defined tacit knowledge as action-oriented knowledge that is acquired without the help of others for the purpose of achieving personal goals. Tacit knowledge may sometimes be described as 'unspoken rules', those complex rules that are learned implicitly through everyday life. Using the example of a child learning language, tacit knowledge is the grammatical structure whereas, tacit knowing is the process of unconsciously acquiring the grammatical structure. Certainly, intuition appears to be associated with tacit knowledge and tacit knowing in some way. Perhaps tacit knowledge and tacit knowing may turn out to underpin intuition in some way. Closely associated with intuition, tacit knowing and tacit knowledge is implicit learning (Reber, 1989; Langan-Fox & Shirley, 1996).

4.3.5 Implicit Learning

Implicit learning is thought to underpin the process of intuition (Reber, 1989). Part of implicit learning is implicit knowledge, where abstract knowledge is learned without conscious effort (Reber, 1989). Research in implicit learning is extensive and has a history of using the artificial grammar methodology as a way of testing for implicit learning where individuals learn sets of consonants and the ordering of the consonants follow complex, abstract rules, as well as using visual search and eye blink techniques. Although implicit learning is assumed to be non-conscious, researchers (Reber & Lewis, 1977) have shown that over a period of time, participants learning artificial grammar are able to begin to verbally express the rules. While implicit learning may begin as a non-conscious process, the knowledge gained may be communicated to others at a later date, unlike intuition where there is no verbal account of the steps involved in thinking. In a critique of recent research, Shanks (2010) suggests that the empirical evidence for implicit learning is mixed at best. On the other hand, researchers (Lieberman, 2000) suggest that there are some types of knowledge that are learned implicitly. For instance, the rules that define social interaction are considered to be learned implicitly, without conscious effort (Lieberman, 2000). Lieberman (2000) states that implicitly learned knowledge is foundational to intuition. Like implicit learning, guessing is different from intuition.

4.3.6 Guessing

Guessing is not intuition (Fu, Dienes & Fu, 2010). Fu et al. (2010) were able to distinguish between guessing and intuition through the clever use of an attribution test using serial reaction time tasks administered to 64 undergraduate students. In the attribution test, individuals were given two locations and asked to predict the position of the third location. Fu et al. (2010), operationalised the difference between intuition and guessing as the degree of control (measured as self-report and milliseconds) over knowledge about the presence or absence of structure in a test item. Fu et al. (2010) found a significant difference between self-reported experience of guessing and intuition as well as demonstrating a statistically significant difference in the amount of time taken for guessing and intuition. Intuitive responses took significantly more time than guessed responses and Fu et al. (2010) suggest that this difference in response time is due to some fluency in the use of knowledge that is below conscious awareness. Coincidentally, Fu et al.'s (2010) study adds to the evidence from nursing (McCutcheon & Pincombe, 2010) that self-report assessment of intuition is a valid way of measuring the construct. Given the multiplicity of conceptualisations of intuition, Hodgkinson et al. (2008) cogently argue for the use of evidence from neuroscience to provide a "coherent overarching conceptual framework" (p. 8) of intuition.

4.4 A Basic Overview of the Neuroscience of Intuition

This section highlights the neuroscience evidence for the associative processing, non-conscious, affective and social components of intuition that can be used to improve the theoretical foundation for components of intuitive style.

Technological advances, faster computers and brain imaging, have paved the way for a detailed understanding and better explanations of intuition that would benefit any research on intuitive style. Along the way, a number of researchers (see Evans & Frankish, 2009 for an extensive review) have posited dual-process theories of cognition together with evidence from current experimental studies (e.g. Glöckner, 2008) and brain imaging studies that are yielding important information about the nature of intuition and may act as a guide to defining and understanding the components of intuitive style.

4.4.1 Associative, Rapid, Non-conscious Processing

It appears that there is sound neurological evidence for the distinct cognition components of associative processing, rapid processing and non-conscious processing (e.g. Stanovich & West, 2000) which underlie intuition that can then be used in re-conceptualising intuitive style.

The experience of non-conscious processing in intuitive style is a 'just knowing' without being able to verbalise the steps one took along the way. These non-conscious, rapid processes of intuitive style appear to operate for a wide variety of information from maths problems (Priola, Smith, & Armstrong, 2004) through to relationships (Armstrong, Allinson, & Hayes, 2002) suggesting that not only can sensory representations be non-conscious but also the cognitive aspects of intuitive style.

Stanovich and West (2000) in their article on individual differences in cognitive performance provide a summary of dual-process theories for the purpose of explaining the ways in which information may be construed, each slightly different from the other, that can be brought together under the headings of System 1 and System 2. System 1 is described as "associative, holistic, automatic, relatively undemanding of cognitive capacity, relatively fast, acquisition by biology, and personal experience" (p.

659). In contrast, System 2 is described as “rule-based, analytic, controlled, demanding of cognitive capacity, relatively slow, acquisition by cultural exposure and formal tuition” (p. 659). System 1 tends to focus on contextual cues particularly personal/relational cues and looks for intentionality, whereas, System 2 appears to be independent of context and personal/relational cues and is abstract. From these descriptions of System 1 and 2 it can be seen that these systems are strikingly similar to intuition and analysis, respectively, in the way each System processes.

Lieberman (2000) brought together the evidence from neurophysiology and neuropsychology on implicit learning and predictive behaviours based on non-conscious information processing, as well as evidence from deficit studies involving Parkinson’s and Huntington’s diseases, to propose that both implicit learning and intuition have their basis in the neurology of the basal ganglia. Lieberman (2000) concludes, based on level of processing, that intuition is likely to “operate by way of implicit learning” (p. 127) supporting the notion that intuition relies on experiences and associative learning (Betsch, 2008; Glöckner & Witteman, 2010).

Lieberman (2007) goes on to provide the detail of the neurological aspects of X-System and C-System in a paper reviewing the neuroscience of core processes in social cognition drawing on many different studies. In Lieberman's (2007) paper, the X-System (akin to System 1, intuitive) is described as automatic, spontaneous and parallel processing, sensory, non-conscious, operates under conditions of high arousal using the evolutionary older parts of the brain and where the products of X-System are experienced as reality. In addition, the X-System is involved in representing common cases and symmetry. In contrast, the C-System (akin to System 2, analytical) is effortful, intentional, slow and serial processing, linguistic, conscious, is impaired by high cognitive load using the evolutionary newer parts of the brain where the products of C-System are experienced as self-generated. The C-System is also involved in representing abstract concepts, special cases and asymmetry.

Thus, the cognitive components of **associative**, **rapid** and **non-conscious** processing have a base in psychoneurobiology which can then be examined as part of developing a multidimensional self-report scale of intuitive style.

4.4.2 Social Processing

Notably, social/interpersonal relations arose from the literature review (Chapter 3) as a new item of interest not previously considered as a central component of intuitive style. Evidence from the neuroscience of intuition (e.g. Lieberman, 2000) provides support for the claim to include social processing as part of intuitive style.

Lieberman (2007) in his social cognitive approach to intuition cogently demonstrated that intuition plays an important role in relationships via non-conscious, rapid processing of non-verbal cues. In particular, X-System seems to be involved in representing and decoding the non-verbal cues of others. Ambady, Bernieri, and Richeson (2000) together with Lieberman (2000) have drawn together a large body of earlier social neuroscience research on non-verbal processing (e.g. Cohen, Prather, Town & Hynd, 1990) to demonstrate that the non-conscious, rapid and associative processing of observed non-verbal cues make up a significant proportion of social processing. Further, Lieberman (2007) documents the evidence for two types of social processing (internally-focused and externally-focused processing) involving observed non-verbal cues. Internally-focused processing concentrates on the mental interior of self or others, whereas, externally-focused processing concentrates on the external material or physical features of self or others. This evidence may help to explain why incidents such as the following can occur:

> A nurse working in a hospital looks at a patient and has an intuitive experience that the patient is severely unwell in spite of all physical evidence (e.g. normal heart rate, normal temperature) to the contrary. Acting on intuition, the nurse calls the doctor and the doctor examines the patient coming to the conclusion that there is nothing amiss. However, some time later (2-3 hours) the patient rapidly deteriorates and requires intensive care (based on Sadler-Smith, 2008).

It seems that the nurse has observed the patient and non-consciously, rapidly processed internally- and externally- focused non-verbal cues resulting in a ‘gut feel’ that the patient is severely unwell.

Arguably, the social processing component of intuitive style should be conceptualised as the dispositional experience of the preferential processing of observed non-verbal cues.

Thus, the social processing component of **observed non-verbal cues** is psychoneurobiologically-based and can then be examined as part of a multidimensional self-report measure of intuitive style.

4.4.3 Positive and Negative Affect

Affect was part of the original conceptualisation of intuitive style (Allinson & Hayes, 1996) and the literature review (Chapter 3) indicated that affect is central to intuitive style. However, recent neuroscience can help improve the theoretical foundation for affect as part of intuitive style.

In independent and earlier research to that of Lieberman's (2007), Damasio (1999, 2005) presents strikingly similar findings to those of Lieberman's (2007) X- and C- Systems based on evidence from clients with neurological deficits. Damasio (2005) presents evidence from history and current practice concerning the role of emotions in cognition. This is pertinent to the current thesis because it has long been held that affect and cognition should be treated separately, and perhaps this approach has hindered previous work on intuition because not only does affect seem to play a role in intuition, but also the body seems to play a role in some form and any knowledge that helps to explain why these three areas may be part of intuition may also help to detail the potential key components of intuitive style.

Damasio’s (2005) work covers historical accounts of acquired injury to the prefrontal cortex as well as evidence from recent patient deficit studies (NB: criticisms of this work are examined in Chapter 6). Notably, the case of Phineas Gage (from whence the saying: ‘Gage was no longer Gage’ comes) forms the initial explanation of what happens when individuals loose the link between affect and cognition, or cognition and body, through injury to areas of the prefrontal cortex. That is, individuals are no longer able to make efficient and adaptive decisions, among other functional deficits, or behave in ways that are socially conducive to interaction with others. Damasio cites a number of patient deficit studies to support his assertion that the prefrontal cortex, particularly the ventromedial section, is involved in the linkage of affect with cognition. In addition, the basal ganglia, amygdala, anterior cingulated cortex and the insula cortex are implicated as playing central roles in the manifestation of emotions and the bringing into mind bodily states in response to personal and social needs. In particular, he states that damage to the ventromedial prefrontal cortex alone leads to deficits in affect and, importantly for intuition, apparent deficits in the linkage between affect and cognition appear to negatively influence personal and social decision making (Damasio, 2005) which would likely impact any intuitive processes. In addition, the patients experienced disruption in their experience of and expression of emotions and feelings. In addition, there is evidence that damage to the anterior cingulate cortex leads to deficits in cognition and affect such that there may be no outward expressions of action perhaps best captured in the colloquial saying ‘the lights are on, but no-one is home’.

The deficits in linkage between affect and cognition suggest that the ventromedial prefrontal cortex and the amygdala may be part of the neurological circuitry that helps to explain intuition. In their work with patients who have damage to the ventromedial prefrontal cortex and the amygdala, Bechara and Damasio (2005) demonstrate that although the patients exhibited normal intellect, they were not able to make advantageous decisions in real-life.

In patients with damage to the ventromedial prefrontal cortex alone, Bechara and Damasio (2005) found that these patients were not able to make advantageous decisions due to the lack of integration of cognitions with emotions which would usually result in predicting the consequences of actions in normal adults. Further, Bechara and Damasio (2005) propose that negative and positive emotions may be processed in different parts of the ventromedial area. Bechara and Damasio (2005) cite evidence that shows that damage to the right vetromedial cortex results in an absence of predicting future negative consequences, whereas damage to the left ventromedial cortex does not lead to an absence of predicting future negative consequences. Bechara and Damasio (2005) suggest that damage to the left ventromedial cortex may lead to an absence of predicting future positive consequences. Further evidence for the involvement of specific neural structures in intuition comes from research by Volz and von Cramon (2006).

Volz and von Cramon (2006) studied the functional magnetic resonance images of 15 individuals who were instructed to respond to visual gestalt-like stimuli according to whether or not they felt that the stimuli were real objects. Stimuli were presented at three levels of increasing visual degradation as well as a no stimulus condition acting as a baseline for brain activation (Volz & von Cramon, 2006). Volz and von Cramon (2006) demonstrated an association between activation of specific areas in the orbitofrontal cortex, amygdala, right cerebellum as well as the right anterior insula, right thalamus and the ventral occipito-temporal cortex with intuitive processing. The areas of activation associated with intuition shown by Volz and von Cramon (2006) are also part of Leiberman's (2007) X-System.

Furthermore, not only do Lieberman (2007) and Damasio (2005) agree on the descriptions and types of processes X-System and C-System are responsible for, but also they tend to agree on the underlying brain structures correlated with these processes. In brief, Damasio (2005) and Lieberman (2007) agree that the basal ganglia, amygdala, dorsal anterior cingulate and the ventromedial prefrontal cortex are highly correlated with X-System processes and they differ on the inclusion of the hypothalamus (Damasio, 2005) and the lateral temporal cortex (Lieberman, 2007).

Thus, from the above evidence, the conclusion may be drawn that **positive** and **negative affective states** should be included as components in a psychoneurobiological-based multidimensional intuitive style, not just on the basis of descriptors of the experience of intuition, but also because there is emerging neurological evidence that helps to explain the experience of emotions as part of intuition.

4.4.4 Physical Sensations

Whilst physical sensations or 'gut feelings' are central to the experience and formulation of intuitive style, further evidence needs to be sought to strengthen such claims. The neuroscience of intuition (e.g. Damasio, 1999) can provide such evidence.

The physical sensations component of intuition was not dealt with in the previous literature. There is one explanation for physical sensations, the somatic marker theory (Damasio, 2005) that has an extensive research program. This research program also provides evidence for non-conscious and rapid processing.

In a monograph on the neurobiology of reason, including the ways in which emotions (affects) and the body (soma) contribute to consciousness Damasio (2005) hypothesised two types of physical sensations: specific and direct visceral responses (direct bodily responses), and non-visceral sensations termed somatic markers (physical sensations) – the activation of neuronal structures involved in forming mental representations of bodily states known as the as-if-body loop (see Chapter 6 for an extensive critique) – are connected to specific stimuli via learning and socialisation through the presence or absence of reward and punishment. As Damasio (2005) states, the learned connection between somatic makers and specific stimuli is contingent upon typical brain structure and function as well as cultural norms for the action of the somatic markers, physical sensations, to be considered functionally adaptive. Damage to the right somatosensory cortex appears to lead to deficits in interoception, or the bringing of bodily states to mind leaving patients with no sense of the state of their body (Damasio, 2005). Such deficits in interoception have important consequences for intuition and intuitive style because interoception may turn out to play a role in explaining the sense of having a physical sensation.

Indeed, Bechara, Damasio, Damasio and Tranel (1997) investigated the role of somatic markers in a study about the influence of non-conscious processing on decision making. In their study, participants (ten typically developing adults and six adult patients with acquired brain injury bilaterally to the prefrontal cortex and impaired decision making) performed gambling tasks with fake money (Bechara et al, 1997). The gambling task consisted of four decks of cards, 2 advantageous with greater monetary rewards and 2 disadvantageous with greater monetary losses, where turning over a card yielded immediate monetary gain and some cards yielded monetary loss (Bechara et al., 1997). Individuals had no way of knowing which cards would appear and in what order as they selected cards from each deck (Bechara et al., 1997). One deck was advantageous over the timespan of the game even though the participants incurred on balance early losses, whereas the other decks were not advantageous even though the participants incurred on balance early gains. Individuals were measured for performance on the task, skin conductance immediately after turning over a card and self-report of their conceptualization of the game (Bechara et al., 1997). Bechara et al (1997) found that normal adults generated anticipatory skin conductance responses when turning cards over from the disadvantageous decks before they had rationally conceptualized any pattern of gains and losses in the task. Furthermore, Bechara et al (1997) found that normal adults reported that they were deciding advantageously (choosing decks with monetary gain) on a hunch/gut feeling/physical sensation, corresponding to changes in skin conductance. In comparison, patients did not show any change in skin conductance nor were they able make advantageous decisions even though they were able to accurately state which decks were advantageous and which decks were not. In addition, Bechara et al.'s (1997) findings highlight a number of components of intuitive style in normal adults: physical sensations, affect, non-conscious and associative processing of information. In particular, Bechara et al. (1997) state that:

> "In one [system], either the sensory representation of the situation or of the facts evoked by it activate neural systems that hold non-declarative dispositional knowledge related to the individual's previous emotional experience of similar situations… The ensuing non-conscious signals then act as covert biases on the circuits that support processes of cognitive evaluation and reasoning." (p.1294)

Thus, the **physical sensations** of intuitive style have a base in psychoneurobiology which can then be examined as part of developing a multidimensional self-report scale of intuitive style.

4.5 Proposed Major Components of Intuitive Style

Many definitions and a number of neurological based approaches to intuition were reviewed above for the purposes of identifying potential components and explanations of existing components that may help to build a psychoneurobiological-based multidimensional intuitive style process model. Although there remains variation among the recent conceptualisations of intuition, it has been shown that a number of components of intuition are consistently noted in the literature and are supported by neuroscience. These components are:

- rapid processing
- non-conscious processing
- associative processing
- positive and negative affects
- physical sensations
- observed non-verbal cues (social)

From the evidence presented in the current chapter, a working definition of intuitive style may be given as follows:

> *Intuitive style is a system whereby there is a preferential integration of different aspects of cognition, affect and somatic processes, below the level of effortful thought that results in the experience of an affective physical sensation.*

This then leaves the model open to adjustment following firstly the examination of the factor structure and then evidence from the process modelling. It is likely that some components, although useful as descriptors of intuitive style, may turn out to not be significant indicators from a psychometric or process modelling perspective.

Conclusion

This chapter presented an overview of the current research developments in intuition to address the need for an improved theory of intuitive style that will help to explain recent psychometric findings suggesting that intuitive style should be treated as a multidimensional construct.

This brief review of the neuroscience of intuition demonstrated evidence for rapid, associative and non-conscious processing, observed non-verbal cues, positive and negative affect, and physical sensations aspects of intuition. This evidence is used to re-conceptualise intuitive style and to formulate components for the purpose of developing a new scale to measure a psychoneurobiological-based multidimensional intuitive style. By re-conceptualising the components of intuitive style, this chapter has moved the definition of intuitive style from the abstract notion of ‘gut feelings’ to a more concrete and testable concept.

Chapter 5

Development, Refinement and Evaluation of the Intuitive Cognitive Style Scale

Introduction

Based on the literature presented in Chapter 4, a new scale was developed to measure intuitive style. The aim of developing a new scale to measure intuitive style was to clarify and understand the components that go together to make up the psychoneurobiological-based multidimensional process model. Subsumed in this aim is an attempt to address the psychometric and theoretical issues raised in regard to the intuition pole of intuition-analysis.

Furthermore, the purpose of developing a new scale of intuitive style not only for use in research but also for use in clinical practice needs to be considered. Intuitive style is frequently used in occupational and organisational settings and a new scale may help to further clarify the ways in which individual differences influence job choice and help to predict individuals' job satisfaction. Recent research that conceptualizes the physical sensations component of intuition as a neurological process (e.g. Bechara & Damasio, 2005) suggests that intuitive style may turn out to have a role to play in compulsive disorders as well as anger management. Such a diverse range of applications is not unexpected given that intuitive style's close cousin, intuition, may be considered to be a 'bridging construct' (Hodgkinson et al., 2008) that links different areas in the social sciences. Therefore, the clinical application of a new intuitive style scale needs to be kept in mind particularly in regard to the length and meaning of the new scale.

To design a new scale with a process model in mind requires a number of separate steps to be taken. The scale needs to be developed based on what is known about the components that may fit together to make up the psychoneurobiological-based multidimensional intuitive style process, the underlying structure of the scale should be replicated and issues of reliability and validity need to be addressed. To meet the needs of a stepped approach, this chapter was broken up into sections. The first section addresses the scale development including scale development theory, the second section presents the preliminary analyses of the scale and the third section presents that scale factor structure replication. Finally the discussion and limitations sections end the chapter followed by the chapter conclusion.

5.1 Scale Development

A number of texts (Dawis, 1987; DeVellis, 2003; Kline, 1986) present detailed guidelines for scale construction and were used as guides in the construction of a new scale to measure the psychoneurobiological-based multidimensional intuitive style. According to DeVellis (2003) and Kline (1986), the basic principles of scale construction should address the following important points in relation to the scale itself which include: the consistency of the scale internally and across time (reliability), the scale should measure the latent (inferred via observation) variable that the scale was intended to measure (validity), the scale should elicit a broad range of responses (discriminatory power) as well as having scores that are representative of the population for which the scale was intended (standardization).

Different researchers suggest different approaches to scale development, however many rely on the steps provided by DeVellis (2003). The main steps are to clarify the construct, generate items, choose a response format, seek expert review of the items, pilot test the items, evaluate the items and optimise the scale. In the current case, the outcomes of the process modelling should also inform the scale development process.

These steps are used in the current thesis to develop the Intuitive Cognitive Style Scale (ICSS). As part of the scale development process, replication of the factor structure will be performed as a robust means of optimising the scale. Optimising the scale in this manner will, hopefully, highlight the key dimensions and components of a psychoneurobiological-based multidimensional intuitive style that can then be evaluated in the process model. In addition, because previous work has treated intuitive style as one pole of a bipolar item, the first step in developing the new scale, clarifying the construct, was very important.

5.2 Clarify the Construct

Chapters 3 and 4 reviewed the research evidence for intuitive style and evidence for a re-conceptualisation of a psychoneurobiological-based intuitive style based on what is known about intuition, respectively. The findings from the review of literature on intuition demonstrated a variety of definitions of intuition and that the majority of researchers employ dual-process theories to explain the dimensions present in intuition. These dimensions are the cognitive, the affective and the somatic.

Further empirical evidence from neuroscience was presented (Chapter 4) to provide an explanation of the somatic items as key components in intuitive style. Drawing from the literature on intuition, intuitive style was re-conceptualised as:

> *The preferential integration of different aspects of cognition, affect and somatic processes below the level of effortful thought that results in the experience of an affective physical sensation*

and it was suggested that dimensions of intuitive style may be made up of a number of components (see Table 6).

Table 6. Dimensions of Intuitive Style

Cognition	Affect	Somatic
Holistic/associative	Positive	Direct bodily responses
Non-conscious	Negative	‘as-if-body’ physical sensations
Rapid/Spontaneous		
Observed non-verbal cues		

Moreover, components within each dimension may be strongly associated and as such, the subscales created to measure each dimension should be correlated. There may or may not be correlations between dimensions and exploratory work together with factor structure replication should help to clarify the underlying structure. In addition to theoretical clarification, the purpose of the scale should be made explicit (DeVellis, 2003).

The primary purpose of the ICSS is to model intuitive style as a psychoneurobiological-based multidimensional process. Since the ICSS may be used in both research and practice, it is envisaged that there may be some tension between parsimony and theory present during the development phase of the scale.

In addition, a psychoneurobiological-based multidimensional approach to intuitive style was taken into account in designing the ICSS as a multidimensional construct consistent with the recommendations by Hodgkinson et al. (2008). To date, it appears that there are no other multidimensional measures of intuitive style, based on the neuroscience of intuition, available in the peer reviewed literature. Having clarified the construct, the next step is to generate many items to measure each proposed dimension of intuitive style.

5.3 Generation of the Item Pool

Using the evidence gleaned from the literature, suitable items for each dimension of a psychoneurobiological-based multidimensional intuitive style were generated. DeVellis (2003) suggested investigating the literature, similar scales to the scale proposed and qualitative reports for ideas of types of items to be included in the new scale. The literature review of intuition-analysis (Chapter 3) and the neuroscience of intuition (Chapter 4), similar scales (e.g. CSI, REI, PID) and qualitative reports (Chapter 3) in the literature as well as anecdotal evidence from clinical practice where used to generate items.

In instruments measuring similar constructs, it appears that it is the physical sensations component that is often used in items. Hence, in generating a multidimensional process model of intuitive style, it was important to capture as clearly as possible descriptors of the additional aspects of intuitive style. To this end, qualitative reports indicating that individuals have varying preferences for intuitive style are important in that they provide the lexical details about individuals' experience.

The dimensions and components in Table 1 were used as a basis on which to form ICSS dimensions and their associated items. A number of items were written to tap each proposed dimension of the ICSS represented in Table 1 with the aim of extensively reflecting as much of each of the components of intuitive style as possible and to allow for redundancy during scale refinement.

However, while it was possible to generate a large number of items for some components of the ICSS (e.g. Positive affect), other components were more challenging. The components of Spontaneous/rapid and Non-conscious were difficult to generate a range of items within a reasonable level of reading difficulty. Although scholars (e.g. Kline, 1986) suggest reducing the insight participants have into the construct being measured, in the case of the ICSS reducing insight may only serve to confuse individuals given the difficulties with reporting on parts of intuitive style thought to be of a non-conscious nature. In addition, the clarity of item wording was taken into account when generating items (Kline, 1986). To this end, each dimension of the ICSS was prefaced by a vignette presenting the concept to be assessed, contained one question and a number of items against which participants were asked to indicate their preference.

In the tendency to present oneself in a positive light (social desirability) and to agree with an item regardless of its content (acquiescence) were taken into account (Kline, 1986) when constructing items for each dimension. To date, there appear to be no measures of intuitive style that take into consideration social desirability either in terms of a balanced scale (Kline, 1986) or as a trait measure (Crowne & Marlowe, 1960) and this lack of observable clarity around the socially desirable nature of cognitive style is considered by a number of researchers (e.g. Richter, 1992) to be a criticism of research in the field of cognitive style.

Although Kline (1986) suggests that the best way to address acquiescent responding is to write pairs of positive and negatively keyed items, this is based on the assumption that the latent variable is dichotomous. In the case of the ICSS, the latent variables underlying intuitive style are considered to be continuous and, as such, it is not possible to write negatively keyed items (Kline, 1986, p. 67). Because it is not possible to write negatively keyed items for continuous scales, Kline (1986) suggests checking (statistically) for acquiescence and writing clear, unambiguous items. To this end, statistical analysis will include inspecting the degree of association between the ICSS and short-form Marlowe Crowne Social Desirability Scale.

Moreover, criticisms made of other cognitive style scales (e.g. CSI: Hodgkinson et al., 2008) were the question wording indicated strategy (what an individual would do) rather than preference were taken into consideration when constructing each question. All questions in the ICSS were worded such that individuals were asked to report their preference or their typical experience. Following the generation of items for the new ICSS scale, the way in which participant's respond to the items needs to be considered.

5.4 Response Format

The continuous nature of the proposed latent variables underlying each component of the psychoneurobiological-based multidimensional intuitive style dictated the types of response formats suitable for use. Therefore, a Likert-type response format was chosen for each item to provide for a wide range of responses and is consistent with research in individual differences (e.g. PID, Betcsh, 2008). A seven point scale was chosen for the purposes of distinguishing between a wide variety of responses. Response scales should discriminate between individuals who fall at the ends of the scale from those who fall in the middle of the scale with the aim of approximating a normal curve (DeVellis, 2003).

Although the differences between odd numbered and even numbered scales are sometimes debated, an odd number scale allows for participants who may need to represent a neutral response or participants who may feel frustrated by being forced into making a choice. On the other hand, an even number of responses forces the individual to commit in one direction or the other. DeVellis (2003, p. 77) states that neither odd nor even number response formats are superior, and furthermore, researchers should consider whether the information provided by a mid-point on the scale is crucial to understanding the construct. In the case of ICSS, a mid-point on the scale may enable understanding about the degree to which individuals are guided by the components of intuitive style. To this end, an odd numbered scale was chosen as the most suitable option for the ICSS and each scale was labelled from 1 (*not at all*) to 7 (*all the time*).

Likert-type response formats may be labelled in different ways (DeVellis, 2003) using numbers or words. Since words may be subject to different interpretations, such as ‘sometimes’ may mean once a week or every two months depending on the individual, a number line was used with the addition of words to help guide participants in indicating their response (DeVellis, 2003) to each item. The next step in the process after looking at response formats is to offer the items for expert review.

5.5 *Expert Review*

DeVellis (2003) suggests sending the item pool to a group of people knowledgeable about the construct for review for the purposes of identifying the relevancy of items to the construct, evaluating the clarity and conciseness of items and as well as an opportunity to gain further suggestions for items. Each dimension vignette, question and items were checked for clarity and coverage of intuitive style before being sent to ten researchers working in individual differences for blind review. The item pool for the ICSS was presented on SurveyGizmo (an online survey software package) beginning with the conceptualisation of intuitive style presented at the beginning of this chapter. Reviewers were asked to indicate the degree to which they thought each item was representative of the construct on a seven point scale (1 = strongly disagree, 4 = neither agree nor disagree, 7 = strongly agree) and had the option of making detailed comment in text box below each item. The reviewers were sent an email requesting their assistance in reviewing items for scale development as part of this thesis. The email contained the link to the survey and reviewers were informed of the anonymity of their responses. In addition, comments were sought from my thesis supervisor.

Eight reviewers provided responses and comments. In general, reviewers indicated that they thought that the item pool tapped intuitive style as conceptualised in the definition provided and two reviewers thought that some items were repetitive and that this repetition may lead to participant frustration. On the basis of responses from my supervisor and reviewers, a number of items were re-worded and some items were removed yielding a ICSS scale of 55 items (Appendix A).

In addition, expert review suggested that some items may be non-normally distributed in the population. In particular, items pertaining to the components of Non-verbal Cues and Physical Sensations. These components may be skewed towards the higher end of the response format because non-verbal cues are taken to be part of typical social skills development and may be explicitly emphasised in workplace training for a number of occupations (e.g. sales, counselling). Similarly, Physical Sensations may be skewed towards the higher end of the response format possibly due to the presence of sayings such as “I have goose bumps” or “It really made my hair stand on end” in everyday lexicon.

Moreover, it was thought that the Non-verbal Cue and Positive Affect components were likely to be strongly associated with socially desirable responding. Again, this may be due to explicit training or typical social skills development.

5.6 Preliminary Analyses

The ICSS was administered to an initial sample for the purposes of reducing the number of items in the scale and for initial exploration of the factor structure. It should be noted here that this initial data collection is the first of two data collections performed to step through the item reduction and factor replication procedure. Information on the initial data collection is detailed in the following section and the information on the second data collection is detailed in the Section 5.22 Factor Structure Replication.

Prior to engaging participants, ethics approval from the Standing Committee on Ethics in Research Involving Humans for Monash University was sought and granted (see Appendix B on the attached CD) including approval of the explanatory statement and all advertising copy.

5.7 Method

5.7.1 Participants

The initial sample of 303 participants was a sample of convenience and sought to gain the responses of intuitives. To this end, advertising was conducted through various organizations including: small businesses, local Victorian council and shire offices and their contractors, government departments, sales, educational institutions, insurance services, health services, Victorian school newsletters, online industry newsletters and university newsletters according to the findings in the literature review (Chapter 3) which demonstrated that intuitive style tended to be associated with specific occupations and job roles.

232 participants were female and 71 male, ranging in age from 18 to 70 (M=35, SD=12.6) with an average education at undergraduate level. 48% of participants reported working full-time, 21.1% part-time, and 20% casual. 4% of participants were full-time caregivers (no paid work) and 5.6% volunteered their time to organisations. The average length of tenure reported was two years.

58% of participants were working in professional roles, 12.9% were employed in clerical and administration jobs, 11% as managers, 9.1% in sales, and 7.2% in community and personal care, technical trades, labourers and machine operators (see Appendix C on the CD).

5.7.1.1 Instruments

The dimensions of the ICSS were administered to participants interspersed between additional instruments to avoid participant fatigue and to reduce any perseverance among ICSS dimensions. To provide information on the ICSS's convergent and discriminant validity three scales as indicated were included as part of the survey. Permission (where applicable) to use the following three scales, the Big Five Inventory, Marlowe-Crowne Social Desirability Scale Short Form C and the Rational-Experiential Inventory, were sought from the appropriate authors and can be found in Appendix B on the CD.

Big Five Inventory (John & Srivastava, 1999)

The Big Five Inventory measures the five factor model of personality traits. It consists of 44 items measuring Extraversion, Neuroticism, Agreeableness, Conscientiousness and Openness to which participants respond from "1 Disagree strongly" to "5 Agree strongly". Example items are "Is full of energy", "Is depressed, blue", "Is helpful and unselfish with others", "Does a thorough job" and "Likes to reflect, play with ideas". The original study reported alpha co-efficients of .75 and Worrell and Cross (2004) reported subscale reliabilities of .70 to .83 for a sample of African American tertiary student participants. Previous research (Allinson & Hayes, 1996) has reported significant correlations between intuition-analysis from -.22 to .45 for Cattell's 16 Personality Factor measure of personality. Of note, the Introversion-Extroversion subscale correlated with intuition-analysis at -.22 indicating that analysis was positively associated with extraversion. Therefore, it is likely that in the current research a multidimensional intuitive style construct may be negatively associated with extraversion.

Marlowe-Crowne Social Desirability Scale Short Form C (MC-C: Reynolds, 1982)

Marlowe-Crowne is a 13 item scale and was used to measure socially desirable responding attitudes and traits. Participants respond to items as either "True" or "False". Example items include "No matter who I'm talking to, I'm always a good listener" and "I am always courteous, even to people who are disagreeable". Given the apparent social nature of intuitive style, it was important to determine if socially desirable responding was a factor influencing the results. To date, it appears that social desirability has not been measured in conjunction with the bipolar intuition-analysis construct and so there are no previous data to indicate possible components that may be susceptible to socially desirable responding.

Rational-Experiential Inventory (Epstein, 1991)

The REI is a 31 item measure consisting of two separate scales. The Need for Cognition scale operationalises rational system of thinking very similar to that of analytic cognitive style, whereas, the Faith in Intuition scale operationalises the experiential system of thinking very similar to that of intuitive style. Epstein (1990) proposed that these two systems are separate and interact with each other, forming a dual-process model of cognition. Example items include "I am a very intuitive person" (Faith in Intuition) and "I prefer my life to be filled with puzzles that I must solve" (Need for Cognition). Epstein et al. (1996) reported subscale alpha reliabilities of .87 and .77 for Need for Cognition and Faith in Intuition, respectively. Björklünd and Backström (2008) reported similar subscale alpha's of .86 (Rationality) and .88 (Experientiality) for a sample of Scandinavian tertiary students. In a comparison with a modified version of the CSI (see Chapter 3), Hodgkinson et al. (2009) found that the CSI Analytic subscale items loaded on the same factor as the REI Rational subscale items, with the exception of five items that loaded on the same factor as the REI Experiential. In comparison, the CSI Intuitive subscale items loaded on the same two factors as the REI Experiential, the first factor representing intuition. This suggests that the ICSS should be associated with the REI Experiential subscale and not associated with the REI Analytic subscale.

Self-report Intuitiveness

A vignette was created to assess self-reported intuitiveness. The idea was to provide a broad base of descriptors of intuitive style in everyday life as follows:

Please indicate whether or not the following applies to you:

I would call myself an intuitive person. I like to get a sense of the whole picture. I experience feelings in my body and emotions (positive or negative) when I think. The feelings in my body and emotions I experience help to guide my thinking.

Participants were given the option of responding “Yes” or “No” to this question.

5.8 Procedure

An online freely available survey software package (SurveyGizmo) was used to administer the survey in an anonymous manner. The survey was active until an acceptable number of completed responses were gained within the allocated time frame. The survey was then downloaded to Statistics Package for the Social Sciences (SPSS) –version 19 (IBM, 2010) for analysis.

5.8.1 Software procedures

SurveyGizmo is freely available to researchers with a university email address. The development survey was constructed on line and included a save and return function where participants may save their progress and return at a later date to complete the survey. The save and return function automatically generates a unique url (uniform resource locator) that is sent to the email address provided by the participant. Email addresses are stored on a separate database and SurveyGizmo was set to automatically send out reminders to complete the survey every seven days.

The introductory first page of the survey contained the explanatory statement and email details of the researcher. Following the introductory page, ReCAPTCHA[4] was inserted to prevent spamming and survey was posted as a secure site, with settings to prevent indexing by websites and one user per IP address to comply with the copyright requirements of the commercially available instruments. Thereafter, each page contained survey items and the last page contained a quote and a thank you message. Pages with survey items contained copyright information, where applicable, and instructions to participants, or a repeat of the instructions, where more than one page was required to present the items. Survey items were presented in a table of radio buttons that required the participant to click to select their response. Each page containing survey items was designed to be user friendly where the text font was chosen for visual clarity, hovering the mouse over the radio buttons revealed the response format (e.g. 1 Not at all), minimal scrolling was required (or none at all) to see all items on a page and the page colours were selected for minimal glare. The survey was sent to three colleagues to check its functionality on a variety of operating systems.

SurveyGizmo allows for the export of data in SPSS file format. This means that experimenter errors in data entry can be avoided. However, this does not obviate the need to check the data set for accuracy as other errors may creep in if the data set needs re-coding. Questionnaire items from the survey are imported into the Label section of SPSS and variable numbers provided automatically by SurveyGizmo are imported into the variable Name section of SPSS. All other SPSS information about each variable (e.g. width, values, measure) are automatically encoded from the questionnaire and imported directly into the appropriate columns in the Variable view of SPSS. Some re-coding may be necessary for ease of use

[4] ReCAPTCHA is a small program that is a **C**ompletely **A**utomated **P**ublic **T**uring test to tell **C**omputers and **H**uman **A**part and prevents spamming by presenting an image of characters which the participant needs to type into a response box.

in SPSS (e.g. re-coding Identification numbers) depending on the way in which the survey was constructed.

5.9 Statistical Procedures

5.9.1 Data cleaning

The sample was randomly split into two parts using SPSS where subsample 1 was used for the exploratory factor analysis and subsample 2 for replication. Data cleaning and preparation was done on each subsample using SPSS. Tabachnick and Fidell (2001, p. 85) recommend a series of steps in cleaning and preparing a set of data for analyses. These steps are separated into univariate and multivariate data.

There was initial inspection of the univariate descriptive statistics for accuracy of input, out-of-range values, plausible means and standard deviations, univariate outliers. The amount and distribution of missing data was evaluated and pairwise plots checked for nonlinearity and heteroscedasticity. Skewness, kurtosis and probability plots were checked and any non-normal variables identified for transformation (where appropriate).

Inspection of the multivariate data was done to identify and deal with multivariate outliers, locating and describing any variables causing multivariate outliers and to evaluate variables for multicolinearity and singularity. These steps were implemented in the development of the ICSS as follows:

5.9.1.1 Inspection of Univariate Descriptives

Once the data were imported into SPSS, the data was checked for missing data and response bias. Cases with excessive amounts of missing data or clear response bias (giving the same response to all items) were removed from the data set. The mean scores, standard deviations, skewness and kurtosis were calculated for each item in the ICSS (see Appendix D) and inspected for out-of-range values and the plausibility of the data. The distribution of scores for each item was inspected by histograms. Probability and detrended plots and box-and-whisker plots were checked for the presence of univariate outliers. Items with restricted ranges (low variance) were excluded from further analyses as the results of factor analytic and structural equation modelling procedures are dependent on mathematical operations using variance.

Outliers were noted for further investigation. According to Pallant (2007), the influence of outliers may be assessed using the 5% Trimmed Mean value available in SPSS Explore. The 5% Trimmed Mean is the value calculated following the exclusion of the top and bottom 5% of scores, removing the influence of outliers on the mean. The Trimmed mean and the mean can then be compared. Pallant (2007) suggests that where the trimmed mean and the mean are very different, then the outliers may be investigated further in multivariate analyses.

Nonlinearity and heteroscedasticity were investigated using pairwise plots of ICSS items grouped by gender. Where variables demonstrated heteroscedasticity, they were cross-checked against the skewness values in univariate descriptives.

5.10 Raw Data Visualisation

In addition, MatLab version 7.11 (Mathworks, R2010b) was used to plot the data in three dimensions (see Figures 1 – 6 below: note that positive and negative affect were graphed together) as an additional way of inspecting the raw data for useful information for each component of intuitive style. One advantage of inspection of three dimensional plots is that it is easy to see the (non)normal shape of the responses to each question.

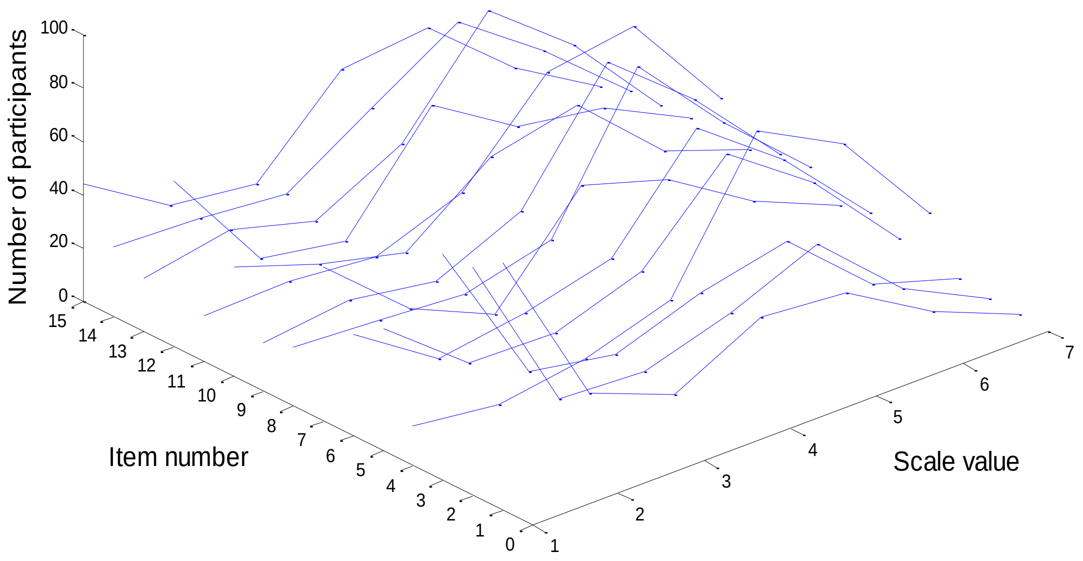


Figure 3. Physical Sensations Component Raw Data (Items 1- 15)

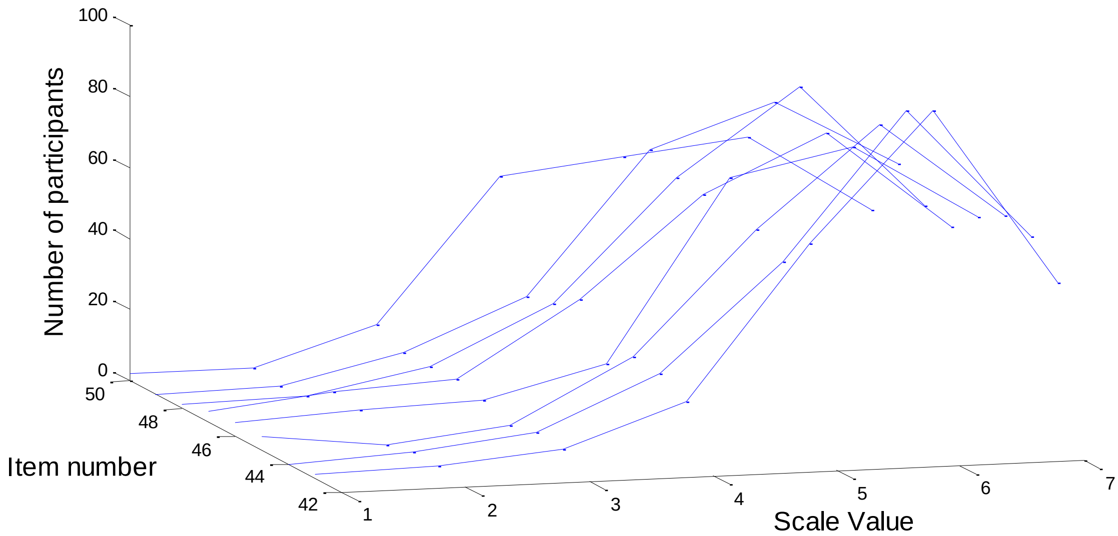


Figure 4. Big Picture Component Raw Data (Items 41 – 50)

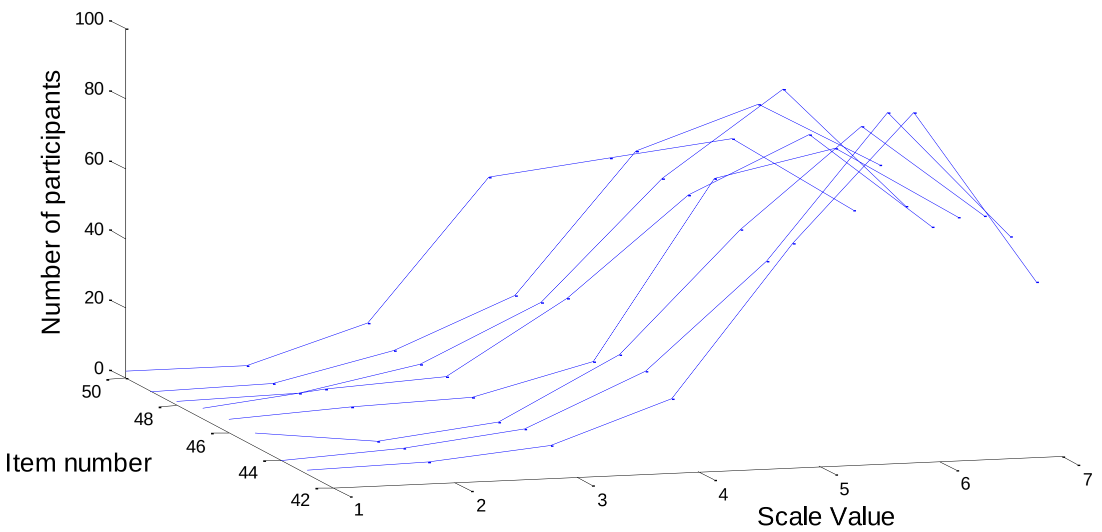


Figure 5. Positive and Negative Affect Raw Data (Items 26 - 40)

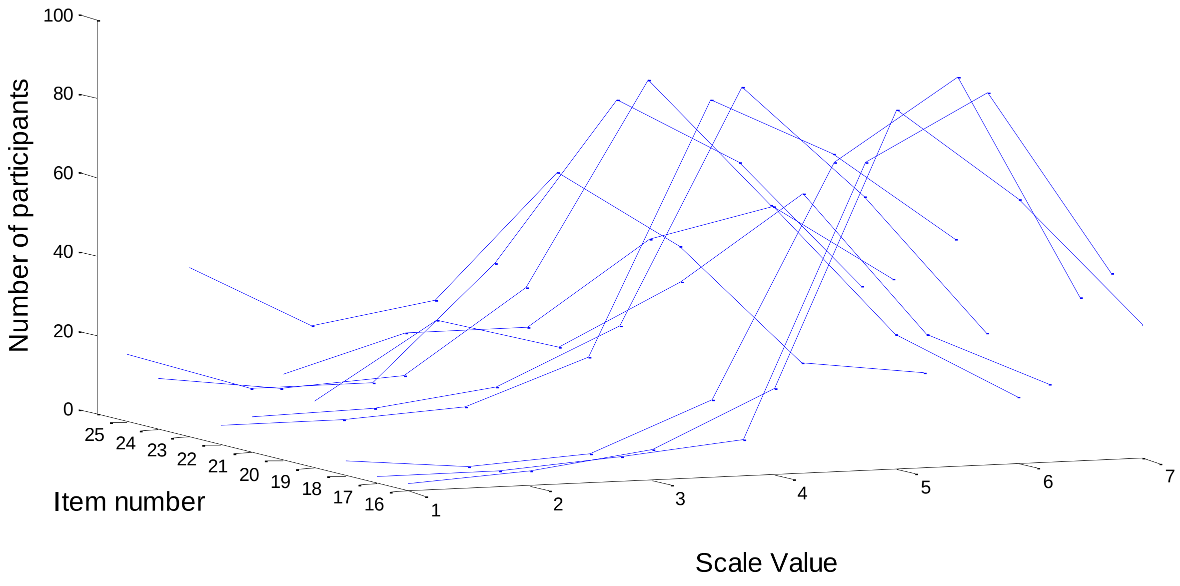


Figure 6. Observed Non-verbal Cues Component Raw Data (Items 16-25)

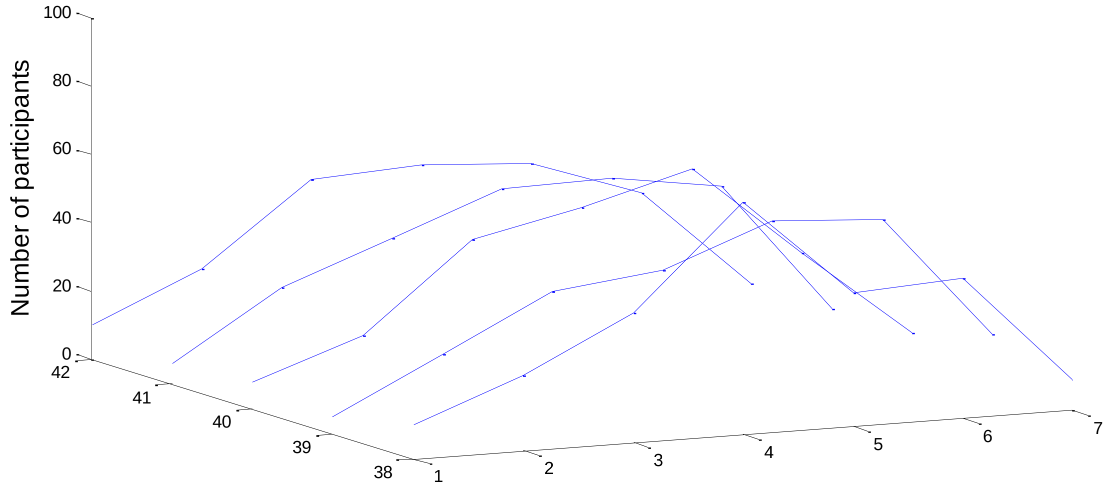


Figure 7. Rapid Component Raw Data (Items 38 – 42)

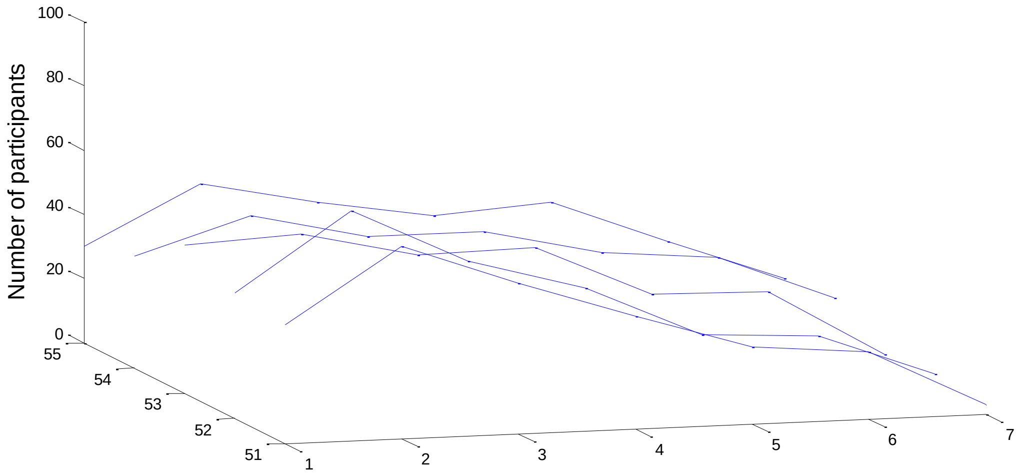


Figure 8. Non-conscious Component Raw Data (Items 52 – 55)

5.11 Multivariate Outliers

To investigate further, data were inspected for multivariate outliers for each case. To this end, the Mahalanobis Distance was calculated for each case using the scores on the ICSS. Cases with significant Mahalanobis distance values were checked for errors and response bias and removed from the data set as required. In addition, the variables were evaluated for multicolinearity and singularity by inspecting the bivariate correlation matrixes generated in SPSS for each instrument. Multicolinearity is a problem for statistical analyses requiring matrix inversion (e.g. factor analysis: Tabachnick & Fidell, 2001). No evidence of multicolinearity or singularity was found.

5.12 Additional Statistical Considerations

For the purposes of refining the ICSS, the strict requirements of violations of normality were somewhat relaxed. Researchers (e.g. Costello & Osbourne, 2005; Pallant, 2007) note that it is unlikely that researchers in the social sciences will have normally distributed data and that it is usually the case that data violate normality in one way or another. Moreover, some ICSS items were hypothesised to have higher means than others and to have skewed distributions in the population.

Furthermore, the purpose of this initial study is to describe and explore the data and not to make inferences about the sample or population. While researchers usually rely on statistical significance, in the case of analysing the data from the development sample, statistical inference is not particularly important. Of greater value are the correlation coefficients because they indicate the direction and magnitude of the relationship between variables of ICSS at the scale level and the other instruments in better understanding the nomological net of intuitive style (DeVellis, 2003). Consideration was also given to the processes of data reduction, determining the number of latent variables underlying the ICSS and defining the meaning of the latent variables by exploratory factor analysis which does not rely on inferential statistics. Once a collection of items has undergone the scale development process, then confirmatory factor analyses (such as those used in structural equation modelling) can be applied to new samples to test and further hone the findings from the exploratory analysis (DeVellis, 2003; Tabachnick & Fiddell, 2001).

5.13 Exploratory Factor Analysis

Exploratory factor analysis procedures serve to provide for data reduction and determining the number and meaning of latent variables (DeVellis, 2003). Factor analysis has been strongly critiqued (e.g. DeVellis, 2003) with regard to the ad hoc nature of decision making that may occur at various steps in the process. The steps at which decisions must be made are: sample size, factor extraction method, rotation method and number of factors to extract.

To facilitate best practice in exploratory factor analysis, Costello and Osbourne (2005) reported on current practice in the literature and then proceeded to test various sample sizes, extraction methods, rotation method and number of factors to extract by monte carlo analyses using a large database and a scale with known, well-examined statistical properties. They suggested that researchers tend to use principal components analysis as a method of extraction because it is the default setting on a number of statistical software packages rather than for statistical reasons. Costello and Osbourne (2005) go on to present a solid case for the use of maximum likelihood factor analysis for relatively normally distributed data and principal factor (principal axis factors) when data violate normality rather than using principal components even when using factor analysis for data reduction. Their monte carlo analysis demonstrated that sample sizes of 2(cases):1(variable) produced correct factor solutions 10% of the time, whereas, ratios of 5:1 produced correct factor solutions 40% of the time. Costello and Osbourne's (2005) findings are comparable to Comrey's (1973) classifications of sample sizes for factor analysis where 100 participants is considered poor, 200 fair, 300 good, 500 very good, and 1,000 excellent.

In terms of factor extraction and rotation methods, Costello and Osbourne (2005) compared principal components with maximum likelihood estimation (MLE) for orthogonal (varimax) and oblique (direct oblimin) rotations. Costello and Osbourne (2005) demonstrated that although both extraction methods produced identical eigenvalues after extraction, principal components gave significantly higher total variance and higher item loadings that were expected due to the inclusion of all variance (unlike MLE which uses the shared variance). Costello and Osbourne (2005) argued that principal components leads to an overestimation of the variance accounted for because of the inclusion of error and unique variance with the shared variance. In terms of the rotation method, Costello and Osbourne (2005) demonstrated that orthogonal and oblique rotations produced nearly the same results within each method of extraction and argue that oblique rotation is preferable because "oblique rotation will always reproduce an orthogonal solution but not visa versa" (p. 7).

In researching the best way to determine the number of factors to interpret, Costello and Osbourne (2005) demonstrated that Kaiser's criterion (retaining eigenvalues greater than 1) is one of the "least accurate" (p. 2) methods of determining the number of factors to interpret. Indeed, they found that 36% of their samples retained too many factors using Kaiser's criterion. Costello and Osbourne (2005) suggested that the number of factors to be considered should be set a priori according to the theory underpinning the scale and investigated using the scree test. Kline (1986) has argued that the scree test is the best way of determining the number of factors in a data set because of its availability, it is relatively easy to interpret and can be cross-checked by running multiple factor analyses where different numbers of factors are chosen to be retained. The researcher can then inspect each set of factor analyses for strongly loading variables, number of cross-loading variables and communalities to determine the number of factors that are best represented by the data.

Based on these findings, Costello and Osbourne (2005) make the following recommendations:

- researchers acknowledge that exploratory factor analysis is error prone
- given that there are no inferential statistics applied, that factor analysis methods (not principal components) be used with oblique rotation
- scree plots used with multiple factor analyses to determine the number of factors to interpret
- large sample sizes should be used

- further testing of the final factor structure using confirmatory factor analysis with a new sample.

5.14 Scale Refinement

According to Kline (1986) and DeVellis (2003), unsatisfactory scale items need to be identified and removed from the scale. To this end, the pattern of responses to each item was evaluated using histograms and descriptive statistics listing item means, standard deviation, skew and kurtosis. Items were inspected for means 2 or below and 6 or above on the 7 point scale and their degree of variability.

In addition, the internal consistency of the scale was examined by exploring the relationships among items as well as the total-item-correlation values which indicate the degree to which items correlate with the total scale. The adjusted Cronbach's alpha value for each item was inspected to identify items not contributing to the scale.

5.15 Social Desirability

DeVellis (2003) recommends investigating the social desirability of new scales by inspecting the correlations between the new scale and a measure of social desirability such as the Marlowe Crowne Social Desirability Scale Short form C (MCSDS-C) to address any response bias. No item correlations between the MCSDS-C and the ICSS items above the .4 criterion were identified in the current data (see Table 7).

To date, there is no literature on the social desirability of intuitive style and therefore, no indication of which items may be susceptible to socially desirable responding.

Table 7. Association Between ICSS Items and Marlowe-Crowne Social Desirability

ICSS items	Marlowe-Crowne
Tension in my body	-.15*
A sense of joy	.18*
A sense of excitement	.15*
A sense of harmony	.15*
An overall view of things	.26**
See the big picture	.20*
The pieces falling into place	.15*
A sense of completeness	.24**
Total overview	.23**
A sense of the whole pattern	.16*
A global approach	.21*

* $p < .05$, ** $p < .001$

As can be seen from Table 7, although correlations between ICSS items and the MCSDS-C reached statistical significance, none met the criteria of r = .40. Notably, many of the items are those written for the holistic/associative subscale of the ICSS was found to be susceptible to socially desirable responding. In particular, the item ‘An overall view of things’ shared around 6.6% of its variance with social desirability. When considered in practical terms, 6.6% is not large and may not have a strong influence on the data.

Given that the holistic/associative subscale has been one of the most important aspects in defining intuitive style (Allinson & Hayes, 1996; Hodgkinson, et al. 2009), these items were not excluded from the scale based on their association with socially desirable responding. However, subsequent data analyses will look again at these results to see if this pattern remains the same in different samples.

5.16 Inter-Item Correlations Per Subscale

The next action taken to help refine the scale was to drop items according to their degree of association with other items in each subscale (DeVellis, 2003). Before beginning this part of the analysis, the Affect scale was separated into two semantically different scales the first scale consisting of items relating to negative affect and the second consisting of items relating to positive affect because it is unlikely that these items will correlate to form a single scale. DeVellis (2003) suggests dropping items based on their inter-item correlation value as a way of achieving brevity and improving the reliability of the scale. Correlations among items in each subscale were inspected for items exhibiting correlations of less than .30 with a majority of their own subscale items. Appendix C contains the original inter-item correlation tables for each subscale.

The following items were found to load less than .30 and were dropped:

physen1 (Chills)

physen2 (Lump in the throat)

physen3 (Hair standing on end)

physen6 (Tension in my body)

nonver1 (A person's emotions)

nonver7 (The feeling you get from them)

nonver8 (Something in the shape of their mouth)

nonver10 (Something about them)

posaff5 (A sense of significance)

Items showing a single subscale correlation at less than .30 were retained for further analysis. These items were:

physen5 (The tilt of their head)

nonver9 (A sense of excitement)

Dropping items yielded the following inter-item correlations for each of the subscales:

Table 8. Inter-item Correlations for Physical Sensations Subscale

	1	2	3	4	5	6	7	8	9	10	11
Physen4	-	.52**	.44**	.54**	.52**	.50**	.57**	.53**	.62**	.52**	.38**
Physen5		-	.36**	.30**	.25**	.41**	.35**	.41**	.38**	.34**	.35**
Physen7			-	.62**	.55**	.71**	.54**	.39**	.44**	.54**	.52**
Physen8				-	.77**	.75**	.67**	.50**	.58**	.65**	.56**
Physen9					-	.72**	.62**	.44**	.60**	.66**	.58**
Physen10						-	.61**	.52**	.60**	.71**	.69**
Physen11							-	.57**	.60**	.56**	.49**
Physen12								-	.53**	.51**	.51**
Physen13									-	.74**	.62**
Physen14										-	.72**
Physen15											-

* $p < .05$, ** $p < .001$

Table 9. Inter-item Correlations for Observed Non-verbal Cues Subscale

	1	2	3	4	5
Nonver3	-	.41**	.38**	.45**	.44*
Nonver4		-	.61**	.56**	.43**
Nonver5			-	.59**	.48**
Nonver6				-	.46**
Nonver9					-

* p < .05, ** p < .001

Table 10. Inter-item Correlations for Positive Affect Subscale

	1	2	3	4	5	6
posaff1	-	.52**	.51**	.29**	.59**	.32**
posaff2		-	.65**	.43**	.46**	.29**
posaff3			-	.53**	.51**	.30**
posaff4				-	.40**	.44*
posaff5					-	.50**
posaff6						-

* p < .05, ** p < .001

Table 11. Inter-item Correlations for Negative Affect Subscale

	1	2	3	4	5	6
negaff1	-	.66**	.50**	.48**	.41**	.41**
negaff2		-	.68**	.48**	.40**	.60**
negaff3			-	.51**	.39**	.56**
negaff4				-	.59**	.40**
negaff5					-	.38**
negaff6						-

* p < .05, ** p < .001

Table 12. Inter-scale Correlations for Rapid Subscale

	1	2	3	4	5
rapid1	-	.49**	.54**	.53**	.50**
rapid2		-	.71**	.84**	.76**
rapid3			-	.77**	.86**
rapid4				-	.84**
rapid5					-

* p < .05, ** p < .001

Table 13. Inter-item Correlations for Big Picture Subscale

	1	2	3	4	5	6	7	8
bigpic1	-	.67**	.40**	.39**	.40**	.66*	.58**	.45**
bigpic2		-	.33*	.38**	.36**	.67**	.61**	.47**
bigpic3			-	.52**	.63**	.45**	.55**	.45**
bigpic4				-	.59**	.52**	.61**	.40**
bigpic5					-	.53**	.52**	.50**
bigpic6						-	.78**	.56**
bigpic7							-	.55**
bigpic8								-

* p < .05, ** p < .001

Table 14. Inter-item Correlations for Non-conscious Subscale

	1	2	3	4	5
noncon1	-	.81**	.59**	.60**	.58**
noncon2		-	.66**	.69**	.68**
noncon3			-	.67**	.64**
noncon4				-	.85**
noncon5					-

* p < .05, ** p < .001

5.17 Factor Analytic Procedures

Following removal of cases subject to violations of univariate and multivariate normality and initial dropping of items, factor analytic techniques were used for the purposes of data reduction and to determine the most appropriate number and meaning of latent factors underlying the scale. To this end, a series of factor analyses were run as recommended by Costello and Osbourne (2005).

According to Tabachnick and Fidell (2001) data must be suitable for factor analysis in that correlations among scale items should be equal to or greater than .30. The correlation matrix was inspected for correlations .30 and above and for every factor analysis, the Kaiser-Meyer-Oklin (KMO) measure of sampling adequacy and Bartlett's test of sphericity (Bartlett, 1954) were inspected at each iteration of the factor analysis.

5.17.1 Principal Axis Factoring with Direct Oblimin Rotation

Given that the data for analysis did not meet the strict criteria for normality, principal axis factoring (PAF) was the first choice of analysis. The initial KMO (.83) was within acceptable limits, and Bartlett's test of sphericity (χ^2 = 4926, p =.00) was significant indicating that the data were suitable for factor analysis. The initial extraction was set for oblimin rotation and eigenvalues greater than 1. Oblimin rotation was chosen as it was hypothesised that some factors should be correlated. The table of communalities did not show any values less than .30. Inspection of the eigenvalues indicated an estimation of 7 factors to extract commensurate with the scree plot results. A number of items exhibited cross-loadings and these were dropped: physen4, nonver3 and negaff5.

Table 15. PAF ICSS Seven Factor Structure Communalities

Item	Initial	Extraction
PhySen5	.46	.34
PhySen7	.68	.50
PhySen8	.77	.71
PhySen9	.73	.67
PhySen10	.80	.78
PhySen11	.70	.57
PhySen12	.65	.44
PhySen 13	.68	.58
PhySen14	.80	.72
PhySen15	.70	.58
NonVer4	.60	.61
NonVer5	.68	.70
NonVer6	.56	.53
NonVer8	.64	.66
NonVer9	.53	.46
IntEmo1	.69	.67
IntEmo2	.62	.53
IntEmo3	.64	.58
IntEmo4	.62	.48
IntEmo6	.56	.35
IntEmo7	.63	.68
IntEmo11	.62	.57
IntRap1	.52	.44
IntRap2	.78	.76
IntRap3	.82	.80
IntRap4	.85	.85
IntRap5	.86	.85
Assoc1	.60	.52
Assoc2	.65	.56
Assoc3	.64	.52
Assoc4	.62	.51
Assoc5	.66	.54
Assoc6	.79	.78
Assoc7	.76	.74
Assoc8	.53	.48
NonCon1	.73	.60
NonCon2	.65	.76
NonCon3	.65	.59
NonCon4	.82	.76
NonCon5	.81	.73

Table 16. PAF ICSS Seven Factors Total Variance Explained

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	9.517	23.793	23.793	9.139	22.848	22.848	7.275
2	4.846	12.116	35.909	4.464	11.159	34.007	4.667
3	3.645	9.112	45.020	3.364	8.409	42.416	4.431
4	2.827	7.068	52.088	2.454	6.135	48.551	4.312
5	2.636	6.591	58.679	2.299	5.748	54.300	4.903
6	2.027	5.067	63.746	1.619	4.047	58.346	2.984
7	1.541	3.852	67.598	1.142	2.856	61.202	3.758
8	.976	2.440	70.037				
9	.906	2.264	72.302				
10	.859	2.147	74.449				
11	.800	2.000	76.449				
12	.747	1.866	78.315				
13	.714	1.785	80.100				
14	.652	1.631	81.732				
15	.614	1.536	83.268				
16	.545	1.362	84.630				
17	.515	1.289	85.918				
18	.482	1.206	87.124				
19	.425	1.063	88.187				
20	.415	1.038	89.225				
21	.381	.953	90.178				
22	.365	.913	91.091				
23	.354	.885	91.977				
24	.311	.779	92.755				
25	.304	.759	93.514				
26	.285	.712	94.226				
27	.272	.680	94.906				
28	.254	.635	95.541				
29	.220	.549	96.090				
30	.208	.520	96.610				
31	.197	.492	97.103				
32	.177	.443	97.546				
33	.160	.401	97.947				
34	.152	.379	98.326				
35	.143	.356	98.682				
36	.132	.329	99.011				
37	.119	.298	99.309				
38	.111	.278	99.587				
39	.090	.225	99.811				
40	.075	.189	100.000				

Extraction Method: Principal Axis Factoring.

a. When factors are correlated, sums of squared loadings cannot be added to obtain a total variance.

Figure 9. PAF ICSS Seven Factors Scree Plot

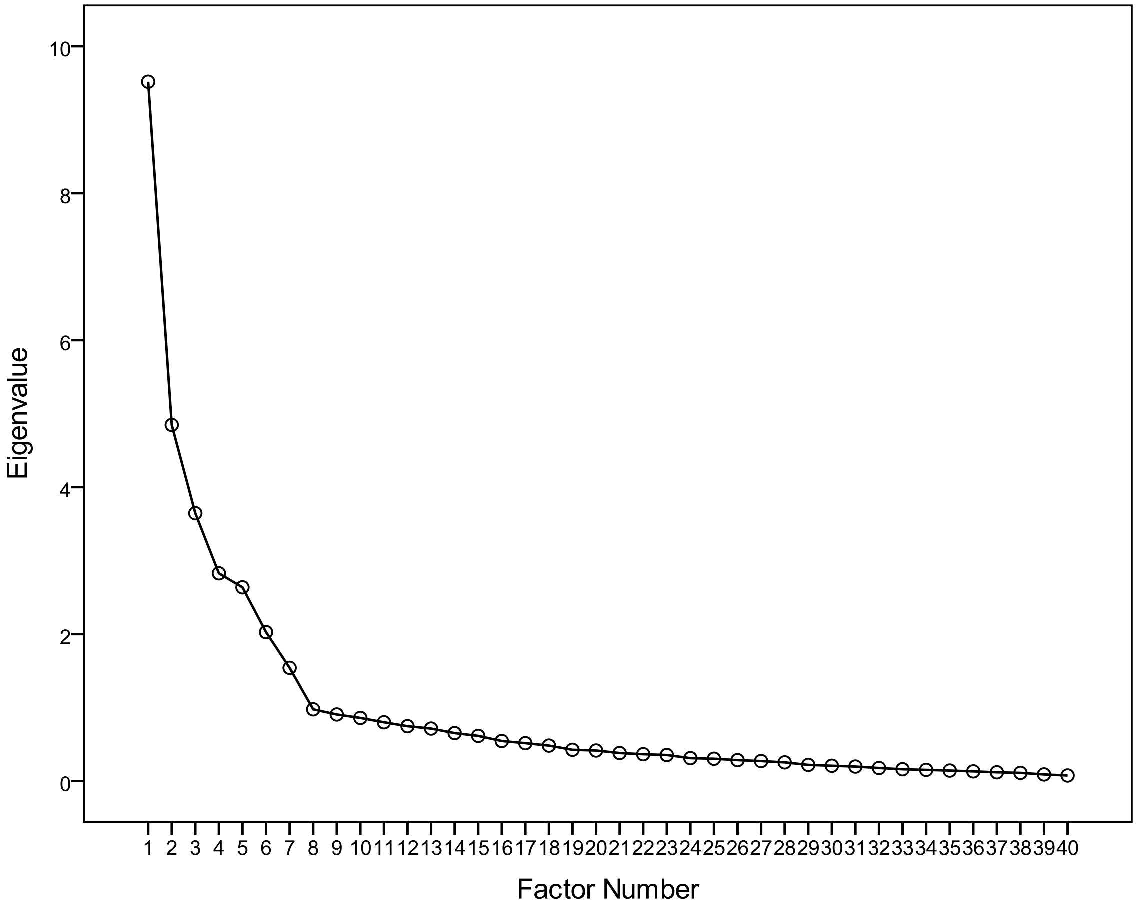


Table 17. PAF ICSS Seven Factor Structure Pattern Matrix

Item	Factor						
	1	2	3	4	5	6	7
Physen5						.36	
Physen7	.67						
Physen8	.86						
Physen9	.83						
Physen10	.89						
Physen11	.69						
Physen12	.51						
Physen13	.69						
Physen14	.81						
Physen15	.73						
Nonver4				-.74			
Nonver5				-.85			
Nonver6				-.66			
Nonver8				-.79			
Nonver9				-.56			
Negaff1						.81	
Negaff2						.70	
Negaff3						.49	
Negaff4						.69	
Posaff1							-.66
Posaff2							-.60
Posaff3							-.78
Posaff4							-.65
Rapid1			.53				
Rapid2			.89				
Rapid3			.85				
Rapid4			.93				
Rapid5			.91				
Bigpic1		.68					
Bigpic2		.64					
Bigpic3		.72					
Bigpic4		.66					
Bigpic5		.69					
Bigpic6		.83					
Bigpic7		.85					
Bigpic8		.61					
Noncon1					.80		
Noncon2					.88		
Noncon3					.72		
Noncon4					.82		
Noncon5					.81		

In line with Costello and Osbourne's (2005) suggestion of looking at factor structures either side of the simple structure, an eight and six factor PAF Oblimin were done (see Appendix C). Inspection of the eight factor and six factor structures revealed deterioration in the pattern matrix indicating that 7 factors may be the best solution. However, further culling of items is required and may change the factor structure.

5.18 Further Factor Analyses

Although the seven factors mirrored the components of intuitive style posited from theory, the low correlations in the factor matrix indicated the need to explore different sets of components to see if there was any improvement on the structure of the scale. To test the structure of the scale further combinations of components forming three alternative scales: association scale, somatic/affective scale, cognition scale and non-verbal scale were generated based on theory (see Appendix C on the CD). However, no further improvement on the initial scale structure was found.

Following the exploratory factor analysis, and contrary to the hypothesis of three separate dimensions (cognitive, affective and somatic), it appeared that the best way to represent intuitive style may be in two dimensions each with their own components. The formation of these distinct dimensions is in some ways, not surprising given that cognition and somatic/affective processes may be considered as being qualitatively very different. Having examined the factor structure of the ICSS, the next step is to move towards a smaller scale by examining the items in each dimension.

5.19 ALPHAMAX Survey Shortening Procedure

To further shorten the subscales, the ALPHAMAX macro (Hayes, 2005) was used in SPSS to determine the best combination of items in each subscale that would yield good item-subscale correlations as well as an acceptable Cronbach's alpha value. Short scales are valuable when they have properties very similar to those of their full scale as they are less demanding of participant's time and effort. Similar to full scales, short versions should have a Cronbach's alpha of around .80 and a Pearson's *r* approaching 1. That is, the internal reliability of the scale should be high and the strength of association between the short scale and the full scale should be high theoretically producing a short scale that measures the same construct as the full scale.

SPSS does provide a means of calculating r for subscales by leaving one item out at a time (see Reliability menu in SPSS). However, Hayes (2005) rightly argued that running such a procedure iteratively does not produce all possible subscales, the value of alpha being dependent on which items were left out, and importantly, there is no method of finding out which of a selection of short scales have large *r* values (p. 11).

ALPHAMAX is a computational program that calculates all possible values of Cronbach's alpha for each combination of items forming a short scale as well as all possible values for the correlation between the sum of the items in each subscale and the sum of the items in the full scale. ALPHAMAX requires a minimum of two items from the pool of items forming the full scale and has the underlying assumption that its associated subscales are each unidimensional. ALPHAMAX uses *n* participants to a set of *k* items and constructs an n x k matrix and produces a datasheet in SPSS containing all possible combinations and subsets of items and their corresponding alpha and *r* values. It is then easy to sort the spreadsheet according to *r* values and locate the best possible smallest combination of items that also yield a high alpha value. Furthermore, ALPHAMAX provides a summary of the highest possible combinations of alpha and *r* in an SPSS output sheet. The researcher is able to then select combinations of items that retain the face and content validity of the full scale.

In addition, Hayes (2005) provides a model to follow when using ALPHAMAX:

- Randomly split sample in half
- Use first half of sample as the development sample and run ALPHAMAX
- Find the set of short scales that meet criteria set by research requirements
- Use the alternate half of sample as the cross validation sample and run ALPHAMAX
- Inspect the data for the set of short scales found in development sample
- Select the short scale that improves on or retains the alpha and *r* values observed in the development sample while retaining face and content validity

Since ALPHAMAX was written for unidimensional scales, and the ICSS is multidimensional, Hayes (2005, p. 20) suggests running ALPHAMAX on items known to load on a common factor. Factor analysis can, once again, be employed to confirm that the short scale retains its factor structure. Confirming the factor structure of the short scale will be performed by replication.

SPSS was used to randomly select approximately 50% of the cases (119) as a development sample to be submitted to the ALPHAMAX macro. The remaining half of the sample was used as a cross validation sample to verify the results from the development sample. Items for each factor of the seven factors shown in Table 22 were treated as full scales and submitted to ALPHAMAX (see Appendix D on the CD).

5.20 ALPHAMAX Development Sample Results

5.20.1 Physical Sensations Subscale

The development sample ALPHAMAX results clearly demonstrated that physen12 was the best candidate to drop as it was shown to decrease the alpha of the subscale. Further inspection of the data revealed that decreasing the number of items to four did result in a decrease in alpha and r values. However, the alpha and *r* values remained within acceptable limits and the item combinations yielding the best alpha are *r* values were selected for cross validation analysis (see Table 18).

Table 18. Physical Sensations Items for Cross-validation

Number of items	Items	α sub	*r* sub
4 (a)	7, 8, 9, 10	.913	.914
4 (b)	8, 9, 10, 14	.902	.945
4 (c)	9, 10, 14, 15	.892	.951

5.20.2 Rapid Subscale

ALPHAMAX highlighted one item, rapid1, that had a negative impact on the subscale mean alpha and was removed. The remaining four items yielded an alpha of .933 and an *r* of .981 and were subjected to cross validation.

5.20.3 Big Picture Subscale

Inspection of the ALPHAMAX results showed that one item, bigpic8, had a negative impact on the mean scale alpha. The remaining four items yielded an alpha of .864 and an *r* of .966.

5.20.4 *Positive Affect Subscale*

The ALPHAMAX results revealed that posaff5 had a negative influence on the mean scale alpha. The remaining four items yielded an alpha of .815 and an *r* of .983.

5.20.5 *Negative Affect Subscale*

ALPHAMAX revealed one item, neg5, negatively impacted on the subscale mean alpha. Further inspection of the data revealed that decreasing the number of items to four did result in a decrease in alpha and *r* values. However, the alpha and *r* values remained within acceptable limits and the item combinations yielding the best alpha and *r* values were selected for cross validation analysis.

Table 19. Negative Affect Items for Cross-validation

Number of items	Items	α sub	*r* sub
4 (a)	1, 3, 5, 10	.851	.956
4 (b)	1, 3, 5, 6	.843	.958
4 (c)	3, 5, 6, 10	.833	.949

5.20.6 *Non-Verbal Subscale*

ALPHAMAX clearly showed that nonver9 had a negative impact on the mean scale alpha and was removed. Removal of one item yielded a four item scale with an alpha of .859 and an *r* of .983.

5.20.7 *Non-Conscious Subscale*

One item, noncon3, had a negative influence on the subscale mean alpha. The remaining four items yielded an alpha of .922 and an *r* of .989.

5.21 ALPHAMAX Cross Validation Sample Results

Following Hayes (2005) suggestions, only the selected item combinations for each subscale from the development sample were subject to cross validation by ALPHAMAX using the remaining half of the sample (137 cases). Data from the cross validation analysis can be found in Appendix E on the CD.

5.21.1 Physical Sensations Subscale

In the cross validation sample, physen12 was shown to decrease the alpha of the subscale (see Appendix E). 4 (a) produced an alpha of .885 and an *r* of .958, 4 (b) produced an alpha of .910 and an *r* of .967, and 4 (c) produced an alpha of .885 and an *r* of .967. 4 (b) consisting of items 8, 9, 10, 14 was the best performing scale with increases in both alpha and *r* while keeping the conceptual meaning of the subscale.

5.21.2 Rapid Subscale

In the cross validation sample, rapid1 was shown to decrease the alpha of the subscale. The alpha increased to .945 and the *r* increased to .982 suggesting quality results for the remaining four items in this subscale.

5.21.3 Big picture Subscale

Again, in the cross validation sample, bigpic8 was shown to have a negative impact on the subscale. In addition, bigpic1 was found to have a slight negative impact on the mean subscale alpha in this sample of cases. However, the alpha and *r* for the four item scale increased from that of the previous sample, .902 and .981 respectively and bigpic1 was retained as a scale item.

5.21.4 Positive Affect Subscale

Similar to the development sample results, posaff4 was found to have a negative impact on the mean alpha subscale value. There was a slight improvement in the value of alpha at .831 and a slight decrease in the value of *r* to .982 in the cross validation sample.

5.21.5 Negative Affect Subscale

In the cross validation sample, negaff5 was shown to decrease the mean alpha of the subscale. 4 (a) produced an alpha of .829 and an *r* of .945, 4 (b) produced an alpha of .821 and an *r* of .952, and 4 (c) produced an alpha of .825 and an *r* of .946. 4 (c) consisting of items 3, 5, 6 ,10 was the best performing scale with minor decreases in alpha and r while keeping the conceptual meaning of the scale.

5.21.6 Non-Verbal Subscale

Similar to the development sample results, nonver9 had a negative impact on the mean subscale alpha. The remaining four items yielded an alpha of .846 and an *r* of .981 demonstrating a slight decrease in internal consistency and reliability across samples.

5.21.7 Non-conscious Subscale

Unlike the results from the development sample, noncon1 was shown to negatively impact the mean subscale alpha instead of noncon3. Further, there were slight decreases in alpha to .892 and *r* to .987.

Having shortened the scale as much as possible, the next step is to do the factor structure replication.

5.22 Factor Structure Replication

Replication of the factor structures of instruments is needed to help ascertain the stability of the scale and to provide further evidence for the assumed latent variables underlying the data. Usually, replication of a factor structure is done by confirmatory factor analysis. In this case, due to the small sample size and the need to create a process model in what follows, the factor structure was replicated using principal axis factoring to allow the factors to emerge from the data.

To do this, a second data collection was implemented with only the ICSS items that remained after the scale reduction procedures. The descriptives for Survey 2 data can be found in Appendix C (on the CD). Survey 2 data were cleaned and prepared before combining with Survey 1 data. Notably, the Big Picture subscale component demonstrated a significant degree of kurtosis, possibly due to social desirability. Unfortunately, due to the amount of data collected in Survey 2 (additional scales were administered that were not reported in this thesis), it would have imposed a burden on participants to answer further questions and therefore, the Marlowe-Crowne Social Desirabilitiy Scale was not included in the current data collection.

5.23 Method

5.23.1 Participants

For the combined data sets, a total of 509 participants responded to items of which, 206 participants 82% female (18% male) responded to Survey 2. In Survey 2, 60% of participants reported on their current occupation: 15% worked in education, training and library occupations, 10.2% in healthcare and supporting occupations, 7.3% in business and financial operations, 3.9% in computer and mathematical operations, 3.4% in architecture and engineering, 3.9% in life sciences, 4.4% community and social service. The remaining participants worked in Legal, Allied health, Food services, Maintenance, Sales, Construction, Security, Transport and Military occupations. 95% of participants spoke English as their first language, with the remaining 5% speaking a language other than English (see Appendix C on the CD).

5.23.2 Instruments and Software Procedure

The ICSS was administered online as part of a larger, two part survey which included occupational interests. Each part of the survey was hosted at a different website so that participants began the survey with the Strong Interest Inventory (not reported in this thesis) and were then redirected to the website hosting the ICSS, REI, BFI and JSS questionnaires. This section of the chapter is restricted to the factor replication modelling.

5.23.3 Statistical Procedure

The data were subjected to inspection for univariate and multivariate outliers, skewness, kurtosis, multicollinearity and singularity analyses. The ICSS items from the initial data collection, post item reduction, and the current data collection were combined (see Appendix C on CD for descriptives) and the sample randomly split in half using SPSS. Factor analyses were run on both samples using PAF with direct oblimin rotation to allow the factor structure to emerge from the data.

Based on the initial exploratory factor structure, the ICSS was divided into two scales of Somatic/Affect and Cognition. Theoretically, the Somatic/Affect and Cognition dimensions are likely to have a low degree of association even though together their integrative functioning are thought to form intuitive style. To use an analogy, the fuel line and the ailerons on an aeroplane are very different in structure and function from each other, yet both are needed to work in consort for the plane to fly; so it appears with the components of intuitive style

5.24 Factor Analyses

The KMO was within acceptable limits and Bartlett's test of sphericity was significant indicating that the data were suitable for factor analysis. The table of communalities showed that one item (phsyen1) fell below the criterion of .3 and no items were found to cross-load. The results for the Somatic/Affective scale are presented first followed by the Cognition scale.

Table 20. ICSS Somatic/Affect Dimension Pattern Matrix Replication Results

	Sample 1 (n=197)				Sample 2 (n=203)			
	1	2	3	4	1	2	3	4
physen1	.72				.63			
physen2	.80				.81			
physen3	.77				.87			
physen4	.84				.76			
bigpic1		-.80				.75		
bigpic2		-.84				.70		
bigpic3		-.84				.79		
bigpic4		-.84				.78		
negaff1			.72				.84	
negaff2			.79				.83	
negaff3			.50				.67	
negaff4			.66				.79	
posaff1				-.65				.69
posaff2				-.67				.64
posaff3				-.74				.66
posaff4				-.74				.59
% Total variance	29.32	16.30	14.18	9.18	24.81	16.46	14.73	11.20
KMO	.78				.77			

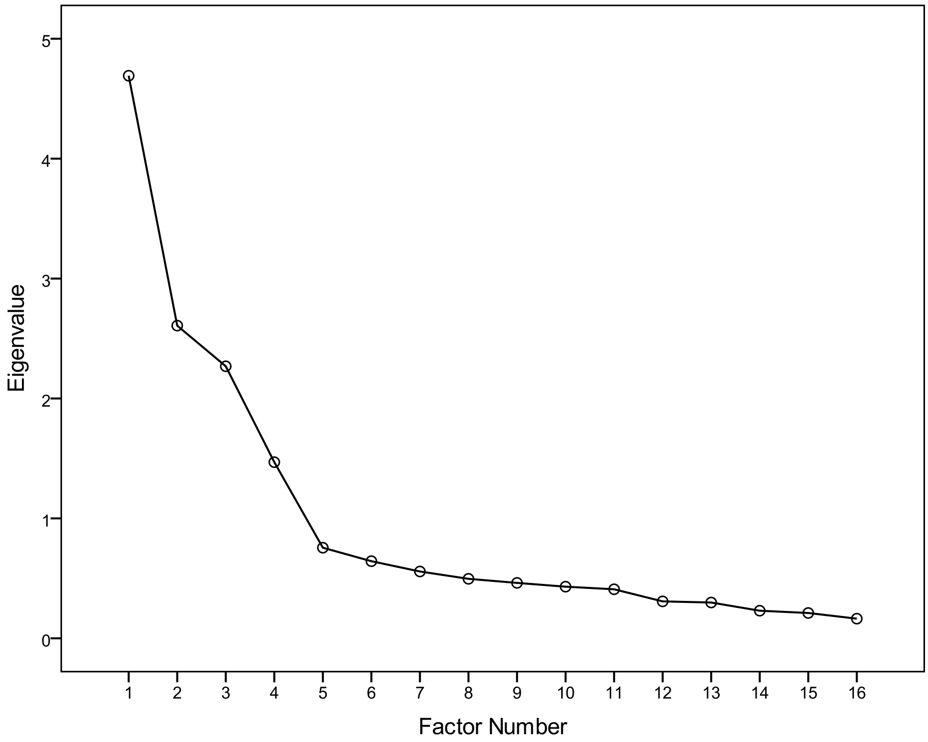


Figure 10. Sample 1 Scree Plot Somatic/Affective Dimension

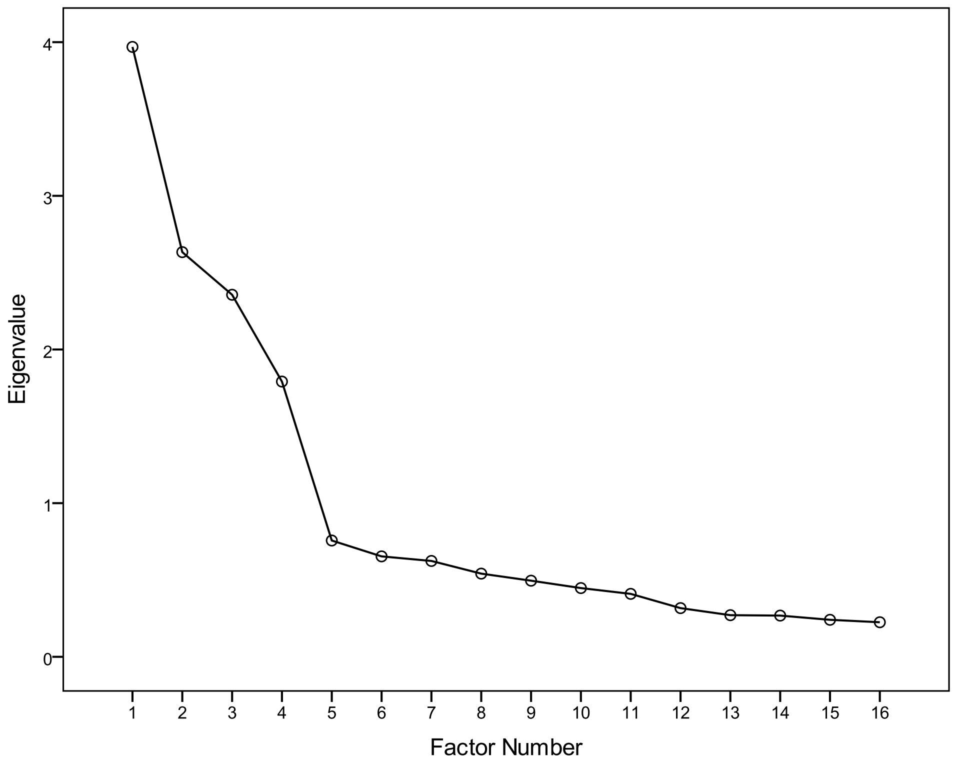


Figure 11. Sample 2 Scree Plot Somatic/Affective Dimension

Table 21. ICSS Cognition Dimension Pattern Matrix Replication Results

	Sample 1 (n=198)			Sample 2 (n=200)		
	1	2	3	1	2	3
nonver1			.72			.64
nonver2			.77			.85
nonver3			.70			.66
nonver4			.68			.77
rapid1	.88			.77		
rapid2	.79			.77		
rapid3	.91			.85		
rapid4	.87			.87		
noncon1		.74			.80	
noncon2		.89			.82	
noncon3		.82			.81	
noncon4		.80			.81	
% Total variance	34.48	20.08	19.01	33.67	20.28	18.07
KMO .80				.70		

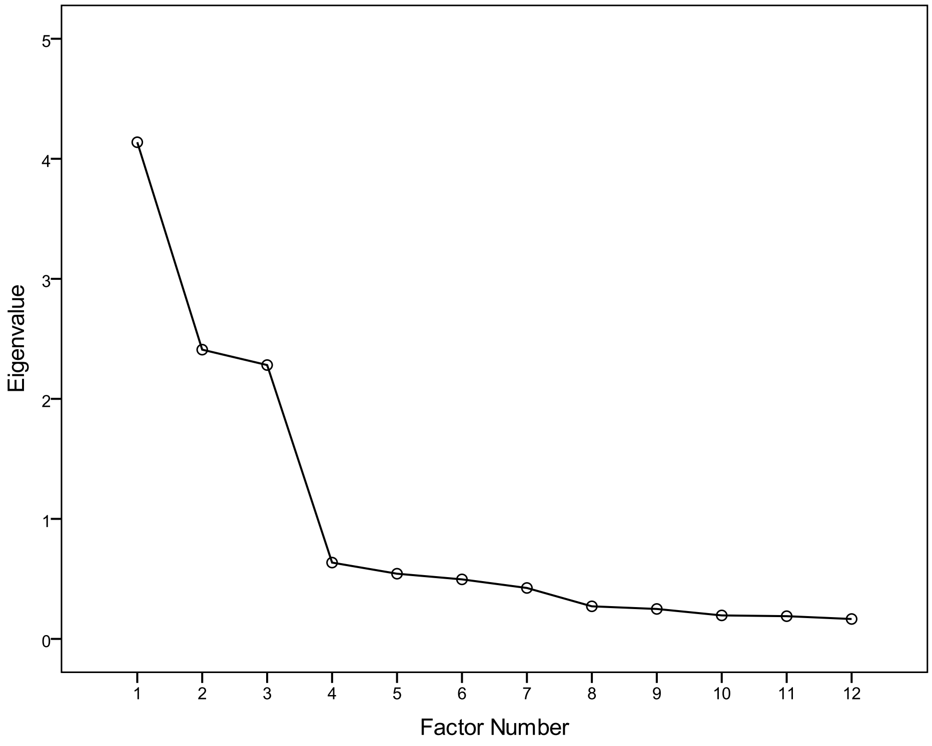


Figure 12. Sample 1 Scree Plot Cognition Component

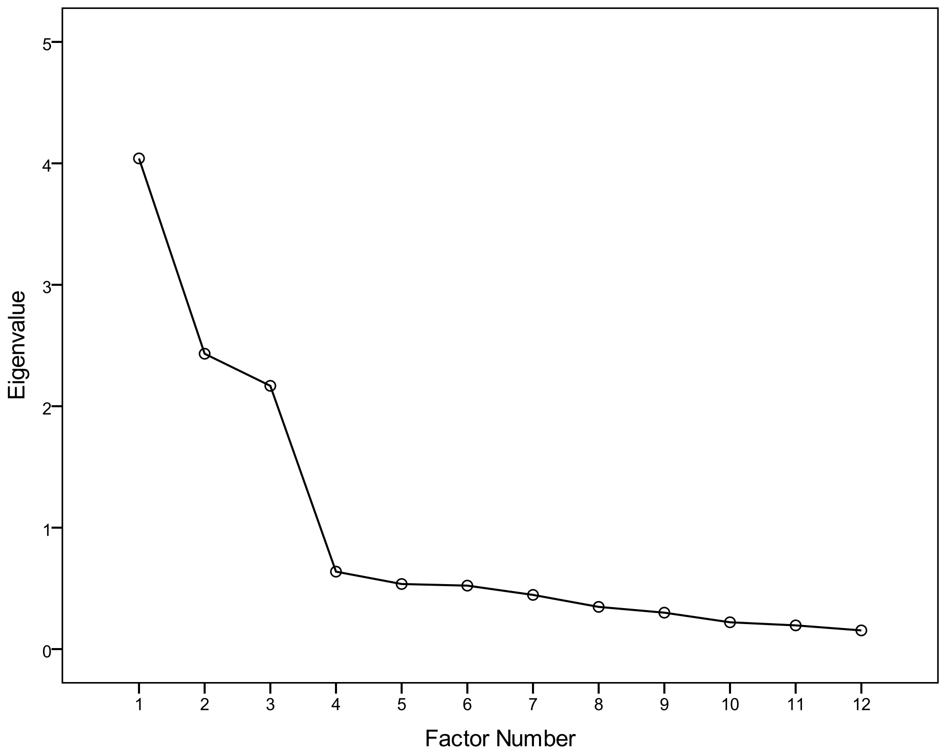


Figure 13. Sample 2 Scree Plot Cognition Component

5.25 Summary of Results

The final ICSS full scale consisted of three dimensions and the seven subscales of Physical Sensations, Big Picture, Positive Affect, Negative Affect, Observed Non-verbal Cues, Rapid and Non-conscious. Each subscale contains four items that have a range of scores between 4 and 28. Items forming each subscale are given in Table 22.

The ICSS Physical Sensations component measured the dispositional experience of ‘gut feelings’ that dominate intuitive style and separate it from analytic cognitive style (Allinson & Hayes, 1996). The ICSS Big Picture component measured the dispositional experience for taking a broad overview of information. The ICSS Positive Affect component measured a dispositional experience for positive feelings guiding thinking whereas the ICSS Negative Affect component measured a dispositional experience for negative feelings and together, these dimensions formed the Somatic/Affective aspect of intuitive style.

ICSS Observed Non-verbal Cues component re-conceptualises intuitive style as a measure of dispositional experience for processing another’s non-verbal cues consistent with earlier evidence (Allinson, Armstrong & Hayes, 2001; Armstrong & Priola, 2001). The ICSS Rapid component, measured the dispositional experience of intuitive style as an almost automatic knowing consistent with previous evidence (p.122, Allinson & Hayes, 1996) and supported neurological evidence (Stanovich & West, 2000) for fast processing. The ICSS Non-conscious component measured the dispositional experience of the difficult-to-articulate-thinking that was not part of Allinson and Hayes (1996) original conceptualisation of the intuition pole of Intuition-Analysis, but appears to have been adopted as part of intuitive cognitive style at a later date (Armstrong & Priola, 2001) and together these components formed the Cognitive aspect of intuitive style.

Table 22. ICSS Subscales and Items

Physical Sensations	An awareness of something An inkling of something A vague sensation A kind of feeling
Big picture	An overall view of things See the big picture Total overview A sense of the whole pattern
Positive Affect	A sense of peacefulness A sense of gladness A sense of joy A sense of harmony
Negative Affect	A feeling of dread A feeling of anxiety A feeling of wrongness A feeling of fear
Observed Non-verbal Cues	A person's breathing The tilt of their head Their posture Something in the shape of their mouth
Rapid	Fast The answer comes right away Rapid Straight away
Non-conscious	I can't explain my thinking I don't know how I know I just know It's just there in my mind

5.26 ICSS Scale Reliability and Validity

This section of the chapter presents the reliability and validity results for the ICSS. Where possible, the analyses are performed using both sets of data. Where it was not possible to use both sets of data, this will be indicated in the headings.

Table 23. Descriptive Statistics for the ICSS Subscales

	N	Mean	SD	Skewness		Kurtosis	
				Statistic	SE	Statistic	SE
Physical sensations	357	17.53	5.64	-.52	.13	-.27	.25
Big picture	347	22.52	3.86	-.90	.13	1.84	.26
Positive affect	345	18.65	4.59	-.73	.13	1.06	.26
Negative affect	345	16.89	.53	-.59	.13	-.17	.26
Observed non-verbal cues	357	17.45	.52	-.37	.13	-.07	.26
Rapid	343	17.13	5.34	-.27	.13	-.35	.26
Non-conscious	347	13.67	5.82	.16	.13	-.74	.26

Table 24. Independent Samples t-test for Gender Differences ICSS Subscales

			Tests for equality of means		CI 95%		
	Mean	SD	*T*	*p*	Lower	Upper	η2
Physicals sensations (equal variances NOT assumed)			2.26	.03	.17	2.49	.01
Male	18.30	5.19					
Female	16.97	5.90					
Big picture (equal variances assumed)			.63	.53	-.56	1.09	.00
Male	22.67	3.56					
Female	22.41	4.07					
Positive affect (equal variances assumed)			-1.39	.00	-1.69	.29	.01
Male	18.23	4.74					
Female	18.93	4.48					
Negative affect (equal variances assumed)			-3.60	.00	-3.29	-.95	.04
Male	15.63	5.58					
Female	17.75	5.33					
Observed non-verbal cues (equal variances assumed)			2.56	.01	.33	2.51	.02
Male	18.26	5.41					
Female	16.84	4.98					
Rapid (equal variances assumed)			.38	.70	-.93	1.38	.00
Male							
Female	17.26	5.63					
	17.04	5.14					
Non-conscious (equal variances assumed)			.87	.38	-.69	1.80	.00
Male	13.99	5.93					
Female	13.44	5.75					

The physical sensations subscale violated the assumption of equality of variance between male and female samples and the appropriate *t*-tests were used. All other subscales were assumed to have equal variance. Physical sensations, positive affect, negative affect and observed non-verbal cues subscales demonstrated significant difference in mean scores between males and females. Effect sizes were calculated for all results. The calculated effect sizes were considered to be small (Cohen, 1988). No significant correlations were found for age and education level (see Appendix F).

5.27 Reliability of the ICSS

One aspect of reliability, internal consistency reliability, was tested in this study. There are two well-accepted ways of measuring internal consistency of scales: Cronbach's alpha and inter-item correlations (Kline, 2005). Inter-item correlation is sometimes taken as the best option of scale reliability because it is not dependent on the length of the scale. Cronbach's alpha for the full scale was .87 and the subscales showed the following Cronbach's alpha: Physical sensations .90, Observed non-verbal cues .85, Negative affect .82, Positive affect .82, Rapid .94, Big picture .88, and Non-conscious .90. These results may be reflective of using the ALPHAMAX procedure to cull items. In this way, the ALPHAMAX has been helpful in building into the scale development process the need for reliability.

In addition, as Briggs and Cheek (1986) suggest "standard reliability [e.g. Cronbach's alpha] estimates of internal consistency are not pure measures of item homogeneity" and therefore a second look at reliability via mean inter-item correlations may be deemed necessary. Mean inter-item correlations for each subscale were: Physical sensations .71, Observed non-verbal cues .59, Negative affect .53, Positive affect .53, Rapid .80, Big picture .60, and Non-conscious .69. Briggs and Cheek (1986) suggest that the best range of values for inter-item correlations is between .2 and .4 with anything greater than .5, as is the case with these subscales, indicating redundant items. Since this scale is to be used as a process model, the Physical sensations variable, being the outcome variable, is of most concern.

5.28 Validity of the ICSS

While the validity of a scale is an ongoing process requiring a substantial research program (Messick, 1995) there are aspects of validity that can be immediately investigated in scale development. In addition, initial foundations may also be built in terms of a construct's nomological net. To this end, convergent, discriminant, face and criterion validity were addressed.

5.28.1 Convergent validity

The ICSS should show a degree of association with scales that measure similar constructs. The Experiential subscale of the REI was used as a similar measure and correlations calculated between the Experiential subscale and the ICSS subscales

Table 25. Bivariate Correlations Between ICSS Subscales and REI Experiential Subscale

	Physical sensations	Big picture	Positive affect	Negative affect	Observed non-verbal cues	Rapid	Non-conscious
Experiential	.38**	.11*	.16**	-.14*	.36**	.17**	.27**

* $p < .05$, ** $p < .001$

The subscales of the ICSS show significant and relatively weak correlations with the subscale of the REI. Notably, the Physical sensations subscale displayed the largest association.

5.28.2 Discriminant Validity

The ICSS should be unrelated to scales that measure different constructs. The Rational (analytic) subscale of the REI was used for this purpose because Hodgkinson and Sadler-Smith (2003b) demonstrated that the REI Rational subscale was not associated with the intuitive pole of the bipolar intuition-analysis.

Table 26. Bivariate Correlations Between ICSS Subscales and the REI Rational Subscale

	Physical sensations	Big picture	Positive affect	Negative affect	Observed non-verbal cues	Rapid	Non-conscious
Rational	-.13*	.15**	.04	-.28**	.31**	.13*	.04

* *p* < .05, ** *p* < .001

Table 27. Bivariate Correlations Between ICSS Subscales and the BFI Subscales

	Physical sensations	Big picture	Positive affect	Negative affect	Observed non-verbal cues	Rapid	Non-conscious
Extraversion	.17**	.18**	.15**	-.15**	.21**	.29**	.07
Agreeable	.18**	.05	.22**	-.21**	.19**	.03	.12*
Neuroticism	.16**	.00	.05	.17**	.19**	-.12*	.10
Conscientious	.10	.21**	.10	-.18**	.19**	.18**	.02
Openness	.23**	.26**	.18**	-.18**	.35**	.13*	.13*

* *p* < .05, ** *p* < .001

The subscales of the ICSS showed mixed discriminant validity results with the REI subscales and showed non-significant correlations for Positive affect and Non-conscious subscales with the Rational subscale, and significant and relatively weak correlations for the remaining subscales. Surprisingly, the Observed non-verbal cues subscale showed a similar degree of correlation to that of the Experiential subscale. This may be because observing non-verbal cues per se are not dependent on affect.

In terms of discriminant validity with personality traits, the ICSS subscales showed mixed results with small non-significant and significant correlations.

5.28.3 Face Validity

Face validity is about the degree to which a scale appears to be valid to the participants and the administrator. Although content and face validity are subjective aspects of scale development (DeVellis, 2003), the items in the ICSS appear to adequately represent the dimensions of intuitive style as defined from theory. In addition, the expert review panel indicated that the items were face valid.

5.28.4 Criterion Validity

Subscales of the ICSS were used to predict intuitiveness using the sample from the first data collection.

Table 28. One-way ANOVA Results for ICSS Subscales and REI Subscales as a Function of Self-reported Intuitiveness

	Intuitive vignette			
	Yes (n=120)	No (n= 51)		
	Mean	Mean	*F*	η2
ICSS Physical sensations	19.09	13.20	44.29**	.21
ICSS Big picture	23.04	22.41	1.24 (ns)	
ICSS Positive affect	19.77	17.06	13.65**	.07
ICSS Negative affect	19.24	16.21	12.18*	.07
ICSS Observed Non-verbal	17.65	14.78	11.82*	.07
ICSS Rapid	17.31	15.82	3.039 (ns)	
ICSS Non-conscious	14.55	10.86	16.25**	.09
REI Rational	48.82	48.07	.93 (ns)	
REI Experiential	42.09	30.59	152.27 **	.41

* *p*< .001, ** *p*< 0001

Of the ICSS subscales, Physical sensations showed the largest effect size in predicting self-reported intuitiveness, where the effect size was similar in magnitude to that of the REI Experiential subscale. Notably, the Big picture and Rapid subscales were non-significant, as was the REI Rational subscale.

5.28.5 A Broader Approach to Validity

Not only are the standard run-of-the-mill types of validity important in relation to the ICSS, but also the broader issues of validity including the notion of validity as an ever evolving judgment about the meaning of scores (Messick, 1995). Moreover, validity is a property of the way in which the scores on an instrument are interpreted as well as the implications of interpreting scoring, including issues of social and political validity (Messick, 1995). Messick (1995) argues for anticipating and noting side effects, positive and negative, of test outcomes to address the social and political validity of test use. To this end, what follows is a circumscribed and by no means exhaustive look at the potential social and political consequences of the ICSS, given that intuitive style has suffered from two main presuppositions: a) that intuitive, or non-rational thinking, is somehow less than logical, hierarchical, step-by-step thinking and, b) the use of labels to describe individuals that result in the individual being boxed into a particular style. This last point may also be described as an 'all or nothing' approach whereby if you are labelled as intuitive then you cannot be analytic. Both presuppositions tend towards an approach to intuitive style that is discriminatory, and therefore, it is important to look closely at any consequences of using the ICSS.

While the negative consequences of using the ICSS are evident historically, the positive consequences are less so and require further investigation. Of particular interest are anecdotal reports the researcher has gathered from participants suggesting that learning about what makes up the intuitive style process, including potential neurological substrates, seems to help intuitives whose self-esteem has been degraded by others explicit comments negatively comparing intuitive style with analytic style, negative learning experiences in school and at work, and by self-comparisons to others who appear to think more linearly than the intuitive. The potential positive consequences of assessing intuitive style using the ICSS seem to be towards increasing self-esteem and self-efficacy that may then have longer term effects. Such effects may lead to enacting self-efficacy behaviours in everyday life including promoting inclusive training and learning approaches, using strengths-based assessment and self-advocacy as well as successful team development as indicated by the findings of Armstrong and Priola (2001). Although these social consequences of using the ICSS may appear to be somewhat trivial, the overall potential benefit to an individual's mental and emotional well-being needs to be taken into consideration.

5.29 Discussion

The aim of this chapter was to develop and validate a psychoneurobiological-based multidimensional intuitive style scale for the purpose of selecting key components to form a process model of intuitive style. The process modelling should help to sort out which of the components, if not all, will be necessary to form a psychometric measure of intuitive style. At this stage, it is envisaged that not all of the components will be useful in a process measure. As such, the following discussion is a preliminary examination of the ICSS with the understanding that the scale may be further modified by the process modelling. The current discussion section is broken up into separate sections according to somatic/affective and cognition dimensions of intuitive style.

5.29.1 ICSS Somatic/Affective Dimension

The proposed dimensions making up the somatic/affective scale appear to fit well in the factor analysis. There are some good correlations between factors that were not in evidence when the cognition components were included. In general, the factor loadings for each of the items with their respective factors are quite good and exhibit a range of values suggesting that different aspects of each construct are reflected in the items. The internal consistency of each subscale is high and this result needs to be subjected to further scrutiny in a separate sample.

5.29.1.2 Physical Sensations

Physical sensations component, or 'gut feeling', has seemed elusive and hard to pin down in terms of measurement. In addition, physical sensations have lacked a clear neurological explanation and have been measured in vague terms. The current research represents a significant move away from previous items similar to "I rely on my gut feelings" and provides concrete terms in which to describe the experience of physical sensations. Notably, 'gut feelings' was one of the items dropped from the scale during the development process. Perhaps this is not surprising in light of the raw data (Figure 3) given the non-normal shape of the distributions for these items.

Although the physically grounded items (chills, hair standing on end, knot in stomach) were dropped from the scale, it may be that these items may form a scale that measures a different latent variable when combined with the remaining physical sensations items and may help at some level to differentiate between somatisation and hypochondria.

5.29.1.3 Big Picture

Visual inspection of the raw data (Figure 4) indicated that the responses to the questions were skewed. However, the skewness statistics were within normal limits. It appears that the effect of social desirability may be seen in the visualised data in the consistent high scores for these questions.

Although Allinson and Hayes (1996) considered taking a broad overview of information to be central to intuitive style, the current results demonstrated the relationship of Big Picture with REI Rational, and not with REI Experiential, indicating that a preference for taking a broad overview may not be a suitable indicator variable for intuitive style. On the other hand, the big picture component may be describing a cognitive process common to both intuitive and analytic styles.

In terms of brain function, Stanovich and West (2000) explain taking a broad overview as formed by the parallel spreading of activation throughout associative neural network circuitry. The activation of associative neural networks may be over-emphasised, or more salient, in intuitive style because of the overall non-conscious experience of intuitive style.

5.29.2.3 Positive Affect

Positive and Negative Affect questions were visualised together in the raw data (Figure 5) and appeared to be within the limits of normality for both components. While Allinson and Hayes (1996) refer to intuitive style as being based on feelings (p. 122), they did not distinguish positive feelings from negative feelings and the potential differences such a distinction may provide in explaining the process of intuitive style. Damasio (1999, 2005) argues that positive emotions associated with processing information are likely to arise from past experience where an association has been made between a particular pattern of information and positive outcomes that are strong enough to evoke parts of the reward/pleasure response. Damasio (2005) suggests that the benefits of positive affect cues on information processing should not be underestimated. In terms of intuitive style, this may mean that having a preference for Positive Affect in guiding thinking may lead intuitives towards opportunities.

5.29.2.4 Negative Affect

Similar to Positive Affect, Negative Affect may be linked to flight/fright/freeze responses in such a way as to act as an alarm bell indicating potential problems (Damasio, 2005). The highest loading variable in the ICSS was ‘a feeling of anxiety’ which may be an indicator of the degree to which intuitives tap into processes that are built on flight/fright/freeze responses. As part of intuitive style, negative affect may alert individuals to information that may be important, such as minute changes in a patient’s condition. Further, the negative affect of intuitive style needs to be distinguished from trait and state anxiety in future research.

5.29.2 ICSS Cognition Dimension

5.29.2.1 Observed Non-verbal Cues

Visualisation of the raw data for the observed non-verbal cues (Figure 6) showed that some questions appeared to be non-normally distributed and these were dropped during the scale development process. Taking into account an Observed Non-verbal Cues component further re-conceptualises intuitive style. Consistent with evidence (Allinson, Armstrong & Hayes, 2001; Armstrong & Priola, 2001) that intuitive style was associated in some way with interpersonal relationships, the current research suggests that intuitives may be non-consciously using their observations of non-verbal cues to guide their thinking.

Research on intuition (Lieberman, 2000) suggested that the action of mirror neurons may help to allow the observer to experience the internal states of the observee, helping to build representations of the associations between patterns of observed information, gut feelings and affective states.

In this way, the intuitive person may be best described as integrating a repertoire of experiences from the cognitive, affect and somatic dimensions. However, a single component or combination of components may be seen as more prominent in an individual’s preference. As such, the expectation may be formed that individuals may vary in the quality of their experience of intuitive style. For example, one person may have a distinct preference for physical sensations. Even though a person may be strong in one component, all the components play a role in intuitive style.

5.29.1.2 Rapid

The Rapid component provides further evidence of the speed of intuitive style and supports Alllinson and Hayes (1996) notion of intuitives enacting immediate judgement (p. 122) as well as evidence for the suggested neurological functioning (Stanovich & West, 2000) underpinning intuitive style. Visualisation of the raw data for the Rapid component displayed a relatively normal distribution (Figure 7) however, what was notable was the decrease in the number of responses to these items compared to the rest of the ICSS. This may have been due to fatigue or, more likely, the lack of variability in the items. It is noticeable that the first item in the Rapid component gained the most responses, perhaps indicating that there is not enough linguistic variety to support many items.

The Rapid component is associated with the REI Experiential and Rational dimensions and BFI Extraversion and showed no association with any other constructs. While it was expected that the ICSS Rapid should be associated with REI Experiential (a measure of intuitive style), it was surprising that the ICSS Rapid was associated with the REI Rational dimension because the REI Rational measures analytic cognitive style and is contrary to Allinson and Hayes' (1996) theory. Allinson and Hayes' (1996) theory of a bipolar intuition-analysis construct implied that items associated with analytic cognitive style are not associated with intuitive style, and visa versa (Allinson & Hayes, 1996). In contrast, the current research (Table 3) adds new knowledge by demonstrating that the experience of almost automatic knowing is not purely constrained to the construct of intuitive style.

5.29.1.3 Non-conscious

It appeared on visualisation of the raw data for the Non-conscious component (Figure 8), that there was a drop-off in the number of participants answering this question. It may be that participants were fatigued by this stage of the survey and decided not to answer, or it may be that these questions were difficult to answer being about the non-conscious component of intuitive style.

The Non-conscious component, measures the experience of the difficult-to-articulate-thinking that was not part of Allinson and Hayes (1996) original conceptualisation of the intuition pole of Intuition-Analysis, but appears to have been adopted as part of intuitive style at a later date (Armstrong, Smith & Priola, 2001). Recent research into brain function (Stanovich & West, 2000) suggests that some cognitive processes can occur at a level that is not deliberative or effortful and is different from notions of sub-conscious or unconscious processes. Notably, Non-conscious was associated with REI Experiential and negatively associated with REI Rational meaning that lower levels of non-conscious processing are associated with analytical cognitive style.

5.30 ICSS Scale Reliability and Validity

The ICSS subscales were shown to meet the requirements for normality and the means and standard deviations were within acceptable limits. Although, the small standard deviations for Negative affect and Observed non-verbal cues indicated that these subscales may be subject to range restriction where the scores fall within a narrow range.

The ICSS was tested for correlations with gender, age and education of which, gender was the only item to be significantly correlated with the ICSS. Inspection of the independent samples t-tests for gender differences showed that there was a significant difference between the means for Physical sensations, Positive affect, Negative affect and Observed non-verbal cues for males and females. The effect of these differences in means was small meaning that further analyses did not take into account gender as a variable. However, it is notable that women scored higher on the Negative affect subscale, indicating that they tended to be guided by their negative feelings when thinking, more so than men and that this difference in means was not reflected in the Positive affect subscale. It may be that women's responses to negative affect are responsible for previous ideas that intuitive style is gendered.

The internal consistency of the ICSS was demonstrated as high, and redundancy of items was indicated in the scale following item removal procedures. On the other hand, because the mean inter-item correlation for each subscale was relatively high, this meant that items in each subscale were a good representation of the latent variables underlying each dimension of the ICSS (DeVellis, 2012). Furthermore, high reliability is stated by DeVellis (2012) as being useful in terms of increasing the power to detect a significant difference when analysing the ICSS in conjunction with any other variable(s).

Validity of the ICSS was demonstrated through the use of convergent and divergent validity, as well as criterion validity. The ICSS showed significant and relatively weak correlations with a measure of a similar construct, Experientiality. Of the ICSS subscales, the Physical sensations subscales showed the largest association with Experientiality. This is not surprising given that both scales theoretically should measure a similar construct and that evidence from previous psychometrics indicated that the REI

Experiential was similar to that of the Intuition pole of the Intuition-analysis construct. In terms of discriminant validity, the ICSS showed relatively weak and non-significant associations with the Rationality subscale of the REI that is thought to measure analytic cognitive style. Surprisingly, Observed non-verbal cues demonstrated the largest association with Rationality. The ICSS showed significant and relatively weak correlations with a measure of personality traits demonstrating that a multidimensional intuitive style construct is something different to personality traits.

5.31 Limitations

In any research there are limitations that place boundaries around the interpretation of the data. In this case, the lack of test-retest reliability is a major limitation. Test-retest reliability would allow the reliability of the ICSS to be seen across time. Although test-retest reliability was not performed in the current research due to time constraints, internal reliability was assessed and found to be adequate for scale development. Given that the purpose of the scale development was to clarify a set of intuitive style components to be examined in a process model, the focus in developing the scale was to balance the requirements of scale development with the needs of developing a process model. In the future, research should endeavour to address the test-retest reliability of the ICSS.

In addition, further factor structure work should be done to replicate the factor structure of the ICSS in a variety of samples. In the current research, the factor structure was generated from the responses of participants who fall into the category of intuitives.

Furthermore, self-report questionnaires may generate biased data and it has been argued that cognitive styles are not best assessed by self-report (Richter, 1992). However, a study examining the association between self-report questionnaires (Preference for Intuition or Deliberation) and behaviour in business settings demonstrated the consistency between self-reports and objective measures of behaviours, indicating that self-reports of intuitiveness, although subjective, are valid measures (Raffaldi, Iannello, Vittani, & Antonnietti, 2012).

Lastly, a good next step in investigating the ICSS would be to use the ICSS in conjunction with a mixed methods or qualitative data collection where similarities and differences between the methods can be examined.

Conclusion

The purpose of this chapter was to develop a scale to measure the psychoneurobiological-based multidimensional intuitive style for the purpose of modelling intuitive style as a process and to try to overcome some of the issues associated with the intuition pole of Allinson and Hayes (1996) intuition-analysis. A review of the literature in Chapter 4 showed that intuitive style was likely to be a multidimensional construct consisting of a set of cognitive (observed non-verbal cues, rapid, non-conscious), affective (positive and negative) and somatic (physical sensations) dimensions. A set of items covering the dimensions of intuitive style were constructed and administered to a development sample. Exploratory factor analysis and replication was performed to investigate the underlying structure of the construct together with a set of statistical scale reduction procedures to produce a final scale with strong psychometric properties.

Of importance are the findings concerning the relationship between intuitive style and social desirability. The literature review demonstrated that previous studies have not taken into consideration the effect of socially desirable responding on the results pertaining to intuitive style. The findings in this chapter demonstrate that the big picture subscale — long held as a key criterion of intuitive style — is subject to socially desirable responding. This finding concerning the impact of social desirability presents an opportunity for further investigation, theoretically and statistically.

Although the results from the development sample need to be taken with some caution because they are exploratory, these results suggest that the Intuitive Cognitive Style Scale (ICSS) is best conceptualized as a psychoneurobiological-based multidimensional construct that has some relationship to a different measure of intuitive style, is distinct from other constructs such as the five factor model of personality and analytic cognitive style.

Intuitive style, as defined in this chapter, forms the basis for understanding intuitive style not as a static outcome, but as a dynamic process. To this end, the next chapter addresses the theoretical rationale for a process model of intuitive style.

"... [Richard Feynman] outstanding intuitionist of our age and a prime example of what may lie in store for anyone who dares to follow the beat of a different drum."

Nobel Laureate Julian Schwinger in his obituary of Nobel Laureate Richard Feynman 1989.

Chapter 6

Theoretical Basis for Intuitive Style as a Psychoneurobiological-Based Process

Introduction

Intuitive style has been conceived and measured as a global variable, one pole of a bipolar intuition-analysis construct rather than a multidimensional variable. Perhaps, the assumptions that have underpinned intuitive style – that is it something not amenable to scientific investigation – have held back developments. As Kuhn (1962) described, sometimes it may be difficult to change a paradigm.

Part of the challenge of investigating intuitive style has been to capture its key characteristics as well as to further improve on its conceptualisation and operationalisation. Chapter five sought to clarify the components of intuitive style through a psychometric approach and seven dimensions were supported that can be grouped into the three main areas of cognitive, affective and somatic processes. This has shifted the view from intuitive style as an outcome, that is, something that is not measurable other than as a final product or outcome, to a potential process model. What is not known, to date, is how the cognitive, affective and somatic dimensions fit together to form a process; as Hodgkinson, Langan-Fox and Sadler-Smith (2008) have stated, there is a pressing need to understand how these dimensions are integrated. To this end, the current chapter addresses the theoretical basis for a psychoneuobiological based process model of intuitive style.

6.1 A Process Model of Intuitive Style

It is possible to draw on existing theories and research which seem to underpin intuition to form a selection of process models. Unlike the methods of cognitive psychology, where models tend to be broken down into their components and steps and examined, intuitive style may be better understood not just as its component parts but as a cascade effect from one part to another, forming a process.

A literature search (PsychInfo, 2011 & Web of Knowledge, 2011) revealed a number of potential models that inform the integration of cognitive, affective and somatic processes in intuitive style. These models have a key assumption on which the integration of cognitive, affective and somatic processes is built which is that the brain is not separate from the body. Although this may seem at first to be obvious, research in some areas of psychology tends to isolate the brain (the neuronal tissue inside the skull) from the rest of the central nervous system (spinal cord and through to peripheral nerves), and therefore, from the body. Indeed, Tucker (2007) states that the current accepted notion is that the mind is, in some way, ‘embodied’ – connected to the body. Thus, integration as a way of understanding intuitive style may need to be viewed from perspectives that encompass the body and the mind.

Siegel (1999) provides an integration of cognitive, affective and somatic processes from the level of the neurobiological to the level of the mind. The mind, in this case, is described as ‘patterns in the flow of energy and information’ (p. 3), where emotion is central to the bringing together of habituated mental states (cognitive, affective and somatic), formed in attachment, in a flexible and adaptive manner as an expression of the underpinning neurobiology. At the level of the mind (Siegel, 1999) presents evidence from caregiver-child attachment studies to support the notion that different types of attachment in children may lead to distinct habitually preferred mental patterns in adults[5]. In particular, Siegel (1999) states that specific attachment states, such as avoidant attachment, reinforce the use of specific mental patterns (rising from the activation of predominantly left hemisphere structures and functions with little conjoint activation of the right structures and functions hemisphere) such that language is loosely connected to somatic states and nonverbal cues, producing a disconnect between cognition and emotion/somatic processes leading to the strong preferential development of linguistic, rational, analytical functioning. This may be seen as being very similar to analytic cognitive style. In addition, Siegel (1999) suggests that secure attachment reinforces integrative, flexible and adaptive mental patterns (arising from conjoint activation of left and right hemisphere structures and functions in balance) where language, somatic and nonverbal cues operate together leading to the preferential development of holistic, non-conscious, affect-laden intuitive functioning that may be seen as very similar to intuitive style.

Supporting Siegel’s (1999) assertion that secure attachment leads to the development of intuitive functioning is evidence from Epstein, Pacini, Denes-Raj, and Heier (1996) that demonstrates a small and significant association of secure attachment with experiential (intuitive) cognitive style. In a study of 973 undergraduate students, Epstein et al. (1996) measured adult attachment as four working models of father and mother (fearful, preoccupied, avoidant and secure) and cognitive style as experiential and rational thinking styles. Epstein et al. (1996) found that individuals with rational cognitive style reported an avoidant relationship with their father and individuals with experiential cognitive style reported secure

[5] Siegel views the mind as not only the patterns in the flow of energy and information but also as the flow of energy and information between brains. Siegel’s (1999) description of habitual and preferred patterns of information and energy flow appears to be very similar to the way in which cognitive style is described. If this is so, then Siegel’s theory may explain the association between cognitive style and attachment found by Epstein et al. (1996).

relationships with parents. Furthermore, men who had experiential cognitive style reported secure relationship with their mothers (Epstein et al., 1996). This suggests some overlap between modern neurobiological theories of attachment and a potential developmental trajectory for intuitive style (not examined in the current thesis).

Indeed, examples of possible process models for intuitive style come from neuroscience approaches to understanding the integration of cognition and affect at the neurobiological level together with the psychological experience giving the psychoneurobiological framework. Two theories, the Somatic Marker Hypothesis (Damasio, 2005) and X-System (Lieberman, 2000) cover the characteristic features of intuitive style that relate to the affective and somatic dimensions as well as partially covering the cognitive features of intuitive style. Two additional theories, System 1 (Kahneman, 2003) and Associative System (Sloman, 1996), may address the cognitive features of intuitive style. The theories associated with the somatic and affective dimensions of intuitive style are critiqued first followed by the theories associated with the cognitive dimension of intuitive style. Following the critique of each theory, testable hypotheses are proposed that represent partial process models of intuitive style as no single model incorporates all seven components of the proposed intuitive style process model.

6.2 Somatic/Affective Theories Applicable to Intuitive Style

6.2.1 Somatic Marker Hypothesis (Damasio, 1999, 2005)

This theory is a neuroscience model that came from studying patients with acquired brain injury to the ventromedial prefrontal cortex (VMPFC: also known as the orbito prefrontal cortex) who showed significant decision-making, social, personality and judgement impairments. The involvement of the VMPFC in decision making was subsequently supported by studies using the Iowa Gambling Task in typically functioning and impaired participants (Bechara, Damasio & Damasio, 2003; Damasio, 1999, 2005). Damasio (2005) posited a theory where changes in internal physiological (soma) states, such as heart rate and neurochemistry, are linked to the input of information through the senses that then trigger affective states necessary for survival as part of the in the initial experience of new information. This process is then generalised to other events. For example, a sharp edge of a rock causes pain in the feet leading to negative affective states which results in the person avoiding standing on sharp rock. Damasio (1999) took this a step further, such that mental representations (somatic markers) of these affective states are made and can be actioned without the involvement of the body. Damasio (1999) labelled this as the 'as-if-body' state that may operate as part of cognition, particularly in decision-making and risk taking. Bechara and Damasio (2005, p. 352) state that

> *"The somatic marker hypothesis provides neurobiological evidence in support of the notion that people often make judgements based on "hunches", "gut feelings" and subjective evaluation of the consequences."*

Furthermore, the research of Bechara, Tranel and Damasio (2000), Bechara, Tranel, and Damasio (2002), Bechara, Damasio, and Damasio (2003) and Bechara, Tranel, Damasio and Damasio (1996) demonstrated that it is possible to a) detect changes in somatic states as part of decision-making regardless of the possible causes of these changes, b) that participants with acquired brain injury to highly specific areas did not evidence changes in somatic states, whereas c) healthy adults did evidence changes in somatic states. These data came from what is known as the Iowa Gambling Task in which participants choose cards from different decks with the object of achieving monetary gains, rather than losses, by the end of the game (see Chapter 4 for further details). Usually, the game is presented visually on computer and requires the participant to make a decision about choosing a card from one of the decks presented. Participants are able to take as much time as they require in making their decisions.

Bechara et al. (2000, 2002, 2003) demonstrated that typically functioning healthy adults involved in the Iowa Gambling Ttask were able to predict prospectively decks of cards that yielded future long-term negative results – loss of money – on the gambling task even when the deck may provide early gains. Moreover, these participants evidenced changes in somatic (internal bodily states) as evidenced by skin conduction responses prior to making a decision about which deck they should choose to achieve a positive outcome and avoid the punishment of losing money on bad choices. However, as Maia and

McClelland (2004) have suggested in their critic of the Somatic Marker Hypothesis, such somatic changes may be due to the risk associated with choosing decks rather than the outcome of choosing decks.

Maia and McClelland (2004) and Dunn, Dalgleish and Lawrence (2006) argue that decision-making may not always be dependent on somatic markers and alternative explanations may be given for no change in somatic state of brain injured participants of the Iowa Gambling Task questioning the involvement of the VMPFC. They suggested alternative explanations including deficits in working memory, learning and attention as well as participants being able to work out the schedule of good and bad decks in the gambling task. An important aspect to arise from these critiques, and crucial to the current research project, is the argument concerning the link between internal bodily states, their mental representations and information coming to the system.

Maia and McClelland (2004) approach the research on the somatic marker hypothesis from the perspective of implicit learning and computational learning. As described in chapter four, implicit learning is considered to be different from intuition and as such, it may be that taking an implicit or computational learning approach to intuition may alter the results of any experimentation. Maia and McClelland (2004) replicated the experiments of Damasio and colleagues with a schedule of detailed questions about participants knowledge of what was going on in the gambling tasks, breaking these questions down into three sub categories ranging from no conscious knowledge of the advantageous strategy to conscious knowledge about decks that will provide the advantage. However, unlike the somatic marker research, they did not ask about how participants felt about the game. Maia and McClelland (2004) participant’s (n = 40) were randomly assigned to two conditions, a replication of Bechara et al.’s (2000) original study and their own study. They found that there was no significant difference between the two study conditions and they were able to replicate the findings of Bechara et al. (1997) according to the first two categories of knowledge designed by Maia and Clelland (2004). They reported that participants were behaving advantageously, that is that the *participants reported a preference for an advantageous deck and were not able to provide information on the outcomes of that* *deck* (Level 1 knowledge category). Therefore, Level 1 category can be interpreted as intuitiveness about the game as participants can indicate which decks are best but are not able to articulate the outcomes of choosing such a deck.

According to Maia and McClelland (2004) participants were able to go on to predict and articulate the outcomes of advantageous decks. They argued that somatic markers are not necessary for making decisions and that acquired knowledge is all that is necessary for making decisions based on the evidence from their study that showed that the majority of participants were able to proceed through to explicit knowledge about the game (Level 2 category). Although Maia and McClelland state that there are alternative explanations for the knowledge gained during the Iowa Gambling Task, it is important to note that their comments apply to Level 2 category knowledge and not to Level 1. They did not provide alternative explanations for Level 1 knowledge. In addition, they suggest that the skin conductance responses during the game may arise from knowledge about decks rather than as a change in bodily states in anticipation of the choice. This is an extremely important point in the debate surrounding the somatic marker hypothesis and further research (presented below) will highlight the process further and distinguish between pre and post knowledge skin conductance responses.

Furthermore, of the participants who behaved advantageously, 90% - 100% reported they would rate one of the advantageous decks as their preference from trial 20 which is very early in the process, arguably before any conscious knowledge of the (dis)advantageousness of the decks. These same participants reported that they would choose to select one of the advantageous decks consistently from trials 70 – 100. Reporting a preference for one of the advantageous decks early on in the game may be taken to be indicative of the somatic marker process even though this group of participants were able to verbalise knowledge. Unfortunately, it is not clear if the knowledge reported was accurate, that is, if the participants reported being able calculate with some degree of accuracy the future outcomes of choosing the best deck. From the quantitative perspective, the argument is that if participants have conscious knowledge of the game, then they should be able to provide a reasonably accurate estimate of the future outcomes of a best deck. In addition, as Maia and McClelland (2004) note, qualitative information about the decks was not collected in their research and so there is no way of knowing what impact qualitative knowledge had on deck selection. It may also be argued that the period of Level 1 knowledge, where participants are able to report preference without being able to express why they have made such a preference, is the period of intuitive processing that perhaps corresponds to the hypothesised somatic marker action. It may be that as participants gain conscious information about the decks that they then do not rely on intuitive processing to help guide their choices. To bring further clarity to the situation, Dunn, Dalgleish and Lawrence (2006) critiqued the evidence for the somatic marker hypothesis in a detailed theoretical paper.

Dunn, Dalgleish and Lawrence (2006) extensively critiqued the somatic marker hypothesis and the use of the Iowa Gambling Task as evidence for brain structures involved in the somatic marker system. As part of this critique, Dunn et al. (2006) appear to misinterpret a quote from the work of Tranel et al. (1999) concerning the way in which the non-conscious somatic markers influence conscious (effortful) decision-making, re-interpreting the conscious part of the statement as “explicit insight”. Insight has been the subject of extensive research and there are differences between somatic markers and insight (see Chapter 4). These differences, in brief, are that insight or the ‘A ha’ experience occurs after a time of deliberative contemplation of the problem followed by a distracting task of some sort and results in the participant being able to verbalise the steps to solve the problem when the insight happens. Whereas, in intuitive processing the steps to solve the problem are not able to be verbalised even when the answer is able to be verbalised. Perhaps the confusion has occurred because it may be that the somatic markers are part of the intuitive process engaged in by individuals prior to explicitly working on a problem using insight.

Furthermore, such a misunderstanding of the differences between somatic markers and insight led to additional comments throughout Dunn et al.’s (2006) paper that re-frame the work on the somatic marker hypothesis in a negative light. In addition, Dunn et al.’s (2006) paper contains a section concerning the causal link between body-state feedback and the Iowa Gambling Task that appears to be out of context in the sense that no claim was made by the somatic marker researchers about causality only that there was evidence of a directional correlation.

Moreover, Dunn et al. (2006) presented neurological evidence that appeared to be detrimental to the role of the VMPFC in the somatic marker hypothesis. In particular, they discuss the work of Naccache et al. (2005) that demonstrated that damage to the VMPFC and intact limbic system still resulted in impaired decision making on the Iowa Gambling Task. What is not discussed further is the implication of an intact emotional system together with damage to the VMPFC for the somatic marker hypothesis. It seems plausible that one may have an intact emotional system that functions normally and that the damage to the VMPFC may still result in poor decision making via a lost link between the limbic system and higher-order cortical functions. This break in the link between the limbic system and the VMPFC implies that the action of the somatic markers may not be fully realised under such conditions. This proposition is supported by the work of Naccache et al. (2005). However, the Naccache et al.'s (2005) results were presented by Dunn et al. (2006) from the perspective that the evidence did not support the somatic marker hypothesis, whereas, Naccache et al.'s (2005) results appear to support the somatic marker hypothesis.

In addition, the section of Dunn et al.'s (2006) paper about the alternative explanations to the somatic marker hypothesis appears to be a little confused. For example, Dunn et al. (2006) seem to present impairments in working memory and executive function as possible explanations for performance on the Iowa Gambling Task and then go on to state in their summary that "it is debatable to what extent these findings are problematic for the SMH [somatic marker hypothesis]" (p. 255). When taken together with the other arguments in the paper, this appears to be a straw man style argument. Perhaps this is because all aspects of the somatic marker hypothesis have not been fully understood, and/or they are looking at the somatic marker hypothesis from the perspective of cognition rather than neurology as argued by Reimann and Bechara (2010). Contrary to the position of Dunn et al. (2006), Dunn, Galton, Morgan, Evans, Oliver, Cusack, et al. (2010) go on to demonstrate that bodily states, via interoception (the detection of changes in internal bodily states), do play a role in intuitive decision-making suggesting that perhaps the original critique was indeed based on a misunderstanding of Damasio's (1999, 2005) somatic marker hypothesis.

Recent research is beginning to demonstrate that awareness of interoception not only plays an important role in making mental representations of bodily states (Tsakiris, Tajadura-Jimenez, & Constantini, 2011) but also intuitive decision-making (Dunn, et al., 2010). There is also an emerging understanding of individual differences in the link between emotion and awareness of interoception (Sze, Gyurak, Yuan, & Levenson, 2010) providing further evidence for the integration of affective and somatic processes.

Interoception seems to be very similar if not the same as part of the somatic marker hypothesis where Damasio (2005) has suggested that changes in bodily states come to awareness. Moreover, evidence (Craig, 2009) indicates that the insular cortex is involved in representing bodily states lending additional support to the Somatic Marker Hypothesis (Damasio, 2005) proposition. Further support for the somatic marker hypothesis, and the process integrating somatic and affective states, has arisen from a number of studies that explicitly test interoception.

Dunn et al. (2010) ran two studies looking at the influence of interoception on the relationship between bodily sensations and emotional arousal in a sample of 58 (35 female, 23 male) healthy typically developing adults. They measured heart rate, degree of subjective arousal and degree of affective valence (positive, neutral, negative) when viewing images, and interoception using a heart-beat perception task. Moderation analysis showed that increased interoception accuracy strengthened the relationship between stronger bodily changes (heart rate) and stronger subjective arousal and this was a small effect ($\Delta R^2 = .12$). They did not find any statistically significant changes for affective valence and did not report the statistical power to detect an effect for the study. The second study sought to demonstrate the role of interoception on individual differences in intuitive decision making. There were 92 (62 female, 30 male) healthy typically developing adults who played a variant of the Iowa Gambling Task designed to tap intuitive decision making. Interoception, heart rate changes, skin conductance responses, participants choice of deck, preference for advantageous deck, and estimated future outcome of the deck were measured. Interoception moderated the relationship between heart rate and skin conductance taken together and intuitive decision making. When somatic markers represented advantageous choices, accuracy of interoception accounted for individual differences in intuitive decision making. However, Dunn et al. (2010) found that when somatic markers represented disadvantageous choices, the accuracy of interoception hindered intuitive decision making. Perhaps this is because the negative effects of the gambling task are not strong enough to trigger the somatic markers linked to negative responses (originating in the fear processing system). This may be because the money lost is only pretend and not money belonging to the participants themselves. It is possible that if participants were asked to wager their own money, their intuitive responses may be significant for disadvantageous decks. In a similar vein to Dunn et al.'s study, Sze, et al. (2010) studied differences in matching subjective affect and interoception between groups of adults who practised formal meditation, dance and controls.

Sze et al. (2010) asked 63 healthy female participants (21 in each group of meditation, dance and control) a range of questions to measure state-trait anxiety, personality traits, body awareness (interoception), mindfulness and physical health. Participants where shown emotion inducing films and were asked to rate their subjective experiences while physiological readings were taken during the tasks.

Furthermore, Sze et al. (2010) found a positive significant correlation between bodily responses for advantageous decks and intuitive ability (p. 1841, r = .41, p < .001) and no significant association of interoceptive accuracy with intuitive ability. This finding is important because, as previous literature (e.g. Sadler-Smith, 2008) has argued, intuitive decision making can result in erroneous decisions. Sze et al. (2010) used moderation analysis to determine the effect of interoceptive accuracy on the relationship between bodily differentiation (difference between bodily changes, measured by heart rate and skin conductance, for advantageous and disadvantageous decks) and intuitive ability. Sze et al. (2010) demonstrated that for bodily differentiation of advantageous choices, accurate interoception was associated with improved intuitive ability. Whereas, for bodily differentiation of disadvantageous choices, there was improved interoception associated with decreased intuitive ability. These findings support the theory that under the experimental conditions positive outcomes are more likely to trigger somatic markers than negative outcomes. Although Sze et al. (2010) findings are about intuitive ability, it is likely that these processes may come into play for intuitive style.

Therefore, based on the evidence for the Somatic Marker Hypothesis two indirect effects models of the somatic marker hypothesis will be tested as partial explanations for the integration of cognitive, affective and somatic processes in the current thesis:

1. Associative processing as operationalised by Big Picture will then trigger positive affect that will then have an indirect effect on physical sensations via non-conscious and rapid processes
2. Associative processing as operationalised by Big Picture will then trigger negative affect that will then have an indirect effect on physical sensations via non-conscious and rapid processes

6.2.2 X-System (Lieberman, 2000)

X-System comes from a dual-process approach to social cognition, or social intuition. As discussed in chapter four, this model has key characteristics of intuition in that it describes a process that is rapid, non-conscious, and associative and includes observed non-verbal cues which may play an important role in intuitive style. To date, it seems that this model appears as a theory only and has not been subjected to explicit testing. Lieberman's (2000) model is based on the functioning of the ventromedial prefrontal cortex (VMPFC), amygdala, basal ganglia, lateral temporal cortex and the dorsal anterior cingulate. These areas of brain functionality partially parallel those of Damasio's (1999) somatic marker hypothesis; both theories including the VMPFC, amygdala, basal ganglia and dorsal anterior cingulate suggesting some common ground for both theories. Lieberman (2000) highlights the role of the basal ganglia and its interaction with the prefrontal cortex by drawing on the acquired brain injury literature and tests of non-verbal cues. Lieberman's (2000) theory suggests that observed non-verbal cues, or any information entering via the senses, are then represented by the basal ganglia linking through to the VMPFC and amygdala. Implicating brain regions in a specific order suggests that mental representation may not occur directly and that there is some intermediary process from the mental representation through non-conscious processing to emotions.

Therefore, two models are posited from Lieberman's (2000) theory:

1. Observed non-verbal cues trigger rapid and non-conscious processing that lead to a positive affect
2. Observed non-verbal cues trigger rapid and non-conscious processing that lead to a negative affect

Having reviewed models that lead to hypotheses about the somatic/affective processes of intuitive style, the next section will review models that lead to hypotheses about the cognitive dimension of intuitive style.

6.3 Cognitive Theories Applicable to Intuitive Style

The cognitive dimension of intuitive style appears to consist of the big picture, non-conscious and rapid components. According to Stanovich and West (2000) there are many models that are proposed by researchers as having these cognitive characteristics. Of the many models noted by Stanovich and West (2000), System 1 (Kahneman, 2003; Tyversky & Kahneman, 1977, 1985) is arguably one of the most extensively empirically tested models and Sloman's (1996) Associative System appears to be the only model that explicitly proposes ordering the cognitive components in a process model, thus forming the operationalisation of System 1. Although there are other models (e.g. Evans, 2003; Nisbett & Wilson, 1977), they tend to describe the cognitive characteristics of intuitive style or use similar experiments to that of Tvyersky and Kahneman rather than testing or proposing the ways in which the cognitive characteristics may operate together. System 1 and Associative Processing models are situated in a cognitive psychology approach to decision-making and judgement and are used in this thesis to provide evidence on which to build a process model of the cognitive dimension of intuitive style. System 1 is presented first followed by the Associative processing model.

6.3.1 System 1 (Kahneman, 2003)

System 1 (Kahneman, 2003) is described as being involuntary, automatic and quick, very similar to the non-conscious and rapid components of intuitive style and for this reason is examined as one potential explanation of a process model. These System 1 components are thought to operate through the use of associative processing (similar to big picture component of intuitive style), cognitive heuristics, implicit associations, biases, errors and framing. The differences between intuitive style and each of cognitive heuristics, implicit associations, biases, errors and framing were explained in chapter four. It should be noted that Kahneman (2003) uses the label 'intuitive' to describe the judgements or decisions arising from the operation of System 1 that have a physical sense to them rather than the system itself and that the term affective applies to a heuristics process involving emotions.

The experiments forming the evidence for System 1 are often based on assumptions about the use of probabilistic reasoning in decision making and judgement. The items typically used to test System 1 processes appear to fall into two different contexts: non-social and social. A non-social example would be: “If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?” to which many participants give the answer 100 (Frederick, 2005). A social example would be:

The Linda Problem

“Linda is thirty-one years old, single, outspoken and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in antinuclear demonstrations. Please rank order by probability (highest to lowest) the following:

Linda is a teacher in an elementary school
Linda works in a bookstore and takes yoga classes
Linda is active in the feminist movement
Linda is a psychiatric social worker
Linda is member of the League of Women Voters
Linda is a bank teller
Linda is an insurance sales person
Linda is a bank teller and active in the feminist movement”

86% of people in the original study rated 'Linda is a bank teller and active in the feminist movement' as their highest probability. However, this answer has no greater probability (in fact, it should be less probable) than the answer that 'Linda is a bank teller'. Responses to both the Widget and Linda items are often cited as intuitive or as evidence for non-rational thinking. Of critical consideration to building a process model of intuitive style is that researchers suggest that these two items have a similar mathematical basis, that of Bayesian statistics, underlying the probabilistic reasoning behind the inaccurate responses given to these questions.

Levi (1981, 1983) critiqued the Bayesian assumptions of probabilistic reasoning that underlie System 1 on the grounds that the researchers' interpretation of Bayesian assumptions were inaccurate and there were other more tenable explanations for participant responses (e.g. Gould, 1991; Sadler-Smith, 2008). Others have suggested that probabilistic reasoning based on Bayesian assumptions is a logical method, thus confounding effortful thinking with intuition. Furthermore, there is evidence to show that human reasoning does not fit well with explanations built from theories about probabilistic reasoning or statistics (Stanovich & West, 2000). One explanation comes from Sloman (1996) who suggested that such responses result from pattern matching of similarities in structure (question and answer) rather than Bayesian probabilities. In addition, Kahneman (2003) has since argued that different research designs, other than posing questions that require probabilistic reasoning, are needed to access intuitive responses stating that "Intuitive judgments and preferences are therefore best studied in between-participants designs and in short experiments that provide little information about the experimenter's aims." (p. 712) as a method of reducing the impact of participant's inaccurate statistical thinking on the experimental results. Since the debate over Bayesian assumptions remains unresolved, care needs to be taken when applying evidence from System 1 as part of the argument for a process model of intuitive style. Indeed, one aspect of the items used in System 1 experiments appears to be overlooked.

To date, there appears to be no commentary on the idea that the items used to test System 1 fall into the categories of non-social items and social items. This may turn out to be very important in terms of a process model of intuitive style because non-social items and social items may trigger slightly different processing. Perhaps, social items may be better understood in the context of the Somatic Marker Hypothesis (Damasio, 2005) or X-System (Lieberman, 2007). For example, Lieberman's (2007) evidence for X-System comes from items within social contexts, either self or the interaction of self with others. This approach appears to be very different to that of the non-social type items used in System 1 that are data driven (generally mathematical) and therefore ought not involve the neural circuitry of social processing. Further, evidence from the current research appears to support a case for separating out intuitive processing of social contexts from that of non-social contexts. The replicable and stable factors formed during the analysis of the new ICSS scale (Chapter 5) suggest two dimensions, one processing social context and the other processing non-social contexts.

The extensive evidence from System 1 research forms the background to and is evidence for the rapid, big picture and non-conscious components in a process model of intuitive style. Although Kahenman (2003) notes the characteristic properties of System 1, he does not appear to discuss any order of operations for System 1 properties. Whereas, Sloman (1996) did suggest a plausible model for connecting the properties of System 1 into a process model he called the Associative System.

6.3.2 Associative System (Sloman, 1996)

Intuition, in Sloman's (1996) terms, is viewed as an associative mechanism produced by the operation of the Associative system. Taking a computer processing metaphor (parallel processing in systems network) approach to understanding the Associative system, Sloman (1996) states that information coming into the system is distributed throughout the system in an associative manner: “The network is put into an initial state by activating all those units that represent problem-relevant knowledge, such as facts about the world, goals, and the current context.” (p. 8) which may be akin to the big picture component of intuitive style. This is the first of the theories examined in the current chapter that has anything to say about what happens when information enters the system. Following the activation of the associative networks, the processing is then rapid and non-conscious resulting in a cognitive output. Unlike Damasio (2005) or Lieberman (2000), Sloman (1996) makes no reference to physical sensations or any affective states, placing his process modelling clearly within the boundaries of the cognitive dimension of intuitive style. In addition, Sloman (1996) proposes that context drives the inclusion of information to be processed by the Associative system.

The inclusion of context as a key aspect of the Associative system process sets Sloman's (1996) model apart of other similar systems because other systems, such as System 1 (Kahneman, 2003) appear not to pay attention to the context in which the processing occurs. The context in which the information is processed becomes an important factor in determining which aspects of the system are activated. Sloman (1996) extended this proposition by suggesting that context becomes the selection criteria to determine which features of the information will be linked together through associative processing. An example may help to clarify this notion. The vignette at the beginning of the Linda problem sets the context for the selection of features in the answers, such as feminist movement, that are most likely to be associated with the features in the question, such as Linda was concerned with discrimination and social justice, and draws together related information consistent within the context to form an outcome, Linda is a bank teller and active in the feminist movement. In Sloman's words

> *"... associations are not between concepts but between components or attributes of concepts"* (p. 8)

or in other words, the associations formed in the system are between the features of concepts. When taken together, Sloman's (1996) processing theory and Kahneman's (2003) System 1 present a testable model for the cognitive components of intuitive style.

Therefore, two models will be tested in the current thesis:

1. Associative processing represented by Big Picture component triggers non-conscious processing which then triggers rapid processing yielding physical sensations
2. Associative processing represented by Big Picture component triggers rapid processing which then triggers non-conscious processing yielding physical sensations

Conclusion

This chapter presented a theoretical basis from which to develop a process model that integrates the cognitive, affective and somatic processes of intuitive style. The evidence for different aspects of the process model, the somatic/affective dimension and cognitive dimension, were discussed. Potential models for the somatic/affective dimension were suggested from two theories, the Somatic Marker Hypothesis and X-System. The Somatic Marker Hypothesis and X-System will be tested individually as explanations for the somatic/affective part of a process model of intuitive style.

For the cognitive dimension of intuitive style, potential models were suggested from two theories, System 1 and the Associative System. System 1 and Associative System model will be taken together and tested as an explanation for the cognitive process part of a process model of intuitive style. This moves the research on intuitive style forward by proposing a substantive theoretical framework, based in psychoneurobiology, which explains the ways in which the cognitive, affective and somatic processes of intuitive style may be integrated.

"At that very moment…[the memory] had produced a longing (yet it was also fruition) which had flowed over from the mind and seemed to involve the whole body."

C. S. Lewis (1955)

Chapter 7

Process Model of Intuitive Style

Introduction

This chapter sets out to test process models of a psychoneurobiological-based multidimensional intuitive style. The purpose of this chapter is to test the theoretical models described in chapter six and from the results, to develop a complete process model of intuitive style. At this point in time, there is a single method of testing such process models which is by using serial mediation. To date, it appears that this is the first known instance in the literature of the application of serial mediation to the exploration of a habitual mental preference for processing information.

Serial mediation may be enacted in two ways as a structural equation model or as a process model for indirect effects. Mediation in SEM requires that the relationship between X and Y be significant and this is not an appropriate assumption to hold in regard to the relations among components of intuitive style because some relations are non-significant. To overcome this assumption, Hayes (2011) has designed a statistical model for serial indirect effects and this model will be used to test the proposed models listed in chapter six.

The current chapter is divided into two sections. The first section presents the analytical procedure for serial mediation, including new advances in quantifying indirect effects, and details the PROCESS software macro. The second section presents the results and discussion of the hypothesis testing of various process models of intuitive style.

Part 1

7.1 Analytical Procedure and Model Building

Mediation is a statistical process that answers questions about how or why effects occur (Baron & Kenny, 1986) and may be considered, under certain circumstances, as a test of causality. Causality should be treated with great care when designing mediation research (Wood, Goodman, Beckmann, & Cook, 2007). As with any research, best practice in mediation calls for researchers to explicitly describe their assumptions and the design of their study. To this end, the assumptions made in this research and the design of the current study is specified as follows:

- The current research is non-experimental, and therefore, no assumptions about causality are made from the statistical analysis

- Rationale for the predictor variable to precede the mediator and outcome variables was outlined as part of the literature review in chapter 3.
- Plausible alternative models will be tested
- Independent and mediator variables are assumed to be measured without error
- The Hayes (2011) approach to mediation testing will be used in this thesis.

In the past (not in the current research), for mediation to be said to occur is has been assumed that a) there must be a statistically significant relationship from the predictor (independent) variable to the outcome (dependent) variable, b) there must be a statistically significant relationship from the predictor to the mediator variable, c) there must be a statistically significant relationship from the mediator to the outcome variable, and d) the relationship between the predictor variable and the outcome variable is statistically significantly reduced, preferably to zero, when a mediator variable is introduced (Barron & Kenny, 1986).

Since Baron and Kenny's (1986) seminal article on mediation and moderation, researchers (Shrout & Bolger, 2002; Stone-Romero & Rosopa, 2010) have cogitated on the nature of the relationships among variables in a mediation model (Shaver, 2005; Wood, et al., 2007). There are three key areas in which researchers have made substantive argument for changes in mediation modelling; that the relationship from the independent variable to the outcome variable does not need to be statistically significant when the effect size is likely to be small; quantifying indirect effects by bootstrap methods be used to test the size and significance of indirect effects in small to medium sized samples; and, modelling with serial mediators. Preacher and Hayes (2008) and Hayes and Preacher (2011) present an elegant solution to testing serial mediation.

7.2 Advances in Mediation Modelling

7.2.1 The X → Y Relationship

A number of researchers (e.g. MacKinnon, Krull, & Lockwood, 2000) have argued that the relationship between the predictor and outcome variables does not need to be significant for mediation to occur. In particular, MacKinnon et al. suggest that the association between X and Y may be non-significant when the mediating effect has the opposite sign of that of the direct effect. In this case, the mediating and direct effects cancel each other out. In addition, Shrout and Bolger (2002) suggest that the theoretical rationale for testing mediation relationships take precedence over the statistical test of the effect of X on Y. The application of this approach to serial mediation is presented within the following section.

7.2.2 Serial Mediation

Serial mediation is underpinned by indirect effects and total effects rather than direct effects. Indirect effects are those effects that are the mechanism by which the predictor variable effects the outcome variable via a mediating variable. In other words, the mediating variable explains why there is a relationship between the predictor and the outcome variables. In serial mediation the indirect effects can be linked through a causal-like chain from the predictor to the outcome variable. This allows for the statistical testing of a process model whereby the process is initiated by a variable and then has an indirect effect through a number of variables to produce an outcome. The model in Figure 14 shows a conceptual format of serial mediation with two mediators. In words, the effect of X is transmitted indirectly to Y through M and then through W.

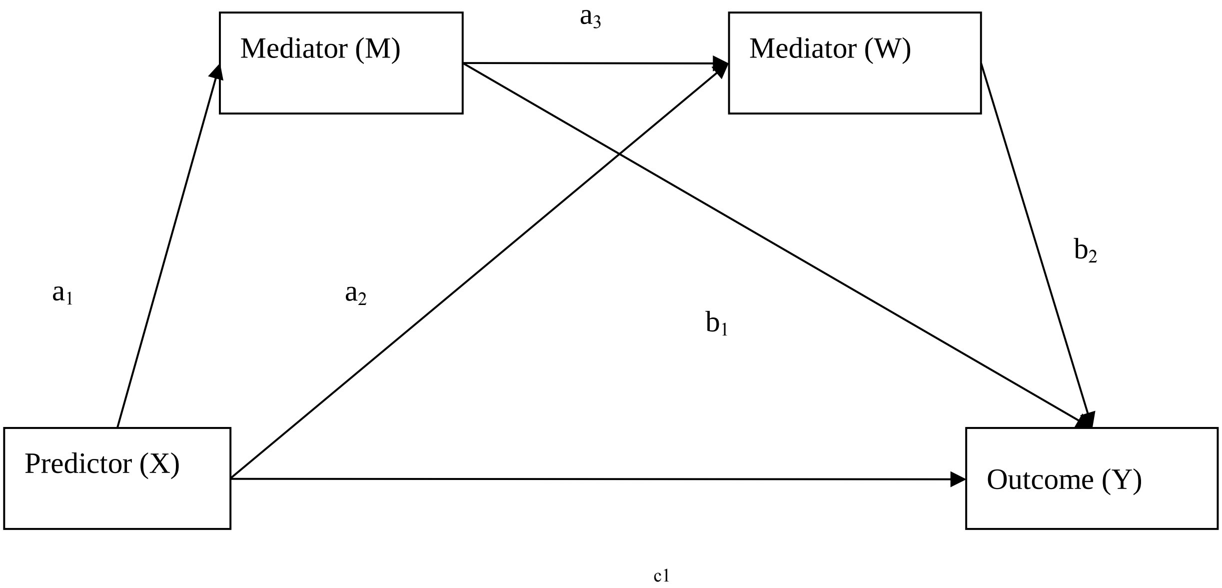


Figure 14. Conceptual Diagram of Serial Mediation (adapted from Preacher & Hayes, 2008)

The total effects are the sum of all indirect effects in the model, that is, the effect through the first mediator plus the effect through the second mediator plus the effect through the first and second mediator, in series, plus the direct effect. This logic helps to partial out the indirect effects in the model. Of particular interest to the current research is the path X – M1 – M2 ... Mi – Y for all mediators.

7.2.3 Application of Non-significant X → Y Relationship to Serial Mediation.

In the current research, it is assumed that the effect sizes will be small (Cohen, 1988) consistent with results from the similar area of personality research. In addition, the associations between predictor variables and outcome variables for some of the models to be tested are non-significant. The modelling process should reveal where there are negative mediation paths that cancel out (partially or completely) the direct effects. Since this is an exploratory approach, it is expected that some models will show cancellation based on inspection of the inter-subscale correlations in chapter five whereas, other models may not show any cancellation.

According to Hayes, there are a number of considerations that need to be taken into account to produce a robust serial mediation model. These are: indirect effects can occur in the absence of a direct effect, quantifying indirect effects, comparing indirect effects and effect sizes.

7.2.4 Testing Indirect Effects with Percentile Bootstrapping

In the past, the Sobel test has been used as a method of choice for determining the standard error of the indirect effect in a mediation model (Baron & Kenny, 1986). Recently, taking advantage of the advances in computing, researchers (Hayes, 2009; Shrout & Bolger, 2002; Wood, Goodman, Beckman & Cook, 2007) have raised four issues concerning the use of the Sobel (1982) test in mediation.

- The Sobel test is a large sample test and using it with medium to small samples violates the assumptions underpinning the test (Sobel, 1982).
- The Sobel test has been shown to have low power when compared to other forms of testing indirect effects (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002)
- The Sobel test assumes that the sampling distribution of the indirect effect is normal. However, Bollen and Stine (1990) have shown that the distribution of the indirect effect is non-normal.
- The Sobel test does not provide the effect size and inferential test of the indirect effect (Hayes & Preacher, 2011).

To overcome these issues, a number of researchers (e.g. Shrout & Bolger, 2002; Preacher & Hayes, 2008) have proposed the use of bootstrapping as a method of testing indirect effects. Moreover, bootstrapping can be used in multiple mediator modelling. Percentile bootstrapped confidence intervals provide an “empirical estimation of the sampling distribution of the indirect effect” (Preacher & Hayes, 2008, p. 883) and does not rely on the assumptions of a normal distribution.

Percentile bootstrapping involves taking random (pseudo) samples of the original dataset thousands of times, returning the ‘used’ sample to the dataset each time, and generating an estimate of the indirect effect. The estimates are then sorted, low to high values, and the associated standard error and the upper and lower bounds of the confidence interval calculated from the desired value of α (Type 1 error rate). To generate confidence intervals, data need to be transformed and the distribution and standard error calculated (Hayes, 2009). This may result in a skewed distribution with inaccurate standard errors leading to inaccurate representation of confidence intervals for the data. To address this problem of inaccurate representation, bootstrapped bias-corrected confidence intervals generate a distribution for the confidence interval that is normal and a stable standard error following the transformation of the data. Efron (1987) states that bias-corrected and accelerated bootstrapped confidence intervals produce increased accuracy beyond that of a bias-corrected bootstrapped interval. This is because the acceleration constant is continually calculated for each point estimate in the bootstrap distribution taking into account the degree of skew in the bootstrapped distribution at that point. This process then allows for the bootstrapped confidence intervals and standard errors for point estimates to reflect the true nature of the distribution of the original data and does not rely on the original data being multivariate normal (Efron, 1987).

Confidence intervals are interpreted (Preacher & Hayes, 2008; Shrout & Bolger, 2002) as not different from zero (i.e. no mediation present) if the confidence interval includes zero. Conversely, when confidence intervals do not include zero, they are interpreted as being different from zero (i.e. mediation is present) and the indirect effect measured and compared.

7.2.5 Effect Sizes

Effect sizes for serial mediation models can be quantified in a number of different ways: the ratio of indirect effect to total effect and the ratio of the direct effect to the total effect (Preacher & Kelley, 2011), indirect effect to direct effect (Sobel, 1982). According to MacKinnon (1995) these effect sizes will be biased if sample sizes are less than 500 and less than 5000, respectively. In addition, Preacher and Kelley (2011) have suggested that the unstandardised indirect effect be interpreted as the effect size when the scales of X and M are on the same metric. Alternatively, partially standardised and fully standardised indirect effects may be calculated. Partially standardised indirect effects are produced by calculating the ratio of the indirect effect to the standard deviation of Y (MacKinnon, 2008). Completely standardised indirect effects are calculated by multiplying the co-efficient by the ratio of the standard deviations for X and Y. These effect sizes and others (k R) are available in the software used for the current analysis and confidence intervals for effect sizes can be bootstrapped.

Although partially standardised and completely standardised effect sizes are produced by PROCESS, the current sample size (less than 500) will not meet the requirements to avoid bias. Therefore, Preacher and Kelley's (2011) method of interpreting the unstandardised indirect effect as the effect size will be used.

7.3 PROCESS Macro for Serial Mediation

PROCESS (Hayes, 2011) is a software macro written in SPSS code that may be used to statistically analyse serial mediation models. Up to four mediators can be modelled in serial using PROCESS. The PROCESS macro and documentation can be found at http://www.afhayes.com/spss-sas-and-mplus-macros-and-code.html. In addition, percentile bootstrapped confidence intervals are available for each of the indirect effects and for effect sizes. PROCESS simultaneously analyses all possible paths in the model, thus addressing the need to control for increased Type I error rate.

Part 2

7.4 Method

All Survey 1 participant information, instruments, data collection procedures and preliminary data cleaning were presented in Chapter 5 (Scale development and validation). ICSS scale data using only the subscale totals for: Physical sensations (physen), Big picture (bigpic), Positive affect (posaff), Negative affect (negaff), Rapid (rapid), Non-conscious (noncon) and Observed non-verbal cues (nonver) were used in the process modelling. PROCESS macro was used as a script in SPSS to run the serial mediation modelling. The inter-subscale correlations are presented in Table 29 for ease of reference.

Table 29. Inter-subscale Correlations for the ICSS

		1	2	3	4	5	6	7
1	Physical sensations	-	.18**	.17**	.19**	.34**	.38**	.20**
2	Big picture		-	.16**	.15**	.20**	.04	.23*
3	Positive affect			-	.19**	.34**	.28**	.14*
4	Negative affect				-	-.01	.23**	-.00
5	Observed non-verbal cues					-	.18**	.20**
6	Non-conscious						-	.22*
7	Rapid							-

* $p < .05$, ** $p < .001$

The presentation of the results is broken up into two main sections one each for the somatic/affective dimension and for the cognitive dimension of intuitive style. A discussion of the results follows each section and there is a general discussion of results to conclude the chapter.

7.5 Results

7.5.1 Somatic/Affective Models

7.5.1.1 Somatic Marker Hypothesis (Damasio, 1999)

The rationale behind this model is as described in neurological terms by Bechara and Damasio (2005, p. 341) which carries the experience of part of the psychoneurobiological-based intuitive style process. Because the Somatic Marker Hypothesis can be a mental re-representation, it should be amenable to psychometric formulations. In this model, associative processing (big picture) of information begins the process leading to an affective state, processed non-consciously and rapidly and triggering a physical sensation as presented in Section 6.2.1. The modelling for the Somatic Marker Hypotheses is separated into positive affect and negative affect models as it would be highly unlikely for positive and negative affect to occur at the same time in an individual.

Positive Affect Hypotheses

H1: Big picture leads to positive affect that in turn leads to physical sensations

H2: Big picture leads to positive affect that in turn leads to rapid processing that in turn leads to physical sensations

H3: Big picture leads to positive affect that in turn leads to non-conscious processing that in turn leads to physical sensations

H4: Big picture leads to positive affect that in turn leads to rapid processing that in turn leads to non-conscious processing that in turn leads to physical sensations

H5: Big picture leads to rapid processing that in turn leads to physical sensations

H6: Big picture leads to rapid processing that in turn leads to non-conscious processing that in turn leads to physical sensations

H7: Big picture leads to non-conscious processing that in turn leads to physical sensations

Negative Affect Hypotheses

H8: Big picture leads to negative affect that in turn leads to physical sensations

H9: Big picture leads to negative affect that in turn leads to rapid processing that in turn leads to physical sensations

H10: Big picture leads to negative affect that in turn leads to non-conscious processing that in turn leads to physical sensations

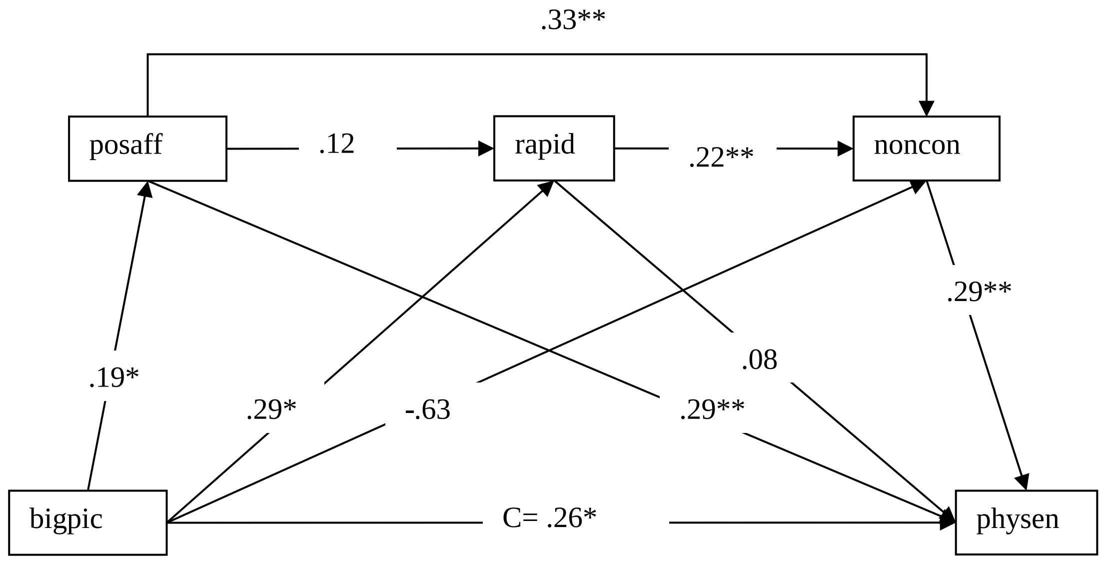
H11: Big picture leads to negative affect that in turn leads to rapid processing that in turn leads to non-conscious processing that in turn leads to physical sensations

H12: Big picture leads to rapid processing that in turn leads to physical sensations

H13: Big picture leads to non-conscious processing that in turn leads to physical sensations

H14: Big picture leads to rapid processing that in turn leads to non-conscious processing that in turn leads to physical sensations

Path co-efficients are presented in Figures 2 and 3 and the results for these hypotheses in Tables 2 and 3.



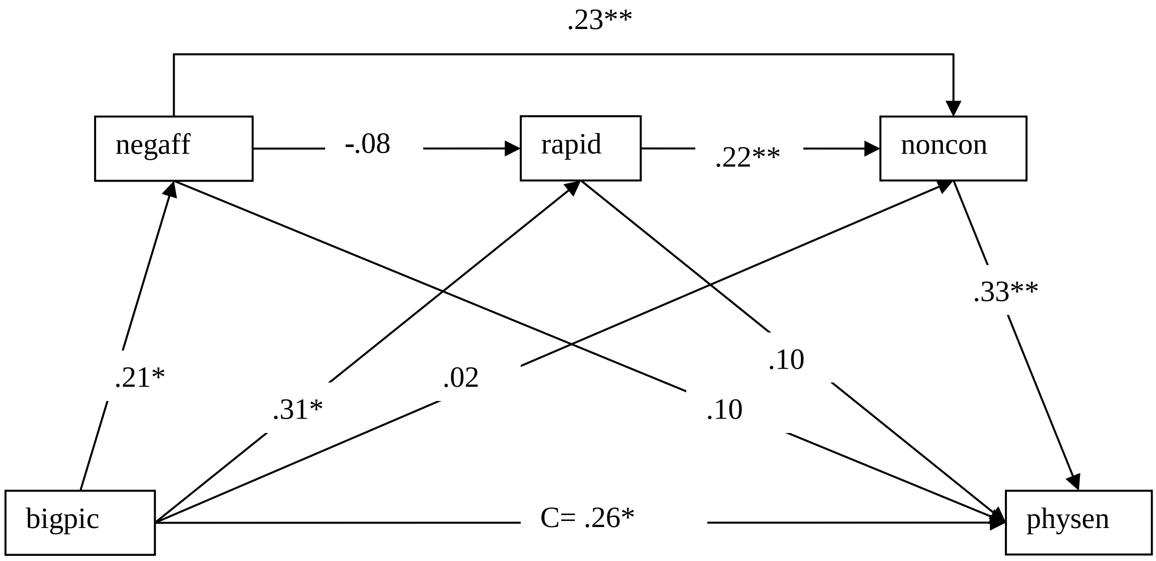
*p< .05, **p<.001, C= total effects

Figure 15. Path Co-efficients for the Somatic Marker Model (Positive affect) (n = 340)

Table 30. Direct and Indirect Effects of Big Picture on Physical Sensations with Positive Affect (n=340)

		Direct effect on Physical sensations	Indirect effect on Physical Sensations (Bootstrap Standard Error)
	Big Picture	.16 (.07), *p* = .03	
H1	→ Positive affect →		.05 (.03)*
H2	→ Positive affect → Rapid →		.002 (.002)
H3	→ Positive affect → Non-conscious →		.02 (.01)*
H4	→ Positive affect → Rapid → Non-conscious →		.001 (.001)*
H5	→ Rapid →		.02 (.02)
H6	→ Rapid → Non-conscious →		.02 (.01)*
H7	→ Non-conscious →		-.02 (.02)

* $p < .05$



*p< .05, **p<.001, C= total effects

Figure 16. Path Co-efficients for Somatic Marker Model (Negative affect) (n = 340)

Table 31. Direct and Indirect Effects from Big Picture to Physical Sensations with Negative Affect (n = 340)

		Direct effect on Physical sensations	Indirect effect on Physical Sensations (Bootstrap Standard Error)
	Big Picture	.18 (.08), p = .02	
H8	→ Negative affect		.02 (.02)
H9	→ Negative affect → Rapid →		-.002 (.002)
H10	→ Negative affect → Non-conscious→		.02 (.01)*
H11	→ Negative affect → Rapid → Non-conscious →		.01 (.00)*
H12	→ Rapid →		.03 (.02)
H13	→ Non-conscious →		.01 (.03)
H14	→ Rapid → Non-conscious→		.00 (.002)

* p < .05

7.5.1.2 X- System (Lieberman, 2000) Based Self-Report Models

The rationale for this model is based on, but not equivalent to, the neurological model in Lieberman (2000) which describes the processing of social information as presented in Section 6.2.2. The neurological model indicated that the self-report experience of the somatic/affective dimension of intuitive style may begin with observing non-verbal cues of others, rapidly and non-conscious processing the information, which then triggers an affective state. The modelling for the X-System hypotheses are separated out into positive affect and negative affect models. The following hypotheses were tested:

H15: Observed non-verbal cues lead to rapid processing that in turn lead to positive affect

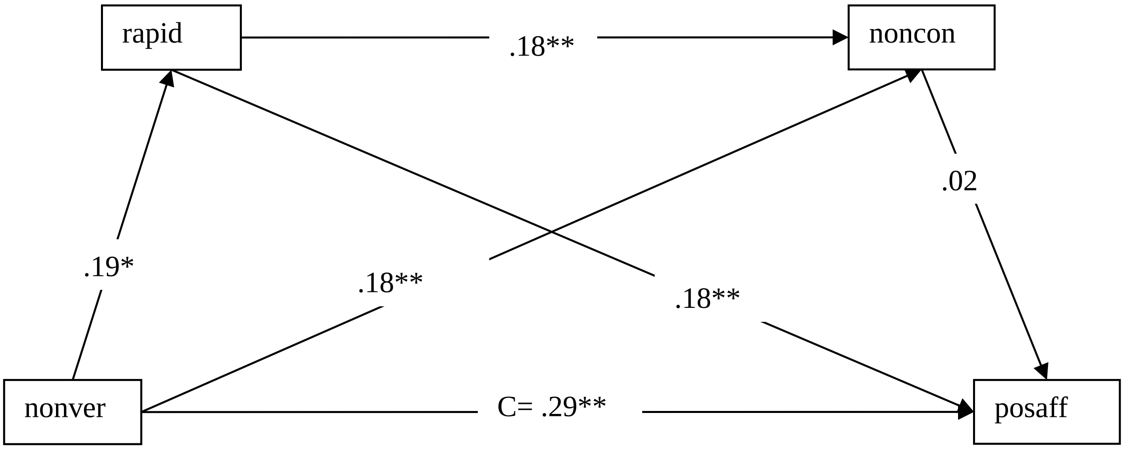
H16: Observed non-verbal cues lead to non-conscious that in turn lead to positive affect

H17: Observed non-verbal cues lead to rapid processing that in turn lead to non-conscious processing that in turn lead to positive affect

H18: Observed non-verbal cues lead to rapid processing that in turn lead to negative affect

H19: Observed non-verbal cues lead to non-conscious that in turn lead to negative affect

H20: Observed non-verbal cues lead to rapid processing that in turn lead to non-conscious processing that in turn lead to negative affect



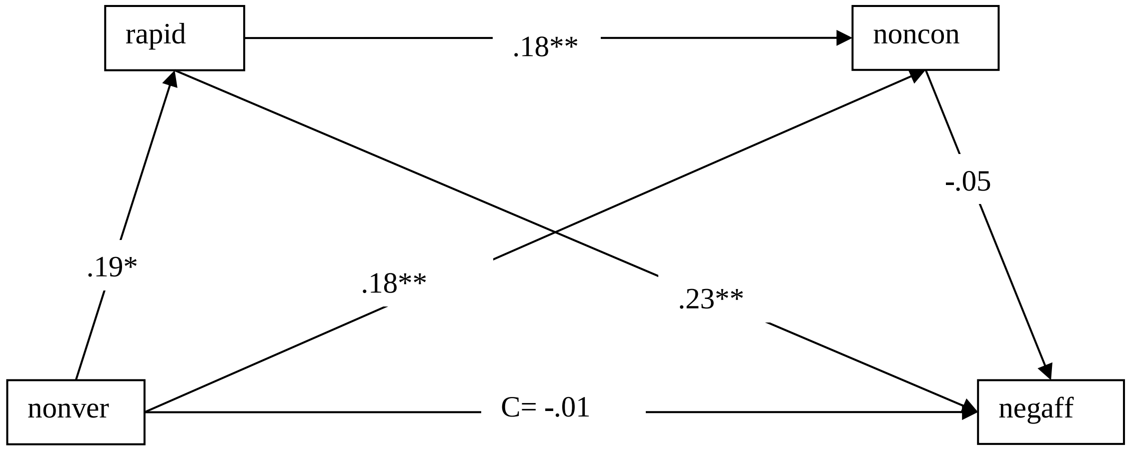
*p< .05, **p<.001, C= total effects

Figure 17. Path Co-efficients for X-System Based Self-Report Model with Positive Affect (n =340)

Table 32. Direct and Indirect Effects from Observed Non-verbal Cues to Positive Affect (n=340)

		Direct effect on Positive Affect	Indirect effect on Positive Affect (Bootstrap Standard Error)
	Observed non-verbal cues	.25 (.05), *p* = .00	
H15	→ Rapid →		.004 (.001)
H16	→ Non-conscious →		.03 (.01)*
H17	→ Rapid → Non-conscious →		.001 (.002)

* $p < .05$



*p< .05, **p<.001, C= total effects

Figure 18. Path Co-efficients for X-System Based Self-Report Model with Negative Affect (n=340)

Table 33. Direct and Indirect Effects from Observed Non-verbal Cues to Negative Affect (n=340)

		Direct effect on Negative Affect	Indirect effect on Negative Affect (Bootstrap Standard Error)
	Observed non-verbal cues	-.04 (.06), *p* = .47	
H18	→ Rapid →		-.01 (.01)
H19	→ Non-conscious →		.04 (.02)*
H20	→ Non-conscious → Rapid →		-.002 (.002)

* $p < .05$

7.6 Discussion of Somatic/Affective Models

Serial mediation modelling was used to test theoretical process models of intuitive style. Models were formed from theories developed by Damasio (1999), Lieberman (2000), and Sloman (1985). These models are addressed individually and then a discussion will be presented about which features of intuitive style are necessary and sufficient to form a process. The Hayes (2009) approach to indirect effects was used in the current research. This means that instead of using the causal steps strategy (Baron & Kenny, 1986), indirect effects are used and their size in the population are estimated. The further away from zero the value of the indirect effect is, the stronger the indirect effect.

7.6.1 Somatic Marker Hypothesis (Damasio, 1999)

This theory suggested that associative processing (big picture) leads to the physical sensations through the triggering of positive or negative affect that then cascades through rapid and non-conscious processing. The modelling is broken up into models containing either positive or negative affect

7.6.1.1 Positive Affect Models

Four of the Positive affect models were found to be significant and these are presented first followed by the non-significant models.

Model 1. Big picture → Positive affect → Physical sensations (H1)

This model presents the most parsimonious explanation of a process model of intuitive style. The direct link between positive feelings has been highlighted in style research and is detectable on physiological measures. It supports the contention of style researchers (e.g. Allinson & Hayes, 1996) using psychological measures of intuitive style that emotions are involved in intuitive processes. This model also supports the evidence garnered from physiological research on intuition (Dunn et al., 2010; Reimann & Bechara, 2010) that emotions appear to play a central role in intuitive processing. The indirect effect value for this model was not close to zero indicating that the effect was of medium strength.

Model 3. Big picture → Positive affect → Non-conscious → Physical sensations (H3)

This model adds the notion that intuitive style is something that is non-conscious; that is, it occurs below the level of effortful thinking as a second mediator between big picture and physical sensations. Non-conscious processing is often described as a characteristic of intuition (Allinson & Hayes, 1996; Sadler-Smith, 2008), and the modelling suggests that non-conscious processing in intuitive style occurs after emotions are triggered. This would support the contention of Damasio (2005) because the somatic marker hypothesis suggests that affective states are triggered by information coming in through the senses processed by the limbic system (emotions) and then directly linked through the ventromedial prefrontal cortex, all operating below the level of effortful thinking. The indirect effect value for this model approached zero indicating that the strength of the indirect effect was relatively weak.

Model 4. Big picture → Positive affect → Rapid → Non-conscious → Physical sensations (H4)

This model extends Model 3 by adding rapid processing as a mediator. Rapid processing is described by intuition researchers (Hodgkinson et al., 2008) as a characteristic of intuitive processes. In this model, rapid processing appears to facilitate the link between positive affect and non-conscious processing. This would make sense in terms of the processing occurring below the level of effortful thinking.

However, the indirect effect of big picture on physical sensations mediated through positive affect and in turn through rapid processing and in turn through non-conscious is the weakest of all the models. This suggests that rapid processing, while a characteristic of intuitive processes including intuitive style, may turn out to be best considered as being subsumed in the non-conscious aspect. The indirect effect value for this model closely approximated zero indicating that the strength of the indirect effect was very weak.

Model 6. Big picture → Rapid → Non-conscious → Physical sensations (H6)

This is an alternative model that does not include positive affect as a mediator and as such represents only a partial test of Damasio's theory. Big picture has an indirect effect through rapid and then non-conscious processing to physical sensations. This is a plausible model and compares well to Model 2. However, like the previous model, the indirect effect value approached zero indicating the indirect effect was relatively weak.

The models of Big picture → Positive affect → Rapid → Physical sensations (H2), Big picture → Rapid → Physical sensations (H5) and Big picture → Non-conscious → Physical sensations (H7) were found to be non-significant. This may be because all the components are necessary for an indirect effect to occur. Perhaps this is not surprising given that the Rapid and Non-conscious components, when modelled separately, include non-significant path co-efficients (see Figure 15).

7.6.1.2 Negative Affect Models

Models using negative affect were tested. The path co-effients are presented in Figure 16. Two models were found to have significant indirect effects, see Table 31, are presented first followed by the non-significant models.

Model 8. Big picture → Negative affect → Non-conscious → Physical sensations (H8)

This model supports the contention of Damasio (1999) that negative affect plays a role in transferring the indirect effect of big picture to physical sensations. Damasio (1999) proposed that negative affect should act like an alarm to warn of impending negative outcomes. The current model is comparable to Model 3 because the value of the indirect effect approached zero indicating the model was relatively weak.

Model 11. Big picture → Negative affect → Non-conscious → Rapid → Physical sensations (H11)

This model represents a complete test of Damsio's (1999) theory where negative affect acts in the model instead of positive affect. The same theoretical reasoning underlies this model as was applied to Model 6 where associative (big picture) processing triggers negative emotions that are then processed non-consciously in turn rapidly to lead to physical sensations. However, the value of the indirect effect for this model approached zero indicating the model was weak.

The models of Big picture → Negative affect → Physical sensations (H8), Big picture → Negative affect → Rapid → Physical sensations (H9), Big picture → Rapid → Physical sensations (H12), Big picture → Non-conscious → Physical sensations (H13) and Big picture → Rapid → Non-conscious → Physical sensations (H14) were non-significant. Similar to the Positive affect models, in each path there is a non-significant co-efficient. This further supports the finding that affect has a central role in intuitive style and that positive affect may turn out to be the strongest mediator of the link between associative processing and the bodily sensations of physical sensations.

In terms of intuitive style, the tests of Damasio's (1999) somatic marker hypothesis indicate that information processed in an associative manner (big picture) triggers a positive emotional state (marker), in turn leading to a positive physical sensations. This may be because people may experience many positive emotional states in a broad range of contexts where the outcomes are positive that then lead to the positive somatic marker being easily activated as a habitual response to information. That is, the somatic marker hypothesis and its supporting evidence from neuroscience and physiological tests appears to explain part of intuitive style.

On the other hand, the results for the negative affect models were very weak. This may be because negative affective markers, possibly formed from the fear system (Damasio, 1999), may not be triggered often enough in everyday life to form a strong somatic marker and therefore may not be used habitually as a style. Everyday life would not be considered as fear inducing for the majority of people and thus may not trigger the involvement of a negative somatic marker. On the other hand, everyday life may offer many opportunities for reward and positive affective states, thus resulting in a measurable difference between positive and negative somatic markers in intuitive style.

Moreover, the difference between positive and negative somatic markers may turn out to be an area of fruitful future research. In particular, using strong positive, weak positive, strong negative, weak negative and neural stimuli and measuring physiological changes in heart rate and skin conductance along with psychological measures may help to further delineate the boundaries of somatic markers in intuitive style. The stimuli would need to be well thought through and perhaps the use of virtual reality technologies may offer options for delivering stimuli as a first-person experience that potentially mimics real life in a way that other stimuli, such as video, cannot do. Virtual reality options are currently being investigated as a way of delivering therapy for post-traumatic stress disorder because of the direct first-person experience of the stimuli (Rizzo et al., 2011). Future research could take advantage of ongoing technological advancement in virtual reality to further hone our understanding of intuitive style.

7.6.2 X-System (Lieberman, 2000) Based Self-Report Model

This neurological theory suggested components of intuitive cognitive style should be processed in a specific order such that observed non-verbal cues lead to affective states through a cascade of non-conscious then rapid processing of information. Models for positive and negative affect were tested.

7.6.2.1 Positive affect model

Model 16. Observed non-verbal cues → Non-conscious → Positive affect (H16)

This model supported Lieberman’s (2000) neurological evidence that observed information is then processed non-consciously through the ventromedial prefrontal cortex which then triggers the involvement of the amygdala resulting in an affective state. This model is the first model to test the idea that the processes involved in intuitive style may be contextually determined. In this case, the context is social and the cascade beginning with observed non-verbal cues, that many people process automatically and below the level of effortful thinking, differs from previous models that have started with big picture associative processing. The value of the indirect effect was near zero indicating a relatively small effect.

The Observed non-verbal cues → Rapid → Positive affect (H15) and the Observed non-verbal cues → Non-conscious → Rapid → Positive affect (H17) models were non-significant. This may be because rapid may be subsumed by the non-conscious construct. Perhaps people are aware that they automatically process their observations of others non-verbal cues and do not notice, therefore are unable to report, that they do so in a rapid manner. Or perhaps the rapid processing of observed non-verbal cues is not something that people consider. The next set of models using negative affect may help to support these findings.

7.6.2.2 Negative affect model

Model 19. Observed non-verbal cues → Non-conscious → Negative affect (H19)

This model was statistically significant and of a similar strength to that of the positive affect model presented above. The result for this model adds further to the evidence supporting Lieberman's (2000) model as well as laying a foundation of evidence for intuitive style as a set of processes for which different aspects are triggered depending on the context of the situation. The value of the indirect effect was not close to zero indicating a relatively medium effect.

The Observed non-verbal cues → Rapid → Negative affect (H18) and the Observed non-verbal cues → Non-conscious → Rapid → Negative affect (H20) models were found to be non-significant. This finding mirrors that of the corresponding positive affect models. This suggests that the Rapid construct may turn out to be superfluous.

7.7 Cognitive Models

7.7.1 Associative System (Sloman, 1996)

This theory suggests that intuitive processes are associative and activate rapid and non-conscious processing leading to physical sensations as presented in Section 6.3.2. The variables rapid and non-conscious were swapped to form a plausible alternative model. The following hypotheses were tested:

H21: Big picture processing leads to rapid processing that in turn leads to physical sensations

H22: Big picture processing leads to rapid processing that in turn leads to non-conscious processing that in turn leads to physical sensations

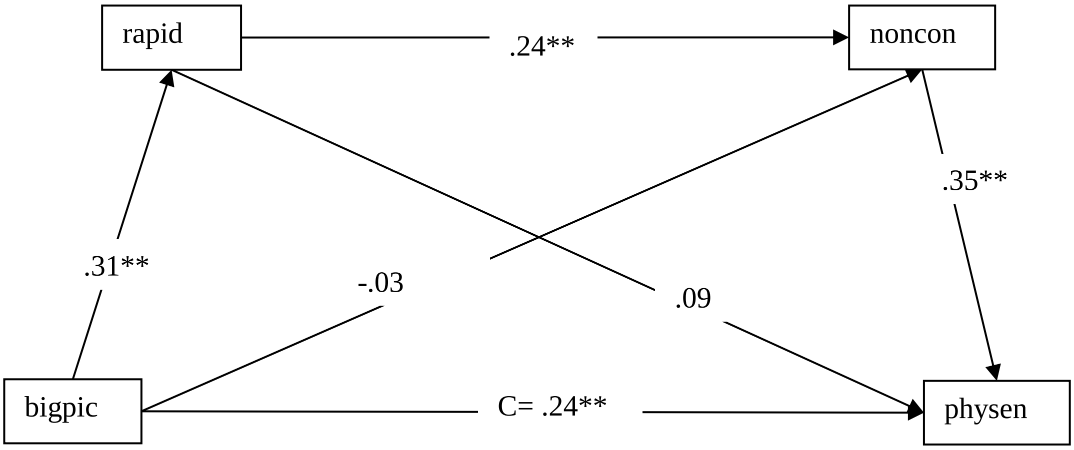
H23: Big picture processing leads to non-conscious processing that in turn leads to physical sensations

Alternate Models

H24: Big picture processing leads to non-conscious processing that in turn leads to physical sensations

H25: Big picture processing leads to non-conscious processing that in turn leads to rapid processing that in turn leads to physical sensations

H26: Big picture processing leads to rapid processing that in turn leads to physical sensations



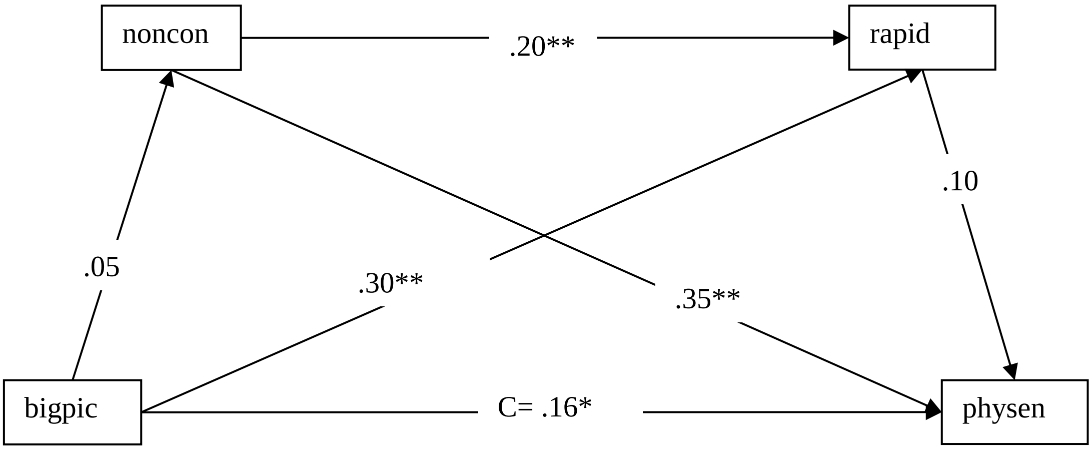
*$p < .05$, **$p < .001$, C= total effects

Figure 19. Co-efficients for the Associative System (Sloman, 1986) Model (n = 343)

Table 34. Direct and Indirect Effects of Big picture on Physical Sensations for Associative System (n=343)

		Direct effect on Physical sensations	Indirect effect on Physical sensations (Bootstrap Standard Error)
	Big Picture	.20 (.08), $p = .01$	
H21	→ Rapid →		.03 (.02)
H22	→ Rapid → Non-conscious →		.03 (.01)*
H23	→ Non-conscious →		-.01 (.03)

* $p < .05$



*p< .05, **p<.001, C= total effects

Figure 20. Path Co-efficients for Alternate Order of Variables in Associative System Model (n=343)

Table 35. Direct and Indirect Effects of Big Picture on Physical Sensations for Alternate Order of Variables in Associative System Model (n=343)

		Direct effect on Physical sensations	Indirect effect on Physical sensations (Bootstrap Standard Error)
	Big Picture	.20 (.08), $p = .01$	
H24	→Non-conscious →		.02 (.03)
H25	→ Non-conscious → Rapid →		.001 (.002)
H26	→ Rapid →		.03 (.02)

7.8 Discussion of Cognitive Models

7.8.1 Associative System (Sloman, 1996) models

The Associative system theory suggested that processing of information begins by drawing on a wide associative network of related information that is then processed rapidly and non-consciously to result in an intuition. In terms of intuitive style, the intuition term was thought of as the physical sensations outcome of intuitive style processes. In addition, the Associative System model was thought to be more applicable to non-social data due to the description provided by Sloman (1996). For this reason, the social variables of intuitive style (observed non-verbal cues, positive and negative affect) were not modelled as part of the Associative System.

The hypothesis that big picture would lead to rapid then non-conscious processing, in turn, leading to physical sensations was supported. The hypotheses that big picture would lead to rapid processing, in turn, leading to physical sensations and big picture leading to non-conscious processing, in turn, leading to physical sensations were not supported. None of the alternative order variable models for the Associative System were supported.

Model 22. Bigpic → Rapid → Non-conscious → Physical sensations (H22)

This model supports that contention that the Associative System processes information in an associative manner, rapidly, at a level that is non-conscious and that leads to physical sensations. This model was re-framed as an intuitive style process. In terms of intuitive style, this model suggests that it may be appropriate to consider the intuitive style process as initiated by a network of features of concepts that then trigger rapid and non-conscious processing of the information in turn leading to a physical sensation. In addition, the findings from this model provide the initial evidence for the notion that context may drive the selection and inclusion of intuitive style components. This model showed a significant indirect effect. The value of the indirect effect was moving away from zero indicating a relatively medium effect.

The Big picture → Rapid → Physical sensations (H21) and Big picture → Non-conscious → Physical sensations (H23) models were non-significant as were all the alternate order variable models. This may be because there were non-significant path coefficients in these models. These non-significant results add to those found for the Somatic Marker Hypothesis and System X models and when take together suggest that there may be an order to the rapid and non-conscious aspects of intuitive style.

7.9 Exploratory Modelling: A Complete Intuitive Style Process

Based on the results of the somatic/affective and cognitive models presented above in Sections 7.6 and 7.7, a complete process model for the experience of intuitive style was developed. The model begins with the Big Picture component, representing associative processing, supported by evidence from X-System (Lieberman, 2007), the Somatic Marker Hypothesis (Damasio, 2005) and the Associative System (Sloman, 1996). In these models, the psychological experience is carried by the underlying associative neural circuitry, which appears to be the stable way in which intuitives process all incoming information, regardless of the type of information. The positive and negative affective states were shown in the above models to be significant variables in the modelling consistent with the neurological approach integrating affect with cognition and body (Damasio, 1999). The rapid component appeared to have the strongest effect in the cognitive models, suggesting that intuitives are more likely to notice the intuitive experience as being affective and rapid rather than non-conscious. Observed non-verbal cue variable was also shown to be a significant variable in the modelling. As in the previous modelling, separate models were run for each of negative and positive affect. The following hypotheses were tested:

Positive Affect Hypotheses

H27: Big picture leads to positive affect that in turn leads to physical sensations

H28: Big picture leads to positive affect that in turn leads to observed non-verbal cues that in turn leads to physical sensations

H29: Big picture leads to positive affect that in turn leads to observed non-verbal cues that in turn leads to rapid processing that in turn leads to physical sensations

H30: Big picture leads to positive affect that in turn leads to rapid processing that in turn leads to physical sensations

H31: Big picture leads to observed non-verbal cues that in turn leads to physical sensations

H32: Big picture leads to observed non-verbal cues that in turn leads to rapid processing that in turn leads to physical sensations

H33: Big picture leads to rapid processing that in turn leads to physical sensations

Negative Affect Hypotheses

H34: Big picture leads to negative affect that in turn leads to physical sensations

H35: Big picture leads to negative affect that in turn leads to observed non-verbal cues that in turn leads to physical sensations

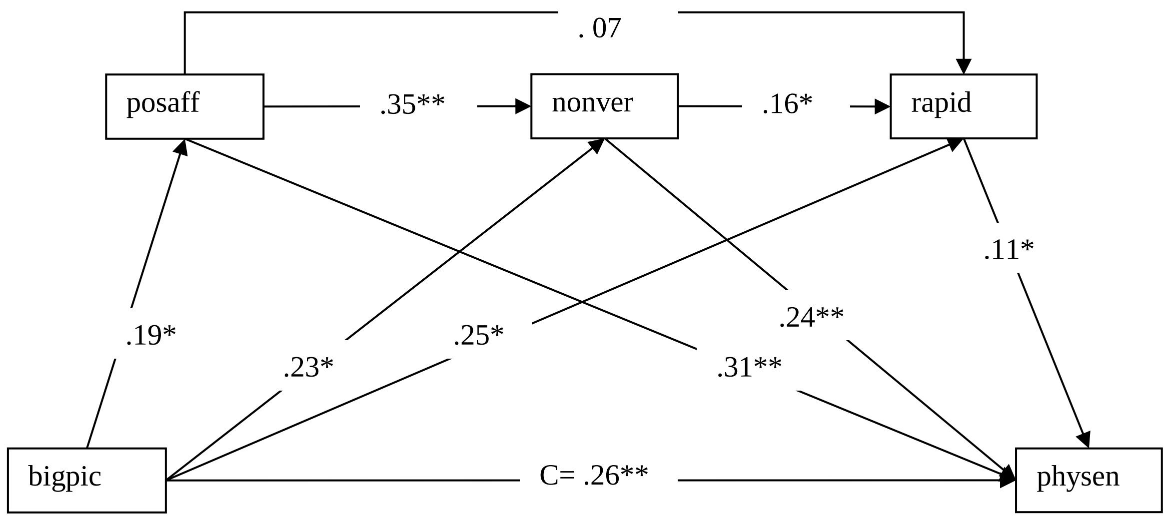
H36: Big picture leads to negative affect that in turn leads to observed non-verbal cues that in turn leads to rapid processing that in turn leads to physical sensations

H37: Big picture leads to negative affect that in turn leads to rapid processing that in turn leads to physical sensations

H38: Big picture leads to observed non-verbal cues that in turn leads to physical sensations

H39: Big picture leads to observed non-verbal cures that in turn leads to rapid processing that in turn leads to physical sensations

H40: Big picture leads to rapid processing that in turn leads to physical sensations



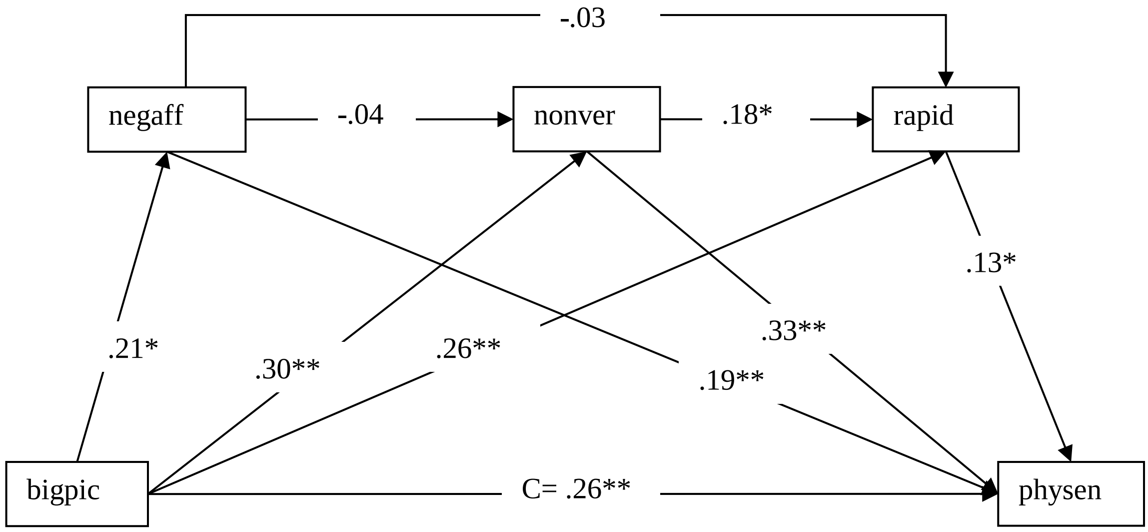
*p< .05, **p<.001, C= total effects

Figure 21. Path Co-efficients for Complete Intuitive Style Model (Positive Affect) (n = 340)

Table 36. Direct and Indirect Effects of Big Picture on Physical Sensations for Complete Intuitive Style Model (Positive Affect) (n =340)

		Direct effect on Physical sensations (n=340)	Indirect effect on Physical Sensations (Bootstrap Standard Error)
	Big Picture	.10 (.08), *p*=.21	
H27	→ Positive affect →		.06 (.03)*
H28	→ Positive affect → Observed non-verbal →		.02 (.01)*
H29	→ Positive affect → Observed non-verbal→ Rapid →		.001 (.001)*
H30	→ Positive affect → Rapid →		.00 (.00)
H31	→ Observed non-verbal →		.05 (.02)*
H32	→ Observed non-verbal → Rapid →		.004 (.003)*
H33	→ Rapid →		.03 (.02)*

* $p < .05$



*p< .05, **p<.001, C= total effects

Figure 22. Path Co-efficients for Complete Intuitive Style Model (Negative Affect) (n = 340)

Table 37. Direct and Indirect Effects of Big Picture on Physical Sensations for Complete Intuitive Style Model (Negative Affect) (n =340)

		Direct effect on Physical sensations (n=340)	Indirect effect on Physical Sensations (Bootstrap Standard Error)
	Big Picture	.08 (.08), *p*=.30	
H34	→ Negative affect →		.04 (.02)*
H35	→Negative affect → Observed non-verbal →		.00 (.00)
H36	→Negative affect → Observed non-verbal→ Rapid→		.00 (.00)
H37	→Negative affect → Rapid →		.00 (.00)
H38	→ Observed non-verbal →		.10 (.03)*
H39	→ Observed non-verbal →Rapid →		.01 (.00)*
H40	→Rapid →		.03 (.02)*

* $p < .05$

7.10 Discussion Complete Intuitive Style Models

Because much of the discussions presented above for the previous models is relevant to the current section and it would be superfluous to repeat the same, this discussion will focus on the top three models from each of positive and negative affect.

7.10.1 Positive Affect Modelling

Model 27. Big picture → Positive affect → Physical sensations (H27)

Again, this model turned out to be the most parsimonious explanation, as was shown in Somatic/Affective models. There has been a slight increase in the value of the indirect effects by .01 from the Positive Affect Somatic Marker Model (Table 30), *not close to zero*, showing that the effect was of medium strength.

Model 31. Big picture → Observed non-verbals → Physical sensations (H31)

This is the first model in which observed non-verbal cues was shown to be a mediator. This suggests that a) the Big Picture component is the preferred method of processing, mirroring the underlying, possibly dominant, associative neural processes in intuitive style as indicated by earlier cognitive style research (e.g. Allinson & Hayes, 1996) and b) observed non-verbal cues are an important factor in the experience of intuitives. The value of the indirect effect in this model was similar to that of Model 27 showing that the effect was of medium-small strength.

Model 33. Big picture → Rapid → Physical sensations (H33)

The outcome of the current model contrasted to that of the model shown in the Cognitive Models section, where the indirect effect was non-significant. Perhaps this is because the current model more directly reflects the intuitive style process, incorporating the cognitive, somatic and affective aspects together, than the Cognitive model could ever do. The value of the indirect effect in the model was *towards zero*, being considered a small effect.

7.10.2 Negative Affect Modelling

Model 38. Big picture →Observed non-verbals → Physical sensations (H38)

This model showed the strongest indirect effect size of all the models in the current chapter. The value of the indirect effect in the model was *far away from zero* at .10 showing the effect was of a large size. In the negative affect model, observed non-verbal cues appear to play a large role in the intuitive process. Perhaps this is because intuitives pay more attention to observed non-verbal cues that may lead to negative outcomes, than they do those that may lead to positive outcomes, for the purpose of managing the social interaction in a more positive manner. This would be consistent with the findings from the X-System modelling above. However, the flight/fight/freeze component thought to be part of the negative affect process in intuitive style is one that has a strong automatic neural circuitry foundation (Damasio, 2005) which may explain why the current finding is so strong in comparison to the positive affect modelling.

Model 34. Big picture → Negative Affect → Physical sensations (H34)

This model was consistent with previous modelling, the current chapter, that demonstrated the role of negative affect in triggering physical sensations. The value of the indirect effect was *not close to zero* showing the effect was of a medium strength.

Model 40. Big picture → Rapid → Physical sensations (H40)

Similar to the Positive Affect modelling in the current section, this model appeared to more directly reflect the intuitive style process when the somatic, affective and cognitive aspects are taken together. The value of the indirect effect was *close zero* showing that the effect was of medium-small strength.

7.11 General Discussion

The aim of this chapter was to statistically test process models of a psychoneurobiological-based multidimensional intuitive style, including models that represent the complete process. Two categories of models were tested, somatic/affective and cognitive, that yielded mixed results. Models in each of the two categories were derived from existing theories that have links to intuition and were re-framed in this thesis to help explain intuitive style as a process. Support was demonstrated for the Complete Intuitive Style model via aspects of the Somatic Marker Hypothesis (Damasio, 2005), X-System (Lieberman, 2007) and Associative System (Sloman, 1996) models. Each model was discussed in turn at the end of the corresponding results section and the current section will return to a broader discussion of intuitive style as a process. In general, the intuitive style process appears to begin with the big picture component responsible for associative processing that then triggers positive or negative affect and rapid components yielding physical sensations.

7.11.1 Physical Sensations and the Somatic Marker Hypothesis

In the process model, the bodily sensations that individuals experience when they engage in intuitive style were represented by the physical sensations component. Furthermore, the review of the literature for the process models indicated that physical sensations should be placed as the outcome of the intuitive style process. Using physical sensations as the outcome for the process models was consistent with descriptions of intuitive style as a gut feel across a number of different measures (e.g. Cognitive Style Index, Preference for Intuition or Deliberation) and with the reported experience of the process.

Furthermore, the current research went beyond previous thinking by integrating evidence from neuroscience and cognitive psychology with style research to propose potential mechanisms of dispositional physical sensations. Indeed, the Somatic Marker Hypothesis (Damasio, 1999) presented a parsimonious and substantive explanation for a mechanism of physical sensations in intuitive style. The Somatic Marker Hypothesis is a process model that integrates cognition, emotion and bodily states in thinking and addressed physical sensations as an outcome of a psychoneurobiological process. The current research pitted a number of alternative models, formulated from the Somatic Marker Hypothesis, against each other as mechanisms to explain physical sensations in intuitive style. Models for positive affect were tested separately from those of negative affect as it was thought that triggering both types of affect at the same time would be unlikely. Of the somatic/affective models tested, simple mediation of the relationship between big picture and physical sensations by positive affect resulted in the strongest indirect effect, followed by positive affect triggering non-conscious processing yielding physical sensations. In the alternative negative affect models, negative affect triggered non-conscious processing that then triggered physical sensations; negative affect also triggered non-conscious and rapid processing yielding physical sensations.

Moreover, the current research represents the first known test of the Somatic Marker Hypothesis (Damasio, 1999; 2005) formulated in terms of psychometrics, as previous research has directly tested for somatic markers in terms of physiological changes (e.g Bechara et al., 1996). Since somatic markers are thought to be mental re-representations of the 'as-if-body' loop, somatic markers should be amenable to psychometric measures. Whether or not the psychometrics reflect, to some degree of accuracy, the physiological changes remains an open question and potentially an area of fruitful research. Testing for physiological changes together with the current intuitive style measure should help to further delineate the process. In terms of intuitive style, the somatic marker hypothesis helps to explain the reason why intuitives react with bodily feelings to all types of information.

One issue to consider is the underlying assumption that intuitive style is considered to be a stable, habitual way of processing all types of information which is consistently seen in the current modelling, particularly in the complete models of the intuitive style process. However, in the literature on intuitive style there seems to be no reasonable explanation as to why physical sensations should become a stable, habitual way of responding to information. The Somatic Marker Hypothesis appears to be a plausible explanation for such a process. If, as Damasio (1999) suggests, the somatic markers have an evolutionary basis that promote survival then it seems to be appropriate to suggest that somatic markers can account for the stable preference of physical sensations in intuitive style. Moving on from the neurobiological perspective, attachment processes may also play a role in the development of physical sensations. Differences in attachment types were shown to be associated with an alternative measure of intuitive style and this relationship should be investigated in future research.

Understanding that physical sensations don't just magically appear but have a neurological basis should help to further explain how intuitive style operates in life. In particular, it explained why the research has shown that those with an intuitive style are not able to articulate the steps in their thinking (Allinson & Hayes, 1996; Priola, Smith, & Armstrong, 2004) and respond in a so-called ‘emotional’ way towards information. The current results showed that the inability to articulate steps in thinking should not be seen as a deficit but as a different way of processing information as should the affective states involved in intuitive style. Moreover, the operation of physical sensations in specific circumstances may turn out to be the most appropriate method of processing information. A number of anecdotes have highlighted instances when responding to physical sensations has saved lives. This is balanced by the evidence that being guided by physical sensations in business can be misleading (Kline, 2004). However, as Kline (2004) has stated, life is messy and in times when effortful, detailed thinking is not an option, physical sensations serve as a viable alternative for responding to information.

Along with physical sensations, affect appears to play an important role in intuitive style. The next section discusses the role of affect and details possible theoretical approaches that may be useful in future research.

7.11.2 The Role of Affect in Intuitive Style

In terms of a process model of intuitive style, affect appears to be the mechanism that explains the relationship between information and physical sensations. As C. S. Lewis (1955, p. 166) so eloquently described in the epigraph to this chapter, emotional states seem to involve the whole body. Although emotions have often been thought to be lesser than ratiocination in some way, emotions have played a central role in intuitiveness since its earliest conceptualisation (Dodds, 1964). Previous research (Allinson

& Hayes, 1996) accepted that affect was part of intuitive style and it seems that the understanding of brain functionality at the time, guided researchers to consider right-hemisphere dominance as an explanation linking affect with intuitive style (p. 122) which was a reasonable explanation at that point in time. The advent of new technology, particularly research on the connection between cognition and emotion using brain imaging, seems to have been foundational to understanding intuitive style as a multidimensional construct. So too, have the emerging understandings (Norris & Epstein, 2011; Hodgkinson et al., 2008) of the multidimensionality of constructs similar to intuitive style that have helped to position affect in a key role within the process model.

The Somatic Marker Hypothesis may provide the first known theoretical interpretation of the role of affect in intuitive style. Damasio (1999) suggested that in the first instance, the autonomic nervous system responses leading to positive and negative affective states, are triggered at the initial encounter with objects (or information). Damasio (1999) based this idea on an evolutionary perspective where survival may depend on the triggering of the flight/fight/freeze responses (fear system) and the pleasure/reward responses (reward system) when encountering danger or life-sustaining objects, respectively. Following the initial triggering of the respective system, a mental re-representation linking the bodily state (also known as interoception) and the object may be made and the mental re-representation, the as-if-body loop, may then be activated on subsequent interaction with the object leading to an increased chance of survival (Damasio, 1999. In this manner, affect becomes the mechanism through which processing information is linked to a gut feeling. Some research (Sze et al., 2010) suggested that people vary in their sensitivity to interoception, and perhaps it is not too greater leap to suggest that people may vary in the degree to which affect acts as a part of the as-if-body loop. Such theory should lead to testable hypotheses about individual differences in affect for intuitives and may prove to be a successful avenue of research at a later date. While the Somatic Marker Hypothesis presents a viable explanation for the role of affect in the process of intuitive style, the interaction of affective systems in social cognition also provides a reasonable explanation.

The neurology of social cognition X-System (Lieberman, 2000) included many affective system neural regions and the process of social cognition included affect. This process is most evident in the complete models of intuitive style where affective states and observed non-verbal cues that are part of being social were placed together in a cascade effect in the model. Perhaps this is not surprising given the extensive evidence from infant mental health that shows how affective states are central to the development of social concepts.

The extensive research of Alan Schore (2001a, 2001b, 2002, 2003a, 2003b) has laid the ground work for the role of affective states in infant mental health and is used here as a developmental perspective on the role of affect in the process of intuitive style. Schore (2001a) proposed that both positive and negative affective states are needed for balanced neurological development in infants. As part of this process, positive affective states are presented as a key mechanism in the development of the neurological structures and functions associated with self-concept and self-regulation. Evidence (Schore, 2001b) has shown that hormonal changes related to stress (fear system) and pleasure (reward system) in the infant are strongly associated with corresponding changes in neurology within the social interaction between the infant and the caregiver. Moreover, positive affective states seem to form the basis for the caregiver-infant relationship (Schore 2001a). Typical caregivers may initiate many more positive affective states than negative affective states in relation to the infant. The infant is thought to be able to make mental representations of affective states long before higher order cognitive functions are operational and that these mental representations of affective states incorporate representation of bodily states (Schore, 2001a). As part of this process, the infant may learn that positive affective states result in good outcomes and negative affective states result in bad outcomes. This may then form the foundation for the role of affect as part of intuitive style in adults. Indeed, as part of a larger study Epstein (1996) demonstrated the relationship between secure attachment and the experiential (intuitive processes) system and disrupted attachments and the rational (analytic processes) system.

In relation to the process of intuitive style, this developmental social cognitive perspective supports the predominant nature of affect in the intuitive style process. Overall, it appears that the Somatic Marker

Hypothesis may provide the best explanation for the role of affect triggering physical sensations in intuitive style. Having discussed the potential explanations for physical sensations and affect in intuitive style, the next section will take a closer look at the role of observed non-verbal cues.

7.11.3 The Role of Observed Non-verbal Cues in Intuitive Style

Intuitives have been shown to be social and to initiate social-emotional acts in the workplace (Armstrong & Priola, 2001). To better understand the reasons why intuitives are said to be social, observed non-verbal cues were proposed as part of the intuitive process. X-System (Lieberman, 2007) may provide one explanation as to why observing another's non-verbal cues activates the intuitive style system.

The thinking around X-System (Lieberman, 2007) is grounded in evolutionary approaches where X-System is thought to incorporate automatic processes that are linked to the response to danger and survival such that a distinction may be made between internal and external social cognitive intuition processes where external social cognitive processes are described as:

> *"… mental processes that focus on one's own or another's physical and visible features and actions that are perceived through sensory modalities and are experienced as part of the material world."* (p. 261)

In other words, the information has to be attended to in some form or another for X-System to process the information. In the case of intuitive style, this may mean that intuitives may selectively attend to social information coming in through the five senses. Previous research (e.g. Allinson & Hayes, 1996; Allinson, Armstrong & Hayes, 2001; Armstrong & Priola, 2001) has suggested that intuitives are highly social and like social environments. This may be because intuitives focus on observed non-verbal cues in social situations, being able to 'read' another, which then triggers the cascade effect resulting in physical sensations about a situation or person.

In terms of the complete model of intuitive style, the observed non-verbal cues component produced the strongest indirect effect in the negative affect model, contrary to previous suggestions that positive affect may turn out to be the strongest affective component. The current finding in the complete intuitive style model suggests that a negative affective trigger, linked to flight/fight/freeze, produces a strong focus on observed non-verbal cues that may act as a warning bell for social danger (Damasio, 1999), perhaps tapping into phylogenically older survival mechanisms.

X-System (Lieberman, 2000) appears to account for the apparent response of intuitives to their interaction with another. The observed non-verbal cues component in the process model of intuitive style is perhaps, responding to the integration of associative networks and the action of mirror neurons in social cognition thereby linking together distinct aspects of somatic makers and social cognitive intuition in intuitive style. However, X-System cannot explain physical sensations and some alternate model that encompasses both aspects needs to be considered.

7.11.4 The Role of Associative Networks in Intuitive Style

The Big picture component has featured in both the Somatic Marker Hypothesis and X-System explanations of intuitive style. The role of the big picture component has also featured prominently in previous theories of intuitive style (Allinson & Hayes, 1996) and has been supported by the findings of the current research project. In the current thesis, a theoretical explanation for the Big Picture component was sought to help build a substantive theory of intuitive style as a process model. The Associative System (Sloman, 1996) was used to provide the theoretical foundation for the big picture component of intuitive style and was viewed from the perspective of the cognitive dimension of it.

The Associative System theory (Sloman, 1996) states that information is distributed in an associative, or Big Picture, manner through the activation of all information relevant to the situation at hand. In terms of the theoretical development of a process model of intuitive style, this would mean that the activation of all relevant information in an associative manner would detail the first part of the Somatic Marker Hypothesis so that input of information via the senses activates the associative network leading to the triggering of the somatic marker. This explanation would account for the notion that some form of pattern-matching may be part of the big picture component of intuitive style (Sadler-Smith, 2009). The Associative System may help to explain the reason why intuitives like to have an overall view of things because of the preference to pattern match the new information with their existing mental re-representations. Sloman (1996) suggested that the Associative System matches similarities in the structure of information. Hence, when intuitives receive information and a close enough match occurs between the pattern represented mentally and the pattern of the new information, the somatic marker is triggered.

Although the Associative System explanation works well with the somatic markers, it may work equally well with X-System (Lieberman, 2000). In the X-System (Lieberman, 2000) model, information is said to be processed in an associative, or parallel, manner that may have originally facilitated survival responses. That is, the associative processing is rapid and bypasses the need for effortful thinking, resulting in a greater chance of survival. Some recent evidence (Jacobs & Klaczynski, 2002) from the judgment and decision making research suggests that young children and adolescents do use heuristic processing, possibly using part of X-System, in contexts similar to that of adults and that there appears to be a developmental trajectory of increased usage of heuristics throughout adolescence. Thus, the Associative System explanation helps to better delineate the experience of the Big Picture in intuitive style.

7.11.5 The Role of Rapid and Non-Conscious Components in Intuitive Style

The rapid and non-conscious components of intuitive style are also part of the Somatic Marker and X-System theories. From the current results, there is a noticeable difference between the roles of rapid and non-conscious components in a process model of intuitive style. This may be because people notice that their intuitive style provides outcomes that occur very quickly in comparison to effortful thinking – not their preference but nevertheless occurs in everyday life – and therefore the rapidity of their style is highlighted against effortful processing. On the other hand, the non-conscious aspects of intuitive style may not be as apparent because there are other cognitive processes (such as insight or implicit learning) that appear to happen at a non-conscious level and therefore the non-conscious component may not be as noticeable experientially. As a result, the rapid component was chosen to be part of the complete intuitive style model and it turned out to be a significant component facilitating the process in both negative and positive affect models.

However, further research needs to sort out the role the non-conscious component may play in intuitive style. It may be that non-conscious processing is incorporated into the rapid component.

7.11.6 The Role of Context in Intuitive Style

The current research demonstrated that there may be a number of feasible explanations for a process model of intuitive style. In investigating the potential for various theories to explain intuitive style as a process rather than as a global construct, it was noted in chapter six that it seems to operate in social and non-social contexts.

Previous research on intuitive style as one pole of the bipolar intuition-analysis construct (Allinson & Hayes, 1996) indicated that intuitives tend to be social and this idea was further supported by Armstrong and Priola (2001) who demonstrated that intuitives initiate more social acts. No explanations were provided as to the reasons why intuitives may be more social than analytics. The current thesis goes beyond previous research by seeking to apply theory from social cognition as an explanation for the social nature of intuitives.

In chapter six, it was suggested that context may play an important role in the intuitive style process, particularly in regard to determining which components of the process model are activated. Indeed, the complete intuitive style models seem to indicate that the observed non-verbal component may be bypassed when in non-social situations. This would mean that the affective component and/or the rapid component may be active in non-social contexts.

Differences between social and non-social contexts may be highlighted for intuitives given the potential role of observed non-verbal cues as part of the intuitive style process. According to the theory of cognitive style in which intuitive style is situated, cognitive style is responsible for the type of information individuals select and attend to (Messick, 1976). By way of an analogy, intuitive style acts like a filter or lens through which intuitives view the world around them. This means that when information comes in via the senses, intuitives have a preference for information that fits with their style. Taking a X-System (Lieberman, 2000) approach to this, intuitives should then focus on the non-verbal cues they are observing in others, as suggested by the results of the negative affect complete model, and that they would have a preference for initiating social and emotional acts as found by Armstrong and Priola (2001). It may also account for the associations between intuitives and occupations that are social and this association will be tested in the next chapter. Thus, it appears from the current research that tentative conclusions may be drawn about the role of context in triggering different initial components of intuitive style. However, this does not mean that an individual has a different style for different occasions. Intuitive style remains dispositional and context serves only to trigger different components.

7.12 Limitations

In general, style research is often conducted separate from other areas of psychology. Drawing on other areas of psychology to build a process model of intuitive style may be a weakness in this research because it is difficult to know if the results capture only intuitive style and no other constructs. Moreover, it may turn out that the ICSS is nothing more than a way of measuring the frequency of an individual's use of social cognition, somatic markers and associative processing together and doesn't really measure a preferred way of processing information.

In the literature review, it was stated that intuitive style was measured as one pole of a bipolar intuition-analysis construct. The current thesis has suggested that it may be better to conceptualise intuitive style as a psychoneurobiological-based multidimensional process construct. Although a psychoneurobiological-based multidimensional process view of intuitive style may best define the construct, it may not yield better results than the bipolar approach. This is because a multidimensional process model is complex and capturing the operation of intuitive style in real life may turn out to be difficult. It is likely that some aspects of the intuitive experience will not be captured by psychometric instruments. It may be best to limit measuring intuitive style to the physical sensations, big picture, affective and observed non-verbal cues components as these components appear to capture most of the process and experience of intuitive style. Physical sensations, big picture and affective components reflect the somatic/affective and cognitive dimensions of intuitive style as well as capturing the social and non-social operations. In addition, a psychoneurobiological-based multidimensional process model of intuitive style may not address the mixed results for gender, seniority and tenure shown in the literature review because of the complexity of the process model developed in this thesis. In addition, there are a number of limitations to this research such as the use of self-report questionnaires, sample type, lack of replication and statistical issues.

7.12.1Research Methods

7.12.1.1 Self-report questionnaire

The data were collected by self-report questionnaire for the current thesis. This method relies on participant's self-knowledge and research shows that individuals are often inaccurate in their understanding of self. In addition, questionnaire data are subject to social desirability where the participants give the answers they think the researcher wants leading to biased data. To address this, social desirability was measured as a separate variable and the association between social desirability and the intuitive style components were examined. It was demonstrated that one component, big picture, was subject to social desirability. However, the degree of association between big picture and social desirability was small.

Although the use of self-report data to investigate process models of intuitive style has its limitations, it would be difficult to find an alternative means of assessing participants experience of intuitive style because the data are introspective. Future research should seek to use a broader set of outcome measures, particularly behavioural measures to assess intuitive style as a multidimensional process.

7.12.1.2 Sample type

The sample may not be representative of intuitives in general, coming mainly from educational and healthcare settings. Future research should seek to include a wide range of occupational groups. In addition, the majority of the sample was Australian and different ethnic backgrounds may interpret the ICSS in a different manner and future research should seek to include participants of different ethnic backgrounds. Thus, the results of the current research may not turn out to be generalisable to the general population of intuitives.

7.12.1.3 Replication

No attempt was made at replicating the results of the process modelling because of the sample size. In process modelling, bias corrected and accelerated bootstrapped confidence intervals are best performed on very large samples (5000). The sample size of 509 was reduced to 320 on occasions due to missing data. The PROCESS macro has the option of bootstrapping with replacement to generate data for 5000 cases. It is possible that bootstrapping with replacement may exaggerate and perpetuate errors in the data through to the statistical result leading to biased outcomes. Similarly, test-retest reliability needs to be addressed and is considered to be a weakness of the current research as no longitudinal data were collected due to the difficulty in getting a large enough sample.

7.12.1.4 Multitrait Multimethod

In an ideal world the current research would have been strengthened by a multitrait multimethod approach. Multitrait multimethod enables the connecting of different types of data to a single construct. The current research may have benefited from a task approach (Rayner, 2011) as well as the measurement of state and trait based affect to determine any influence of these characteristics on intuitive style. Furthermore, combining the current intuitive style measure with some form of physiological measurement would be an additional method that could be used in measuring intuitive style.

7.12.1.5 Statistical analyses

To date, no statistical method can accurately reflect the complexity of mental processes such as intuitive style. Therefore, error is an inherent part of the current research. This type of error is not one that can be controlled for and may only be partially ameliorated by tightly controlling the statistical analysis. In this case, the steps taken during data screening and preparation produced variables that were multivariate normal. The application of PROCESS introduces further opportunities for error into the analysis. Because the current research is observational, causality has not been claimed as per experimental research. Moreover, the use of mediation in non-experimental research has been criticised due to the lack of manipulation of the mediator and the increase in bias in effects (Bullock & Shang, 2011). In particular, the increase in bias in effects may be due to unobserved variables. Furthermore, because the current research used observed variables and not latent variables, the potential influence of unobserved error in the model was not captured. Any unobserved error may turn out to be responsible for the indirect effects in the model thus yielding poor results. To overcome this issue, the current research needs to be replicated and studied from a latent model perspective.

7.12.1.6 Plausible Alternative Models

Although a number of plausible alternative models were tested for each theory, there remain unobserved alternative models that were not tested in the current research. Alternative models provide alternative explanations for the data and therefore any inferences made from the current models may turn out to be invalid if an alternative model provides a better explanation for the data. As noted by MacCallum et al. (1993, p. 196) the presence of equivalent models "presents a serious challenge to the inferences typically made by researchers".

7.12.1.7 Unobserved Covariates

Spurious associations may also explain the results because some unobserved covariate may be responsible for the mediator and the outcome variables and lead to biased estimates. Potential covariates may include other cognitive styles such as verbaliser and visualisers (object and spatial). The verbaliser and visualiser cognitive styles may be thought of as acting at a sensory level, thus determining what information is selected and attended to for processing. In this way, verbaliser and visualiser cognitive styles may turn out to be covariate(s) in the intuitive process model by causing the mediator and outcome variables.

7.12.1.8 Unobserved Intermediary Variable

In addition, there may be some other variable that is the true intermediary variable between the predictor and outcome variables for each of the theories tested (Judd & Kenny, 1981). In the current research, an unobserved true intermediary variable may account for the process model of intuitive style. One plausible true intermediary may be state-trait affect, particularly state-trait positivity. Since the current research was exploratory in developing a process model of intuitive style, it was not known prior to the scale construction and validation section of this study (Chapter 5), which of the components of intuitive style may turn out to be central to the process model. Moreover, the load on the participants was managed carefully, given the number of items in the Strong Interest Inventory, so that a balance was created between variables chosen to help bound the intuitive process model and the occupational variables needed to understand more about a psychoneurobiological-based multidimensional intuitive style.

7.12.1.9 Bootstrapped Confidence Intervals

A number of limitations to percentile bootstrapping are recognised. Bootstrapping relies on the assumption that the distribution of the sample closely approximates that of the population. Therefore, sample size has an influence on the results of the bootstrap. Further, according to MacKinnon et al. (2004) multiple bootstraps on the same sample will not return the same confidence intervals, meaning that a single bootstrap procedure needs to be taken as evidence without the need for replication. In addition, Biesanz, Falk and Savalei (2010) have shown that bias corrected and accelerated (BCa) bootstrapping may result in an increased Type 1 error rate. While this may be the case in a Monte Carlo style simulation, Hayes (2011) suggests that BCa remains the best method for developing confidence intervals when the distribution of the confidence interval may turn out to be non-normal as it may be in the current research.

7.12.1.10 Effect Size

Preacher and Kelley (2011) note a number of limitations about effect sizes, particularly the nature of the effect size as it is interpreted in the context of the research where small effect sizes may be of substantive practical importance and large effect sizes may hold no substantive practical importance. In the case of the intuitive style process model, small effect sizes were expected in line with the type of variables under investigation. The practical significance of the effect sizes in the current research may turn out to be of no import because it may be the components of intuitive style, physical sensations, positive emotions and associative processing, that hold any value in real-life rather than the size of the effect.

In addition, for effect sizes the characteristics of the data are particularly sensitive to outliers and violations of assumptions of normality. This was addressed in the preliminary data screening and cleaning. A few outliers were found, however, they were included in the data analysis to better understand the experience of intuitive style. Although a few outliers may have adversely biased the effect size, the use of bias correction and accelerated bootstrapped confidence intervals took into account any non-normal standard error distributions generated from the data. Thus, the effect sizes should be interpreted with care and future research should seek to explore effect sizes in an intuitive style process model through replication regardless of statistical significance.

Conclusion

This chapter sought to test psychoneurobiological-based multidimensional process models of intuitive style. A number of theories were used as models to statistically test aspects of a process model of intuitive style. Based on the findings from the research, it was shown that intuitive style can be modelled as a process rather than as a global variable, thus building on earlier work and moving the research base forwards. Competing models were tested for each theory and a number of models were found to be statistically significant. Effect sizes and confidence intervals were generated for each model with bootstrapped standard errors. The strongest effect size was for the intuitive process that began with the big picture component, leading to positive affect, resulting in a physical sensation. A second model that included non-verbal cues as the initiating component triggering the big picture component resulting in positive affect turned out to be a viable option. These results appeared to support the notion that different components of intuitive style may be triggered in social and non-social contexts, thus advancing the theoretical base of intuitive style. Although there are a number of limitations to the current research, these limitations allow for future research to take place and create many opportunities to further investigate a process intuitive style.

"We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time."

T.S. Eliot (1943) "Little Gidding V, The Four Quartets"

Chapter 8

Intuitive Style and Occupational Variables

Introduction

This chapter presents an exploratory investigation of the relationship between the physical sensations component of intuitive style and occupational variables. The preceding chapters developed a new scale to measure the experience of intuitive style and then formed a psychoneurobiological-based multidimensional process model of it where physical sensations were the outcome of the process model. The current chapter returns to occupational variables to, as Eliot (1943) implies, see the research from a fresh perspective. The current chapter looks at the ways in which the five factor model of personality traits may turn out to be the mechanisms through which intuitive style is linked to aspects of job satisfaction.

To compare the current intuitive style psychoneurobiological-based multidimensional process model with previous research, associations between the Physical Sensations component of the ICSS and job satisfaction will be examined. It should be noted that the links between intuitive style and aspects of job satisfaction were found for the bipolar intuition-analysis construct (Allinson & Hayes, 1996; Brigham, De Castro, & Shepherd, 2007) and may not be replicated for the current intuitive style process model thus leading to analyses that have an exploratory flavour.

8.1 Multiple Mediation Modelling

8.1.1 Intuitive Style and Job Satisfaction

A small positive of association was demonstrated between a global measure of job satisfaction and the analysis pole of the bipolar intuition-analysis (Allinson & Hayes, 1996) construct for a small (n=56) group of junior employees in a brewery company. The evidence from Allinson and Hayes (1996) suggests that the relationship between intuitive style and job satisfaction should be small and in the negative direction to take into account the bipolar intuition-analysis structure. That is, the analysis pole was found to be positively associated with job satisfaction.

8.1.2 Intuitive Style and Personality Traits

In Chapter 5, the associations between personality traits and intuitive style components were demonstrated. However, these associations between personality traits and ICSS Physical Sensations were no greater than chance (i.e. less than .30). The association between personality traits and ICSS physical sensations component is replicated in the results section for ease of reading.

However, the intuition pole of intuition-analysis was found to be negatively associated with a measure extraversion (Allinson & Hayes, 1996). That is, the analysis pole was found to be positively associated with extraversion, forcing the intuitive pole to be associated with introversion due to the bipolar nature of the construct. Thus, investigating the relationship between physical sensations and personality traits may not support earlier findings. This is because there are strong indications in the literature (e.g. Armstrong & Priola, 2009; Damasio, 2005; Downey et al., 2006; Epstein et al., 1996; Priola et al., 2004) that intuitive style should be associated with being social.

8.1.3 Personality Traits and Job Satisfaction

The relationship between personality traits and job satisfaction is long-standing with substantial support in the research base (Judge, Heller, & Mount, 2002) and will not be examined in detail for this thesis as the focus of the current research is to develop a process model of intuitive style. In a meta study, Judge et al. (2002) demonstrated correlations between global job satisfaction and the five factor model of personality traits varied with personality traits and calculated expected correlations with job satisfaction of .25 for Extraversion and -.29 for Neuroticism that may be generalisable across studies. Correlations with job satisfaction for Agreeableness (r = .17), Conscientiousness (r = .26) and Openness (r = .02) were shown not to hold across studies in the meta analysis. For the current purpose, the well-established positive relationships between extraversion, agreeableness, conscientiousness and openness with aspects of job satisfaction and the negative relationship between neuroticism and aspects of job satisfaction demonstrated by Judge et al. (2002) will be accepted. The following hypotheses were developed from evidence provided in Sections 3.2.1 and 3.3.

It was hypothesised that:

a) Extraversion would mediate the relationship between ICSS Physical sensations and facets of Job Satisfaction

b) Agreeableness would mediate the relationship between ICSS Physical sensations and facets of Job Satisfaction

c) Conscientiousness would mediate the relationships between ICSS Physical sensations and facets of Job Satisfaction

d) Neuroticism would have a small negative effect on the relationships between ICSS Physical sensations and facets of Job Satisfaction

e) Openness would mediate the relationships between ICSS Physical sensations and facets of Job Satisfaction

8.2 Method

The same data collected in Survey 2 were used here to assess the influence of personality traits on the relationship between ICSS Physical Sensations and aspects of job satisfaction. Survey 2 was administered in two parts where two different websites were used to host different parts of the survey. Participants completed the first part of the survey (regarding occupational interests not reported in this thesis) and were then automatically redirected to the remaining instruments on the second website (SurveyGizmo). The instruments on the second website included the ICSS, the Job Satisfaction Survey and the Big Five Inventory. Throughout both parts of the survey, participants were able to save and return to the website via a direct url provided to their email address.

8.2.1 Instruments

In addition to the ICSS physical sensations and the Big Five Inventory (BFI: see Chapter 5 for instrument details), the Job Satisfaction Scale was used. The descriptives for the Job Satisfaction Scale can be found in Appendix H on the CD.

8.2.1.1 Job Satisfaction Scale (JSS: Spector, 1985)

The JSS is a multidimensional measure of job satisfaction tapping nine facets of which three facets, satisfaction with work (job tasks), satisfaction with supervisor (immediate supervisor) and satisfaction with co-workers (people you work with), were used in the current research. Participants respond to items such as “I like the people I work with” or “I have too much paperwork” on a six-point Likert-type scale ranging from “Strongly Disagree” to “Strongly Agree”. The reported internal consistencies of the subscales are good: Satisfaction with work $\alpha = .78$, Satisfaction with supervisor $\alpha = .82$ and Satisfaction with co-workers $\alpha = .60$. The items in each subscale are summed to give a total score for that subscale (Spector, 1999, 2001).

8.2.2 Statistical Analysis

Instead of testing single mediator models, with the associated increase in familywise error rates, Preacher and Hayes (2008) documented a method for testing multiple parallel mediators in a single model (see Figure 23), where mediators are assessed together, reducing the familywise Type I error rate that would normally be controlled by Bonferroni correction. Not only is the error rate controlled, but also multiple parallel mediation has the added benefits of pitting alternative theories against one another in a single model as well as investigating pairwise contrasts of indirect effects in the model in addition to testing total and indirect effects (Preacher & Hayes, 2008). Using the current research as an example, this means that the five factors from the Big Five personality traits can be modelled together as mediators in a single model. All pairwise contrasts of indirect effects using the five factors can be tested to answer the question: Which of the five personality traits is the strongest mediator of the relationship between job satisfaction and intuitive style? This provides greater detail than a set of five single mediator models can do.

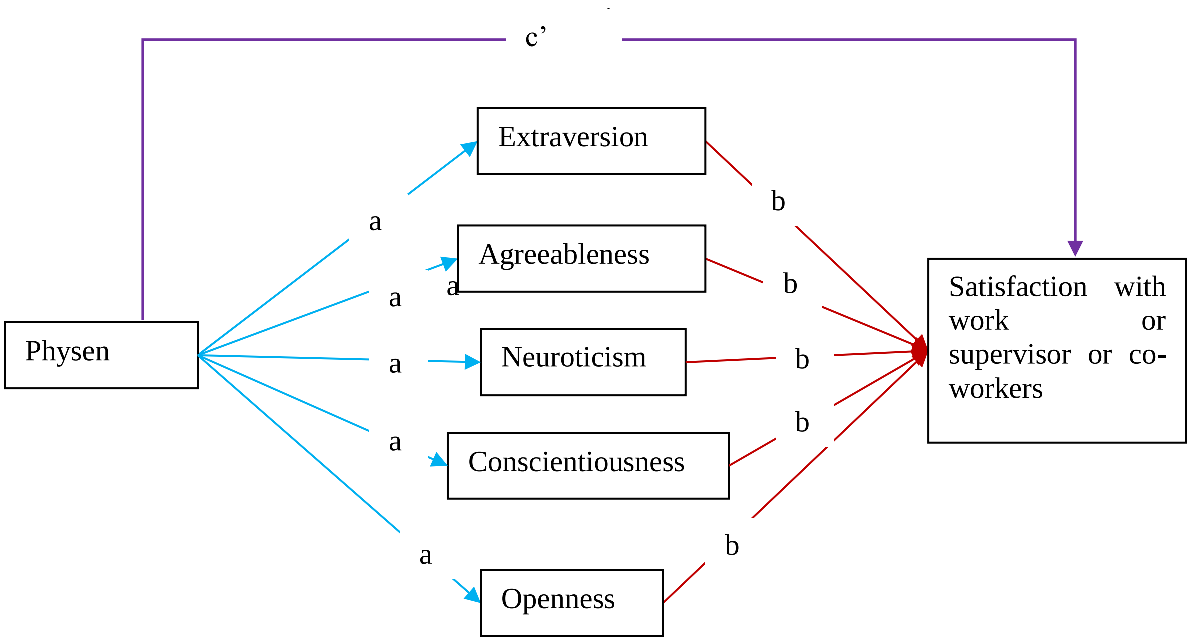


Figure 23. Conceptual Model of Multiple Parallel Mediation

However, in multiple parallel mediation modelling multicollinearity among mediators can be a problem. The inter-scale correlations between the Big Five Factors are presented in Table 38.

Table 38. Inter-scale correlations for the Big Five Inventory (n=339)

		1	2	3	4	5
1	Extraversion	-	.32**	.33**	-.08	.36**
2	Agreeableness		-	.57**	.06	.38**
3	Conscientiousness			-	.03	.39**
4	Neuroticism				-	.31**
5	Openness					-

* p < .05, ** p < .001

8.3 Results

The results of the bivariate correlations are presented first followed by the multiple mediation modelling.

8.3.1 Bivariate Correlations

Table 39. Bivariate Correlations Between Physical Sensations and Job Satisfaction Facets (n=336)

	Satisfaction with work	Satisfaction with supervisor	Satisfaction with co-workers
Physical Sensations	.05 ns	-.02 ns	.05 ns

ns = non-significant

Table 40. Bivariate Correlations Between Physical Sensations and Big Five Facets (n=336)

	Extraversion	Neuroticism	Agreeableness	Conscientiousness	Openness
Physical sensations	.27**	.07	.07	-.01	.08

** $p < .001$, * $p < .05$

Table 41. Bivariate Correlations Between Big Five Facets and Facets of Job Satisfaction (n=336)

	Extraversion	Neuroticism	Agreeableness	Conscientiousness	Openness
Satisfaction with work	.28**	-.13*	.13*	.13*	.11*
Satisfaction with supervisor	.17**	-.06	.19**	.08	.02
Satisfaction with co-workers	.16**	-.14*	.13*	.07	-.01

** $p < .001$, * $p < .05$

The bivariate results provide the conditions for mediation modelling where facets of the Big Five explain the relationship between Physical Sensations and facets of Job satisfaction. Multiple mediation modelling was used to test these relationships.

8.4 Multiple Mediation Modelling

Table 42. Summary of Mediation Results for Satisfaction with Work (n=326)

Model	Independent variable (IV)	Mediating variable (M)	Dependent variable (DV)	Effect of IV on M (a)	Effect of M on DV (b)	Direct effects (c')	Indirect effects (a x b)	Total effects (c)
1	Physen	Extraversion	Work	.22*	.15**	.04	.03†	.00
		Agreeableness		.24*	.02		.00	
		Neuroticism		.18*	-.09*		-.02†	
		Conscientiousness		.11	.01		.00	
		Openness		.31**	.01		.01	

* p< .05, ** p < .001, †Significant point estimate

Table 43. Summary of Mediation Results for Satisfaction with Supervisor (n =326)

Model	Independent variable (IV)	Mediating variable (M)	Dependent variable (DV)	Effect of IV on M (a)	Effect of M on DV (b)	Direct effects (c')	Indirect effects (a x b)	Total effects (c)
2	Physen	Extraversion	Supervisor	.22**	.10*	-.01	.03†	.00
		Agreeableness		.24*	.14*		.03†	
		Neuroticism		.18*	-.02		.00	
		Conscientiousness		.11	-.05		-.01	
		Openness		.31**	-.05		-.02	

*p , > .05, ** p < .001, †Significant point estimate

Table 44. Summary of Mediation Results for Satisfaction with Co-workers (n =326)

Model	Independent variable (IV)	Mediating variable (M)	Dependent variable (DV)	Effect of IV on M (a)	Effect of M on DV (b)	Direct effects (c')	Indirect effects (a x b)	Total effects (c)
3	Physen	Extraversion	Coworkers	.22*	.07*	.04	.01†	.00
		Agreeableness		.24*	.05		.01	
		Neuroticism		.18*	-.06		.00	
		Conscientiousness		.11	.00		-.01	
		Openness		.31**	-.03		-.01	

*p < .05, ** p < .001, †Significant point estimate

8.5 Discussion

This section explored the relationship of ICSS Physical Sensations with job satisfaction to compare the outcome with that of previous intuitive style research.

8.5.1 Bivariate Correlations

8.5.1.1 Intuitive Style and Job Satisfaction

The results for the association between intuitive style and aspects of job satisfaction were non-significant. In the case of a non-significant finding, a priori decision was made to proceed with indirect effects modelling according to MacKinnon, Krull and Lockwood (2000) if the relationship between the predictor and outcome variables need not be significant for mediation to occur.

8.5.1.2 Intuitive Style and Personality Traits

The association between the five factor model of personality traits and intuitive style was examined in chapter five, yielding mixed results.

8.5.1.3 Personality Traits and Job Satisfaction

Consistent with previous evidence, extraversion was significantly associated with all three dimensions of job satisfaction and neuroticism was significantly negatively associated with satisfaction with work and satisfaction with co-workers in the expected direction (Judge et al, 2002). Agreeableness, Conscientiousness and Openness demonstrated mixed significant and non-significant positive associations with dimensions of job satisfaction consistent with the literature (Judge et al., 2002).

8.5.2 Mediation Models

Model 1. Physen → Big Five Facets → Satisfaction with work

Contrary to previous research, indirect effects for extraversion and neuroticism were significant in this model. The indirect effects for agreeableness, conscientiousness and openness were non-significant.

The bootstrapped point estimate for the indirect effect through extraversion was statistically significant. The value of the indirect effect of extraversion was *not close to zero* indicating a medium effect size. It appears that being outgoing, energetic and social (John & Srivastava, 1999) mediated the relationship between physical sensations and satisfaction with work consistent with some evidence from the intuition pole of the bipolar intuition-analysis (e.g. Allinson et al., 2001; Downey, et al., 2006). The current findings make conceptual sense because the social aspects of intuitive style are likely to be facilitated in the workplace through the personality trait of extraversion; intuitives, therefore, are likely to be satisfied with their work in occupations that are social (Prediger, 1982).

The bootstrapped point estimate for the indirect effect through Neuroticism was statistically significant and in the negative direction. The value of the indirect effect of Neuroticism was moving *towards zero* indicating a relatively small effect size. It appears that being free from negative emotional states, calm and emotionally stable (John & Srivastava, 1999) mediated the relationship between physical sensations and satisfaction with work. Again, the current finding make conceptual sense because being constantly emotionally dysregulated may mask any physical sensations whereas, a constant stable emotional state may allow any physical sensations that occur to come to the attention of the individual (Damasio, 2005). Further, being low on Neuroticism is associated with being social (John & Srivastava, 1999) supporting the supposition that intuitive style is related in some manner to social behaviour.

Model 2. Physen → Big Five Facets → Satisfaction with Supervisor

The indirect effects for Extraversion and Agreeableness were significant in this model and the indirect effects for Neuroticism, Conscientiousness and Openness were non-significant. The bootstrapped point estimate for the indirect effect through Extraversion was statistically significant. The value of the indirect effect of Extraversion was *not close to zero* indicating a medium effect size. It appears that being outgoing, energetic and social (John & Srivastava, 1999) mediated the relationship between physical sensations and satisfaction with supervisor. This finding makes conceptual sense because satisfaction with one's supervisor is predicated on an interpersonal relationship (Spector, 1985) thus tapping into the social nature of intuitive style. The current results support earlier findings that being intuitive is likely to facilitate interpersonal relations (e.g. Allinson et al., 2001; Allinson et al., 2006).

The bootstrapped point estimate for the indirect effect through Agreeableness was statistically significant for this model. The value of the indirect effect of Agreeableness was *not close to zero* indicating a medium effect size. It appears that being friendly, helpful and willing to compromise (John & Srivastava, 1999) mediated the relationship between physical sensations and satisfaction with supervisor. Perhaps this is not surprising given that agreeableness may be considered a social trait and as such facilitates the relationship between the social aspects of the intuitive style process with the social context of satisfaction with one's supervisor.

Model 3. Physen → Big Five Facets → Satisfaction with Co-workers

The indirect effect through Extraversion was significant for this model and the indirect effects for Agreeableness, Neuroticism, Conscientiousness and Openness were non-significant. The bootstrapped point estimate for the indirect effect through Extraversion was statistically significant. The value of the indirect effect of Extraversion was *close to zero* indicating a small effect size. Consistent with previous models in the current study, and contrary to earlier findings (Allinson & Hayes, 1996), extraversion (John & Srivastava, 1999) mediated the relationship between physical sensations and satisfaction with co-workers. Again, this finding makes conceptual sense because satisfaction with co-workers is predicated on interpersonal relationships among co-workers (Spector, 1985), and therefore, extraversion should mediate the relationship between intuitive style and satisfaction with co-workers.

8.6 Limitations

There are a few limitations that should be taken into consideration when interpreting the results of the mediation models. Social desirability should be considered here as limitation. No social desirability scale was included in the second data collection used for the current analyses, thus no claims can be made regarding the influence of social desirability on the occupational variables. In addition, a narrow range of occupations was represented by the current sample, possibly introducing bias into the mediation results. Future research should seek to address the roles of social desirability and response bias when looking at the relationship between intuitive style and occupational variables.

In addition, common method bias should be considered as a potential limitation in the mediation modelling because all data was collected via self-report. However, in the case of the current research, the self-report data was used to understand individual’s perceptions rather than to infer objective behaviour and therefore is less likely to cause bias.

Furthermore, issues with multicollinearity should be considered when modelling parallel mediators from a multidimensional scale. Of concern is the strength of association between Agreeableness and Conscientiousness subscales on the Big Five Inventory for the current sample. The association between Agreeableness and Conscientiousness subscales may be problematic because this can hide their function as mediators when modelled together. In the mediation modelling for this chapter, Agreeableness and Conscientiousness were non-significant with the exception of Agreeableness facilitating the relationship between physical sensations and satisfaction with supervisor. Give that the current data are exploratory, future research should explore these mechanisms further by using additional measures of personality traits.

In addition, because the research is cross-sectional a clear statement of directionality between personality traits and intuitive style cannot be claimed except in theory. Future research should seek to address the directionality of relations between personality traits and intuitive style through the use of structural equation modelling.

Conclusion

This chapter set out to explore the relationship between the physical sensations component of the psychoneurobiological-based multidimensional intuitive style process model and occupational variables. There were mixed results in using the five factor model of personality traits to facilitate the relationship between physical sensations and aspects of job satisfaction. Extraversion turned out to be the main mediator between physical sensations and each aspect of job satisfaction, contrary to earlier evidence. In addition, low Neuroticism facilitated the relationship between physical sensations and satisfaction with work, and Agreeableness facilitated the relationship between physical sensations and satisfaction with supervisor. These findings further developed the literature by explaining the mechanism that facilitates job satisfaction for intuitives. In addition, the current findings demonstrated the utility of conceptualising intuitive style as a multidimensional construct separated from analysis by highlighting the relationship between intuitive style and extraversion, contrary to earlier findings from the bipolar intuition-analysis where intuitive style was forced into a negative relationship with extraversion.

In conclusion, the current chapter adds important information to the literature and demonstrated that taking the view of intuitive style as a psychoneurobiological-based multidimensional process model can help to further clarify the role intuitive style plays in the workplace.

"For now we see in the mirror, dimly."

1 Corinthians 13:12a NKJV

Chapter 9

Theoretical Reflections on Intuitive Style: Implications for Research and Practice

Introduction

This theoretical reflections chapter provides the space to consider some of the issues in style research raised by the approach taken in the current thesis and seeks to make stronger links to other pertinent areas of research including fresh developments in neuroscience and clinical applications of the somatic marker theory used in the current thesis to understand intuitive style.

Initially, this chapter will reflect on specific areas of thinking that have concerned cognitive style researchers over the years and then, move on to further theoretical development of the psychoneurobiological-based multidimensional intuitive style process model and finally, address the implications of the intuitive style process model in relation to clinical practice.

9.1 Cognitive Style Research Reflections

This section reflects on some of the ongoing challenges of doing style research that seem to have plagued style for many years. The purpose is not to attempt to solve these challenges with one dash of the pen (or clatter of keyboard) but to raise questions and to cogitate on potential solutions in an attempt to form a corpus of knowledge that may be applied not just to style research but also to the construct of intuition. This section begins with a foray into the epistemology of style research and traverses the issues to do with the nature of style concepts, measurement of style and possibilities for extending the lexicon of intuitive style.

9.1.1 Epistemological Approach

Arguing for a new approach to style research has some implications. Rayner (2011) has suggested, in succinctly quoting Messick's (1994) statement concerning style research, that new paradigms in style research are urgently needed to gain traction over the proliferation of style constructs and approaches, as well as to develop substantive theory and to bridge the apparent disconnect between research and practice across all areas of style and with other areas of psychology. This is not a new observation (e.g. Tiedmann, 1989; Kozhevnikov, 2007), and perhaps rather than looking to personality or cognition as has been done in the past (e.g. Kirton, 1989; Witkin & Goodenough, 1981, respectively), for assistance in developing a new style paradigm, it may be better to take a closer look at other fields for assistance as the current thesis has sought to enact.

Based on the evidence developed in the current thesis, it is argued that style may be best conceptualised as specific large-scale neurological processes that carry the psychological experience of style resulting in definable outcomes such as physical sensations. Taking style as large-scale neurological processes has a number of advantages: Firstly, it addresses the need for a theory of style at the domain level (Rayner, 2011) that is separate from the measurement tool and provides a framework for all styles, not only intuitive style but also other styles such as the object-spatial verbaliser style (Blazhenkova & Kozhevnikov, 2009). This theory may also help to somewhat clarify the debate in style over styles as traits (e.g. Messick, 1976) or styles as states (e.g. Miller, 1987) And may build on the current theory, helping to clarify the trait-state debate by explaining the reasons why styles may sometimes be considered as traits, or trait-like, mirroring the underlying neurological processes, as well as states when selected components of the process are contextually activated as discussed in Section 7.11. Perhaps the multitude of approaches to style research has been driven not only by the epistemology but also by notions about the nature of style itself.

The notion that style must be bipolar may need to change if the field is to develop and to be viewed with regard by psychology in general. Style, it seems, may not be a bipolar construct, but in fact turn out to be the psychological experience of dispositional preferential engagement of large-scale neurological systems.

Indeed, shifting to style as-a-system is a strong claim. However, there is a great deal of supporting evidence that cannot be ignored from an area called interpersonal neurobiology that supports this claim that style may benefit from investigation as a large-scale system. For example, interpersonal neurobiology concerns the integration of cross-disciplinary evidence (e.g. neurobiology, complex non-linear dynamic systems, attachment, evolutionary psychology, memory) about how relationships shape the brain and mind across the lifespan, with a particular focus in understanding the primacy of affect in a theory about self- and other- regulation beginning from birth (e.g. Schore, 2012; Siegel, 2011). The cross-discipline approach to interpersonal neurobiology has supported the notion of large-scale neurobiological systems, indeed, Schore (2012) in an extensive review states that:

> *"We can no longer think of the brain as two halves of a single entity. Rather, these two systems [left and right] process different types of information in very different ways. Numerous studies now indicate that the right and left human brain hemispheres differ in macrostructure, ultrastructure, physiology, chemistry, and control of behaviour." (p. 7)*

Shore (2003a), Siegel (1999), and many others (e.g. Ogden, Minto, & Pain, 2006) have noted that the right-brain system is responsible for the rapid, non-conscious, implicit, affective, somatic, interoceptive, holistic, non-verbal, imagery, spatial, subjective processing, whereas, the left-brain system is responsible for the effortful, conscious, explicit, linguistic, serial, and rational processing. The descriptions of these two systems are remarkably similar to what is known in style research as intuitive style and analytic cognitive style, respectively. This approach also heralds a return to a neurological basis akin to that proposed for the bipolar intuition-analysis construct (Allinson & Hayes, 1996).

The move to style-as-a-system has deep implications for style research. Importantly, the body of research underpinning style-as-a-system from a psychoneurobiological perspective details the ways in which the large-scale systems develop (e.g. Li, Chen, Fleisher, Reiman, Yao, & Wu, 2011), thus addressing the following ongoing issues in style research:

a) answering questions about why there is such a thing as style in the first instance,

b) providing a testable developmental trajectory of style,

c) the ongoing need for a substantive theory,

d) the ongoing need for epistemological change in style research,

e) individual differences in styles; seen as style expressed from an early age,

f) strong ties to other fields of research,

g) implications for mental health (see Section 3 for further discussion)

Moreover, shifting to style-as-a-system means that it is possible for an individual to exhibit a profile of styles (e.g. intuitive and analytic) within which there may be one prominent style, or a profile with a mix of styles that is not contextual but perhaps trait-like. A profile of styles, even when one style is prominent, then allows the expression of other styles depending on the needs of the context. Thus, the context may strongly influence which style is expressed accounting for earlier data that suggested that individuals are flexible in their use of styles (Riding, 2000).

Furthermore, the style-as-a-system clearly distinguishes style from other cognitive processes. For example, visual sensation involves the visual cortices (occipital and sensory), whereas, the object-visual cognitive style has been shown to involve the ventral stream neural networks, in what seems to be a preferential manner, that incorporates V1, V2, V4 and the inferior temporal lobe (Blazenkova, Kozhevnikov, & Motes, 2006).

It also clearly differentiates between sensation and perception, and may explain findings such as Adams (2001) where deaf students exhibited a range of style preferences from visual to verbal indicating that the sensory process does not necessarily need to be intact for style to be present.

Style-as-a-system also accounts for the ‘intermediate’ position on the wholistic-analytic visual-verbal measures because style-as-a-system claims that individuals can have profiles that are balanced in the sense that no one style predominates. Style-as-a-system accounts for the links between wholistic-analytic and visual-verbal, where the wholistic is more likely to be associated with the visual and the analytic with the verbal, based on the understanding of the right- and left- brain systems detailed from interpersonal neurobiology.

If style-as-a-system holds, then it supports Messick’s (1976) notion that style impacts all areas of life: This would include researcher’s epistemological preferences as well as the way in which the researcher construes style. It may then be incumbent upon the researcher to experientially examine their own style so that the researcher is vitally aware of the way their own style impacts on their work. Anecdotal evidence from the current research supports this notion because it became evident that the analytics in the current sample were frustrated and did not understand the intuitive style questions. Indeed, Schore (2012) argued that left-brain approaches do not value right-brain approaches, perhaps to the detriment of knowledge production, suggesting that researchers in style would need to have a good grasp of both left- and right-brain systems. It seems that applying rational thinking to the intuitive needs to be done very carefully with the acknowledgement that some approaches, perhaps those that tend towards analysis such as ability-like instruments, to research in intuitive style may produce limited results and may continue to lead to dead-ends as noted by Hodgkinson et al. (2008).

Moreover, as far as cognitive style researchers are concerned, Reinmann and Bechara (2010) raise the important point that trying to compare data from alternative areas, such as comparing personality or cognitive abilities with style, may not yield the anticipated results and may bring further confusion rather than clarify research endeavours. Taking style-as-a-system moves it away from being a bridge between cognitive abilities and personality (Messick, 1996) and into a completely different paradigm. Style-as-a-system may then drive the approach to style research, perhaps forging links between researchers from different fields, opening up exciting fresh options in style research.

While thinking in the field of style may resist such a change to style-as-a-system, it is important to note that advances in technology, such as computerised testing, and have meant that instead of small, incremental steps forward in research in areas such as intuition, large steps may now be taken. For research on intuition and intuitive style, this has meant that evidence from other areas may be used to further clarify theories which may then be rigorously examined using many different methods including psychometrics.

The current research has addressed one way of looking at the integration of the somatic, affective and cognitive components of intuitive style that may then be extended to understanding intuition. The current findings may be applied to intuition, given that the intuitive style construct developed for the current research was built on the neuroscience of intuition. It seems reasonable, and parsimonious, that a single theoretical framework should underpin the family of intuition constructs; intuition as an ability, style and strategy. However, when integrating across such distinct areas as the somatic, affective and cognitive, each of which are complex in themselves, parsimony may have limited value. Although parsimony is one aim of research, some degree of extension is needed to be able to incorporate all the information making up integrated process models. It appears that while studying individual components of complex constructs yields a great deal of information, getting to the way in which the components are integrated in a process seems to go beyond that of the sum of the component parts. In other words, the integrative process model appears to deliver more data than simply putting together an understanding of each of the components. Such an approach is accepted in other areas of research, such as trauma and experiential research and practice (Odgen, 2006; Fosha, 2009), because studying one construct without studying the other constructs that make up the totality of the process may restrict knowledge creation and application to practice. Whereas, understanding how the parts go together in intuitive style has helped to yield clarity of knowledge beyond that of the component parts. To this end, a new approach to research that can incorporate the study of individual component parts in complex constructs, such as intuition, as well as the study of the same components as part of an integrated process model should be sought in the future. Changing the approach to researching complex constructs has implications for the nature of intuitive style and the way in which the construct is conceived and measured.

9.1.2 Conceptual Clarity

In terms of conceptual clarity, demonstrating that intuitive style and the related variants of intuition are a psychoneurobiological-based multidimensional system may help to shift thinking about the construct. Intuitive style as one pole of a bipolar construct has been very useful in understanding more about individual differences in specific types of behaviours. However, there are two aspects that a bipolar account of intuitive style seems not able to do and these are: deliver an understanding of the key components of intuitive style and understand how the various components go together to yield physical sensations.

9.1.3 Measurement

Critics of style research (e.g. Teidmann, 1989) have pointed out that styles are often conceptualised in the same way as their attendant instruments, meaning that the instrument is the style and visa verse. Taking the style-as-a-system approach, using neurobiology as a theoretical base, separates out the construct from the instrument. However, this approach has further measurement implications. Most importantly, care needs to be taken to understand the appropriate level of neuroscience analysis (Gazzangia, 2010) to which the various measurement techniques may be applied. Given the current intuitive style foundation in psychoneurobiology, its psychometric instrument may be appropriately addressed at the mental re-representation level in neuroscience (Gazzangia, 2010). Not only has the conflagration of the style concept with its instrument been an issue but also the use of self-report surveys.

While self-report surveys give a subjective view of style, mixed method research on intuitive style has demonstrated that observations of intuitives behaviour are consistent with their self-reported style (Armstrong, Priola & Smith, 2001; Raffaldi et al., 2012) indicating that mixed methods may be a cost-effective option for studying cognitive style. The videoing of real-life scenarios designed to elicit stylistic responses together with post hoc structured interviewing, both methods that can be subjected to coding and then quantitative analyses, may turn out to be an appropriate way of further detailing the intuitive processes. However, it seems to be in the nature of intuitive constructs that there may always be an experiential aspect that cannot be addressed using behavioural approaches and this experiential aspect should not be excluded for the sake of behavioural approaches.

9.1.4 Extending the Lexicon of Intuitive Style

One issue that was noted during the current research was the dearth of descriptors for aspects of the intuitive style components. There appears to be a need to further develop a language around the positive affect and physical sensations components of intuitive processes. While there seems to be an extensive lexicon about negative physical sensations, positive physical sensations and physical sensations alone seem to have a limited lexicon. Hopefully, the style-as-a-system approach may allow each component to be individually developed thus further improving conceptual clarity.

9.2 Intuitive Style: An Extended Process Model

The purpose of this section is to deepen the theoretical base of intuitive style as a multidimensional psychoneurobiological-based process model by taking into consideration additional neurobiological findings and recent neuroscience evidence. This section will provide further evidence for the integrative functioning of cognitive, affective and somatic processes in intuitive style together with a hypothesised interaction of intuitive style with analytic cognitive style.

In the experience of intuitive processes, the cognitive, bodily and affective aspects appear to be tightly integrated, such that one does not appear to occur without the other, and the integrated result comes to consciousness in some way. This is most evident when individuals state ‘I just have a bad feeling’ or ‘My gut feel tells me it is the right thing to do’. As argued earlier in the current chapter, this kind of experience seems to point to the operation of large-scale systems.

In this section, the operation of large-scale systems in intuitive style will further develop the systems approach discussed in Section 9.1.1. Evidence from neurobiology will be used to further integrate social processing in intuitive style as well as provide further detail about the integrative functioning of the cognitive, affective and somatic processes. An overall graphical depiction of the ways in which different aspects of functioning may go together to form the system of intuitive style is presented in Figure 24.

9.2.1 System-Level Extension

It was argued earlier in this chapter that intuitive style, and cognitive styles in general, may be best conceived as systems. Further to this argument, the right- and left- brain systems (Schore, 2012) were said to process in ways that are non-conscious, rapid, affective, somatic information and conscious, slow, and effortful, respectively. Although understanding these systems has been helpful in developing the current thesis, there is a suitable extension that focuses on the type of process enacted neurologically rather than neural structure and function. Evans (2008) has proposed the format of type 1 (non-conscious, rapid, associative) and type 2 (conscious, slow, effortful) processes that can operate at many different neurological and mental re-representational levels thereby allowing for all cognitive processes to be in the form of type 1 or type 2, accounting for different forms of cognition.

Chapter 4 discussed the extensive evidence for these non-conscious cognitive processes in terms of intuition research. Here, research looking at subliminal processing is used to further extend understand of such processes.

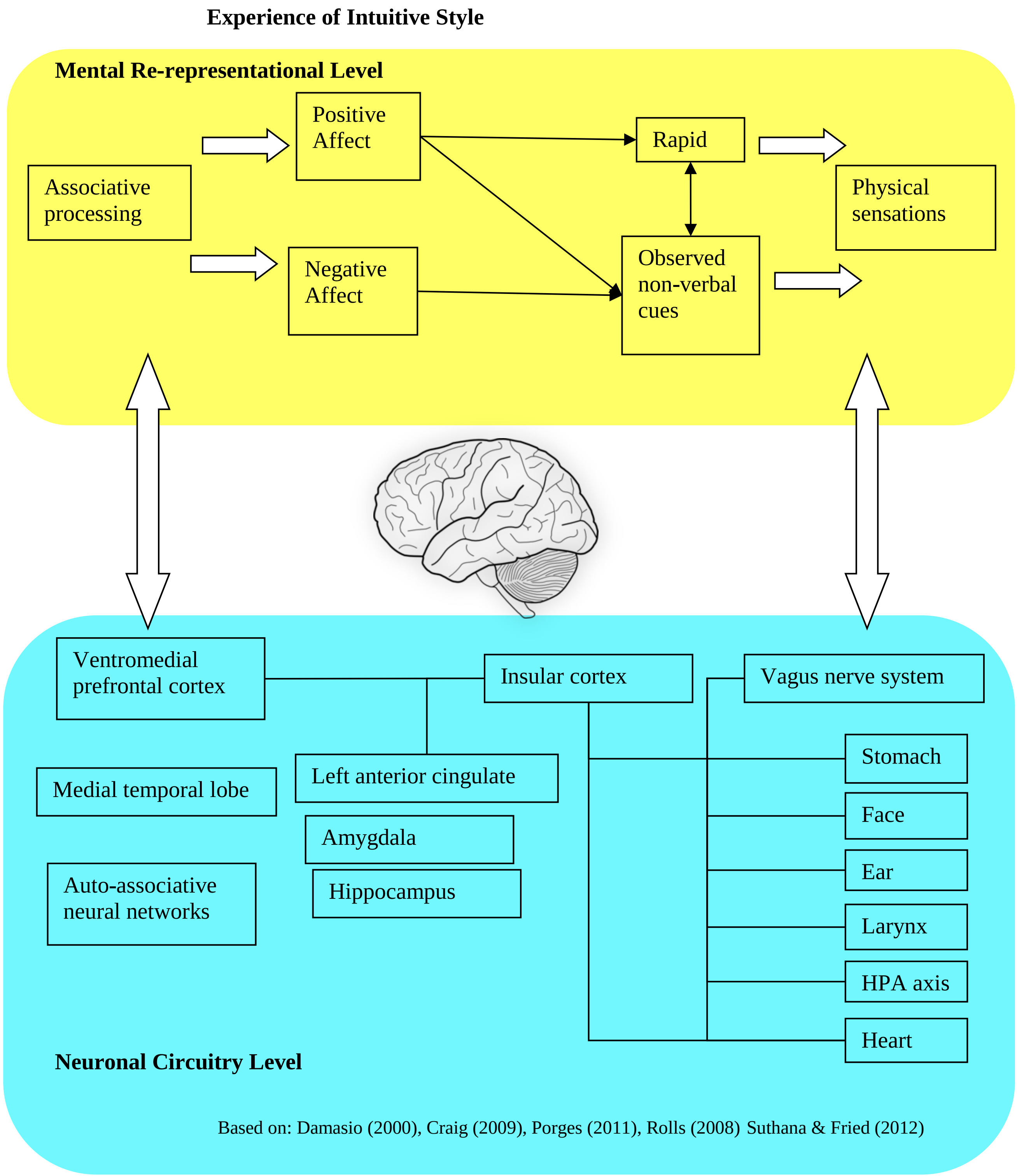


Figure 24. A Graphical Depiction of the Process of Intuitive Style from the Neurological to the Mental Re-representational Level

Subliminal processing is processing that occurs at a level below that of conscious awareness (Kouider & Dehaene, 2007). At a higher-order cognitive level, non-conscious processing of a variety of information is well established and accepted, although not without some debate concerning the depth to which information is processed (Kouider & Dehaene, 2007). Subliminal studies involving sensory perception, such as implicit spatial processing in spatial neglect (Berti, 2002) through to higher-order processing, such as the meaning of words (Nakamura, Dehaene, Jobert, Bihan, & Kouider, 2005), using highly specific techniques to hide target information from participants' awareness have demonstrated that individuals process a wide range of information below the level of consciousness and that hidden target information can influence behaviour (Hassin, Ferguson, Shidlovski, & Gross, 2007). In these studies of subliminal processing, functional magnetic resonance imaging (fMRI) has correlated non-conscious processes with activity in specific brain regions.

Brain regions functionally involved in non-conscious processes depend on the form of subliminal information presented. For example, subliminal visually presented words are processed via what is known as the visual ventral stream (the 'what' pathway, c.f. the 'where' pathway of the dorsal stream) including V1, V2 and V4 in the occipital lobes, limbic system and the medial temporal cortex. Corresponding ventral streams are posited for auditory processing of speech (Specht, Huber, Willmes, Shah, & Jancke, 2008) and processing of language (Hickok & Poeppel, 2004) possibly accounting for intuitives not being able to verbalise the steps taken in thinking. The subliminal fMRI studies show a notable absence of functional brain activity in specific prefrontal cortical areas thought to be involved in allowing information to come into consciousness (Berlin, Rolls, & Kischka, 2004; Kouider & Dehaene, 2007) providing a functional distinction between non-conscious and conscious processes. These same processes may account for the experience of 'just knowing', the non-conscious processing in intuitive style. Furthermore, neuroscience may help to pin down the seemingly illusive intuitive experience of 'gaining an overview' while missing the fine detail.

Intuitives experience associative processing as a preference for an overview, sometimes described as a global view (Allinson & Hayes, 1996) and tend to process information at a broad level rather than a detailed level. Somewhat confused with similar processes such as insight (Gick & Lockhart, 2000) or tacit knowledge (Polanyi, 1967), the experience of associative processing of intuitive style may be explained by underlying neurological functions that are, in themselves, associative (Rolls, 2010).

Associative neural networks are networks that act according to the Hebbian principle that neurons that wire together, fire together (Hebb, 1947). Localised populations of neurons such as auto-associative networks, also known as attractor neural networks are responsible for simultaneous neural activity to do with different types of information that come together for higher-order cognitive functions such as episodic memory or decision-making (Rolls, 2010). One property of attractor neural networks is that only one part of the network needs to be triggered for the whole of the network to be activated (Rolls, 2010). This process at the neuronal level may carry the experience of having an overview at the mental re-representational level for intuitives and may account for the stylistic selection of information, that is, the type of information, the 'big picture' that intuitives pay attention to.

For example, existing mental re-representations (i.e. the abstract concept representing a piece of information) have been shown to strongly influence what information is visually perceived (Cerf et al., 2010). Cerf et al. (2010), in an intracranial electrode study, have shown that when participants are presented with a composite image, they are able to select one image (blocking out the alternate image) by attending to their mental re-representation and in doing so, increase the rate of firing of some neurons while decreasing the rate of firing of other neurons, simultaneously. Since both visual sensory input and visual mental re-representations share specific neurons (Krelman, Kock, & Freid, 2000) in the network, selection of information at the mental re-representative level influences which sensory information is processed. Based on these data, it is plausible that intuitives will select and process information that is consistent with their preference for a global overview, thus accounting for the fact that intuitives tend not to pay attention to fine detail, as well as accounting for the rapid 'knowing' that the new data coming is similar to the mental re-representations stored in their funds of knowledge and any (mis)match would trigger the affective somatic marker yielding physical sensations for better or for worse. That is, even though the fine details of the information are available, intuitives' stylistic preferences for associations among the structural aspects of the information imposed at the mental re-representational level mean that the fine details may not be processed leading to good or poor outcomes of being guided by their physical sensation. Thus, the associative processes of the cognitive aspect experienced in intuitive style as an 'overview' that occurs below the level of conscious awareness may be explained by the interaction of mental meta-representations with the new information coming into the process.

Affective and somatic processes, such as interoception (Craig, 2009), may be considered type 1 processes. This format of type 1 and type 2 processes fits well with the right- and left- brain systems, where type 1 processes may occur in both right- and left- brain systems and type 1 processes in right-brain systems, consistent with neurobiological findings (Schore, 2003a; Schore, 2003b). The interaction of type 1 and 2 processes allows for the results of right-brain system type 2 processes to come to consciousness. The interaction of type 1 and type 2 processes may explain how intuitive style can be a non-conscious process with a conscious result.

Thus, the cognitive, affective and somatic processes of intuitive style may be accounted for as a system at the neurological level together with the corresponding mental re-representational level.

Furthermore, large-scale neural networks that describe resting state (i.e. the participant is not actively engaged in any form of deliberative cognitive processing) functional activity show simultaneous neural activity among distal regions of the brain (Li et al., 2011; Power, Fair, Schlaggar, & Petersen, 2010). While different discrete regions of the brain have functional integrative attributes (such as the insular cortex: Craig, 2009), large-scale functional brain network studies provide insight into the integrative functioning of cognitive, affective and somatic processes via the application of graph theory[6] (small-world networks) to resting state fMRI data. Large-scale neural networks are complex networks that describe the functional interaction of areas of statistically significant high activity within the brain when

[6] Graph theory, known as small world networks, mathematically describes the relationships among items in a network. Conceptually, each item in the network is connected to at least one other item and the number of connections among items in the network can be mapped. Graph theory states that the average number of items between one item and any other item in the network will be six items (commonly known as six degrees of separation). Items that have a large number of connections are considered to be hubs in the network and the relationships among hubs in different networks may then be mapped. Thus, each brain region is its own network and the connections among the hubs of activity in distal brain regions at resting state can easily be mapped as a large-scale network.

the brain is at rest. Sets of large-scale networks separated into sensory networks and higher-order mental re-representation networks have been demonstrated (Li et al., 2011; Power et al., 2010) where sensory networks, including visceral states, impinge on and influence higher-order mental re-representation networks. These large-scale networks perhaps describe brain functionality in a way that is helpful to understanding more about the neurology of intuitive style. In particular, the predominant resting state network appears to be one in which the sensory components influence the higher-order components (Li et al., 2011) supporting the integration of affective and somatic processes with cognitive processes in intuitive style. Not only do large-scale networks provide evidence for integrative functions in intuitive style but also suggest that these integrative functions are not limited to intuitives. This augers well for future potential growth of inter-disciplinary individual differences research because questions such as: Do intuitives have a greater degree of activation of somatic and affective processes that then influence cognitive processes? Does a particular level of activation of somatic and affective processes need to be reached before they impinge on cognition? Do analytics have a similar pattern? How do intuitive and analytic styles interact? may be investigated. Not only does the integration of the cognitive aspects with somatic and affective aspects need further investigation, so does the integration between the somatic and affective aspects of intuitive style.

9.2.2 Neurobiological Extension

Explanations for what may underlie the integration of affective and somatic processes can also be found in the neurobiological literature (Craig, 2009; Damasio, 2005; Porges, 2011). At the neurobiological level, the polyvagal theory (Porges, 2011) offers to intuitive style one explanation of the ways in which the brain and body work together (see Figure 24).

At the neurological level, the vagus “communicates in a bidirectional manner between the viscera and the brain” (Porges, 2003, p. 504). The vagus consists of mylenated (ventral vagal complex) and unmylenated (dorsal vagal complex) neural projections to the gut, heart, face, voice and ear where the ventral vagal complex is responsible for actions such as the physiological down-regulation of the hypothalamuspituitary-adrenal axis and the dorsal vagal complex is responsible for actions such as the physiological response of freeze (Porges, 2011). The ventral and dorsal complexes include the action of neural transmitters and hormones which act in concert with the vagus nerve producing a neurobiological perspective. Porges (2003) states that the interaction between the dorsal and ventral vagal complexes is for the evolutionary purpose of cortical control of heart rate, face, larynx, and pharynx to support positive social behaviours, positive affective states and regulation to calm visceral states as part of what is termed the Social Engagement System thought to be responsible for pro-social behaviours. In this way, the polyvagal theory describes a set of bidirectional neurobiological pathways that may turn out to underlie an individual's interoception and connection of internal bodily states to changes associated with affective states as part of intuitive responses. The polyvagal theory may also account for the social aspects of intuitive style.

Socially, intuitives seem to behave in ways that facilitate prosocial behaviours within and among others (Armstrong & Priola, 2001; Priola et al., 2004) suggesting that perhaps intuitives have a highly functional Social Engagement System (Porges, 2003) that would allow them to non-consciously take in and respond to social information. Furthermore, Porges (2011) argues that visceral states respond as a threat or safety detection system via sensory processing which includes the affective systems, influencing behaviour without reaching levels of effortful thinking. Thus, the polyvagal theory presents a detailed way of understanding the integration of the cognitive, affective and somatic processes from the neurobiological level. In addition to the neurobiological level of integration, the mental re-representational level of integration needs to be considered.

9.2.3 Mental Re-representation Level Extension

A highlight of recent thinking (e.g. Gu, Liu, van Dam, Hof, & Fan, 2012) on the functioning of the insula cortex is the concept that the actions of the anterior insula together with the medial prefrontal cortex may form part of the neural foundation for the mental re-representational level integration of cognition and emotions (Craig, 2002, 2009; Critchley, Wiens, Rotshtein, Ohman & Dolan, 2004). This is in-line with evidence from acquired brain injury patients with damage to the lateral medial prefrontal cortex and intact affective system who are unable to make decisions (Damasio, 2005). Furthermore, a number of studies have demonstrated individual differences in interoception and integration of emotions with interoception (e.g. Dunn, et al., 2010; Sze et al., 2010). Sze et al. (2010) in a small sample, demonstrated that individuals with training emphasising attention to visceral states had the greatest degree of correspondence between changes in their physiology and their reported subjective emotional state, whereas, individuals with training emphasising attention to proprioception demonstrated less correspondence than the visceral state group, followed by the control group that demonstrated the least correspondence between changes in physiology and reported subjective emotional state. Although the sample size was small, these initial findings support part of the Social Engagement System (Porges, 2003) where somatic and affective states are thought to be integrated at the neurobiological level and non-consciously influence behaviour as well as the mental re-representation of somatic and affective states in the insula and medial prefrontal cortex that then come to consciousness, providing substantive detail that may be applied to intuitive style. Dunn et al. (2010) demonstrated that interoceptive awareness moderates the relationship between visceral changes and subjective emotional states and that the nature of the somatic marker (highly adaptive, average or maladaptive) affected the relationship between visceral interoception and intuitive ability. The difference between the highly adaptive, average or maladaptive somatic markers provides the first evidence that a) not all somatic markers are beneficial and b) may help to explain the reason that not all intuitive decisions yield positive results. In addition to providing evidence for the integration of affective and somatic processes in intuitive style, these studies help to delineate where and when cognitive processes are integrated. In particular, the Somatic Marker Hypothesis (Damasio, 2005) specifies one pathway that integrates cognitive processes with affective and somatic processes that cover both neural and mental re-representation levels.

The integration of cognitive processes at a conscious level with affective and somatic processes appears to occur in the ventromedial prefrontal cortex and anterior cingulate cortex as suggested in the Somatic Marker Hypothesis (Damasio, 2005). The ventromedial prefrontal cortex receives information from many different areas of the brain and body as was substantiated by further research demonstrating that emotion and working memory elicited ventromedial prefrontal cortical activation (Gray, Braver & Raichle, 2002). Evidence is beginning to emerge in support of the anterior cingulate cortex as a central site of cognition-affect integration (Craig, 2009; Damasio, 2005). Damasio (2005), having observed patients with damage to the anterior cingulate showed corresponding deficits in expression of affect, reasoning and behaviour, suggested that the anterior cingulate is key to the integration of cognition and affect. This evidence extends the neurobiological foundation of intuitive style and provides a neurological framework supporting the integrative functioning of somatic and affective processes.

Having extensively developed a neurobiological model underpinning intuitive style as an integrated system, the next section presents emerging evidence of the role of physical sensations in psychopathologies.

9.3 Clinical Implications of the Intuitive Style Process Model

In the course of researching the current project, it became apparent that the Somatic Marker Hypothesis (Damasio, 2005), used here to build theory about intuitive style, was investigated in other research to help explain the role of physical sensations in symptomatology for obsessive-compulsive disorders, anti-social behaviours and to describe what it means to be mentally healthy. Although not central to the study of intuitive style, this section looks at the potential for the findings from the current research to inform clinical applications of physical sensations.

9.3.1 Intuitive Style and Psychopathologies

There is a body of evidence beginning to emerge on the role of physical sensations, operationalised as somatic markers, in conduct disorders and aggression (Blair, 2001), anti-social behaviours (Beer et al., 2006; van Honk et al., 2002) and obsessive-compulsive disorder (OCD: Steketee & Frost, 2003), specifically Hoarding which is now considered separate from OCD (American Psychiatric Association, 2013). In particular, it is the demonstrable absence, for reasons still to be fully determined, of physical sensations that appears to be common to these disorders. Although the evidence for a relationship between physical sensations and these disorders is in its infancy, understanding the process that results in physical sensations as detailed in the current thesis may prove useful in some manner.

Underpinning these anti-social disorders and hoarding disorders are some common functional issues. Anti-social behaviour is characterised, neurologically, by poor ventromedial prefrontal cortex functioning resulting in the loss of being able to stand in the shoes of another and to be emotively reflective of their own actions in light of the social and emotional consequences of their behaviour (Damasio, 2005; Tranel, et al., 1997). Similarly, poor functioning of the ventromedial prefrontal cortex and dorsal anterior cingulate cortex was associated with the hoarding disorder (Cavedini, Riboldi, D'Annucci, Belotti, Cisima, & Bellodi 2002; Saxena, Brody, Maidment, Smith, Zohrabi, Katz et al., 2004). Moreover, neurobiologically, anti-social behaviours and OCD are characterised by low skin conductance response on the Iowa Gambling Task (Damasio, 2005; Lawrence et al., 2006).

Understanding that there is a process that results in physical sensations, as presented by intuitive style, may help to delineate the ways in which dysfunction occurs in anti-social behaviours. The findings of the current study demonstrated that in social contexts, the observed non-verbal cues are processed non-consciously resulting in positive or negative affects, thus the process of physical sensations in social contexts may be specifically applied to anti-social behaviours. Indeed, Blair (2001) has stated that the link between the anti-social behaviour and punishment for the anti-social behaviour may not be created. That is, the anti-social individual does not make the negative affective physical sensation that associates the punishment with the anti-social behaviour. The current study suggests that dysregulation of the physical sensations process may occur at specific points in creating the sensation whereby the observed non-verbal cues (the responses of those on the receiving end of the anti-social behaviours) may not be processed, or if they are processed then perhaps the negative affects and/or the somatic changes associated with the anti-social behaviour are misinterpreted.

Slightly different dysregulation of physical sensations to those of anti-social behaviours may occur in hoarding disorders. Hoarding (the excessive collection of items) appears to be one area that is less amenable to therapies (Lawrence et al., 2006), appears to have significantly increased activity in the left prefrontal gyrus and right ventromedial prefrontal cortex compared to controls (Chamberlain, Blackwell, Fineberg, Robbins, & Sahakain, 2005) as well as perseveration and poor decision making, akin to patients with ventromedial prefrontal cortex deficits, (Lawrence et al., 2006) thought to be indicative of over-active circuitry (Chamberlain et al., 2005) involving similar neural components as those of somatic markers and part of the intuitive style model. The findings of the current study on intuitive style may contribute further information about the process at the neurological level and the mental re-representational level.

The model best applicable to hoarding in the current thesis indicates that information is processed associatively, triggering an affective state which then yields physical sensations where dysregulation may occur at any point in the process. Given that the assumed normal process of a somatic marker may involve the ventromedial prefrontal cortex as one of the areas where information comes to consciousness, and this is one of the areas of over-activity in hoarding, it may be that the over-activity prevents the somatic and affective responses becoming conscious such that hoarders have no felt sense of ‘ownership’ or ‘mine-ness’ that is no emotional labelling of an object is made as a mental representation.

Further, in OCD in general, there may be reduced associative processing that would typically enable previous knowledge to inform current decisions, as well as no felt sense of a ‘correct’ place for an object through the involvement of positive and negative affective markers and there may be no mental representation of bodily states as part of thinking. Furthermore, checking behaviours in OCD may be partially explained by a lack of a felt sense of having done the action, that is, no mental re-representation of a positive physical sensation of the completed action may have been made leading to a lack of a felt sense of having done the action, resulting in having to check numerous times. A lack of an intuitive physical sensation should manifest as indecisiveness leading to hoarding – not knowing, or having no feel for where an item belongs (Steketee & Frost, 2003) – consistent with evidence from earlier lesion studies where the patient experiences of indecisiveness over making a decision about a doctors' appointment (Damasio, 2005). Moreover, the hypofunctionality of the dorsal anterior cingulate cortex may lead to reduced subjective emotional awareness (Craig, 2009), constricting the spectrum and intensity of affective states available as part of the process of an intuitive physical sensation in OCD.

However, before testing each individual process that makes up a somatic marker as well as the integration of different aspects of intuitive physical sensations, there needs to be some sort of baseline against which findings can be compared. The current research on intuitive style offers such a baseline in understanding the range and variability of the physical sensations process in typically developing adults. Such comparisons also may require some idea about what mental health looks like. To this end, the next section posits some notions about the healthy development of physical sensations tapping into the findings of the current research.

9.3.2 Intuitive Style and the Healthy Development of Intuitive Physical Sensations

It is the absence of an intuitive physical sensation that appears to have consequences for mental ill health, as discussed above. However, this leaves open questions concerning what constitutes the role of physical sensations in mental health. Current thinking on mental health has posited that it arises from a balance between right- and left- brain systems (Schore, 2012) developed via the attachment process as understood in modern terms, and a balanced integrative functioning of type 1 and type 2 processes (Siegel, 1999). By implication through the application of right- and left- brain systems and type 1 and type 2 processes to detailing the process leading to a physical sensation, intuitive style may have a role to play in describing mental health.

Notably, positive and negative affects central to intuitive style are intact and functioning at birth (Schore, 2003a). Typically developing neonates have an intact functioning limbic system that involves associative type 1 processing of sensory information, particularly visual information to make sense of their environment (in particular to process mentalization and social cues from a significant caregiver), whereas, the higher-order cognitive functions (type 2 processes) of analysis and verbalisation develop at a later stage (Schore, 2003a, 2003b). Furthermore, intuitive processing has been shown to be present in young children (Jacobs & Klaczynski, 2002) implying that intuitive processes are a part of typical development and healthy functioning.

It is well-accepted in infant mental health that early secure attachment allows the brain and mind to develop the right- and left- brain systems and type 1 and type 2 processing in a balanced manner via the regulation of affective states (Schore, 2012; Siegel, 1999). On the other hand, disrupted attachments result in the dysregulation of affective states (Schore, 2003a) and an apparent skew towards the extremes of either right- or left- brain systems and the predominance of type 1 or type 2 processes (Siegel, 1999) meaning that children (and adults) display behaviours that may reflect over-involvement of emotional or physical states or over-involvement of analytic states, respectively, with a corresponding decrease in involvement of the alternative brain system of process type (Shore, 2003b; Siegel, 1999). Perhaps differences in affect regulation via the attachment process influence which cognitive style predominates in a person’s profile such that secure attachment may result in the expression of a balance between intuitive (together with healthy development of affective processes as part of physical sensations) and analytic cognitive styles, whereas disrupted attachments result in the expression of extreme preferences for either intuitive (dysfunctional affective processes as part of physical sensations) or analytic cognitive styles. In this way, research on intuitive style may help to further define mental health. To this end, the detail of the ways in which the intuitive style process operates may provide a step-by-step procedure for addressing dysfunctional regulation arising from disrupted attachment.

Perhaps a step-by-step procedure for addressing dysfunctional regulation may begin with assessment of each aspect forming the process of physical sensations using the ICSS. The modifications to the ICSS applied after statistical analysis of the process modelling (Chapter 7) suggest that selected components of intuitive style could be used together as a clinical tool for assessing the process of physical sensations. Following assessment, therapeutic interventions targeting specific components or the integrative functioning of cognitive, affective and somatic processes may be applied. For example, a person reporting average associative and affective components with low or no physical sensations on the ICSS may benefit from therapeutic techniques such as mindfulness to heighten their degree of interoception of internal bodily states and then learn to interpret the meaning of those internal bodily states, hopefully developing some degree of intuitive physical sensation. However, this line of thinking is highly speculative and would benefit from extensive future research.

Conclusion

Over the years research approaches have developed knowledge around intuitive style, as one pole of the bipolar intuition-analysis variable. However, in the course of advances in research, the psychometric structure of intuitive style as single entity has been brought into question by other researchers who have suggested that intuitive style may be multidimensional, thus drawing into question its theoretical foundations and providing an exciting opportunity for further development.

To this end, the current thesis took into consideration new knowledge developments in the neuroscience of intuition to shed light on potential options for knowledge growth in intuitive style and has demonstrated the development of a psychoneurobiological-based multidimensional process model of intuitive style. To build and understand a psychoneurobiological-based multidimensional process model of intuitive style, a new instrument the Intuitive Cognitive Style Scale (ICSS) was constructed and validated in Chapter 5. The dimensions of intuitive style were then subjected to scrutiny via indirect effects process modelling in Chapter 7 following a review of literature, Chapter 6, from which a set of potential models arose. It emerged from the process modelling that situational factors may determine which aspects of intuitive style are actively forming the process. In particular, there was support for a distinction between social and non-social contexts that influence which components of intuitive style come into play during the process. Further, physical sensations were demonstrated to be the outcome of the intuitive style process. The largest effect sizes were shown to occur in two models: a) when associative processing triggered intuitives to pay attention to other’s non-verbal cues that then resulted in a physical sensation, and b) when associative processing triggered positive affective states that then resulted in a physical sensation.

Because the bipolar version of intuitive style was used extensively to understand individual differences in business settings, the current work returned to examine physical sensations as an outcome of the intuitive style process in relation to occupational variables producing evidence, contrary to earlier findings, that extraversion and agreeableness positively influence the relationship between intuitive style and aspects of job satisfaction, whereas, neuroticism negatively influences the relationship between intuitive style and aspects of job satisfaction.

Moreover, the conceptualisation of intuitive style as a process model turned out to hold important consequences for cognitive style research, particularly in terms of epistemological and measurement considerations making the shift from the bipolar approach to a style-as-a-system approach. Furthermore, the yet-to-be-tested theoretical linkages between intuitive style as a process and new developments in psychoneurobiology may turn out to be informative for areas of mental ill health and mental health alike leaving the way open for future growth in intuitive style research.

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Appendix A

Intuitive Cognitive Style Scale

The following questions relate to your preferred way of thinking in general.

1. People sometimes notice physical sensations in their bodies, such as 'goose bumps' or 'feeling in one's bones' that guide their thinking. What is your preference for the following items in guiding your thinking?

	1 Not at all	2	3	4 Neutral	5	6	7 All the time
Chills							
Lump in the throat							
Hair standing on end							
Gut feeling							
Knot in my stomach							
Tension in my body							
A vague sense in my body							
An awareness of something							
An inkling of something							
A vague sensation							
A sense of knowing							
Sixth sense							
Hunch							
A kind of feeling							
A glimmering of something							

2. People sometimes notice the non-verbal cues (body language) of others and use these to help them think. For example, a nurse may say that a patient 'doesn't look right', or a business manager may say 'something about the way they spoke made me think'. What is your preference for the following items in guiding your thinking?

	1 Not at all	2	3	4 Neutral	5	6	7 All the time
A person's emotions							
Something in the tone of voice							
Something in their face							
A person's breathing							
The tilt of their head							
Their posture							
The feeling you get from them							
Something in the shape of their mouth							
The look in their eye							
Something about them							

3. People sometimes experience positive or negative emotions when they are thinking. For example, some people describe being 'seized by joy' or 'overwhelmed with anxiety' that guide their thinking. What is your preference for the following items in guiding your thinking?

	1 Not at all	2	3	4 Neutral	5	6	7 All the time
A sinking feeling							
A sense of peacefulness							
A feeling of dread							
A sense of gladness							
A feeling of anxiety							
A feeling of wrongness							
A sense of joy							
A feeling of misgiving							
A sense of excitement							
A feeling of fear							
A sense of harmony							
A sense of significance							

4. People sometimes say that they experience their thinking as 'knowing in a flash'. For example, racing car drivers make snap choices about what to do next when driving. What is your experience of the following items in guiding your thinking?

	1 Not at all	2	3	4 Neutral	5	6	7 All the time
My thinking is spontaneous							
Fast							
The answer comes right away							
Rapid							
Straight away							

5. People sometimes take a broad approach when thinking. For example, some people say it is very important to them to 'skim the surface of a lot of information'. What is your preference for the following items in guiding your thinking?

	1 Not at all	2	3	4 Neutral	5	6	7 All the time
An overall view of things							
See the big picture							
A sense of structure							
The pieces falling into place							
A sense of completeness							
Total overview							
A sense of the whole pattern							
A global approach							

6. People sometimes think in a way that means they cannot describe the steps in their thinking. For example, people will say they ‘can’t explain how I know, I just know’, or ‘ I can’t explain how I worked out the answer, I just did’. What is your experience of the following items in your thinking?

	1 Not at all	2	3	4 Neutral	5	6	7 All the time
I can't explain my thinking							
I don't know how I know							
My thinking is unconscious							
I just know							
It's just there in my mind							

Appendices on CD

Appendix B Approvals and Permissions

Ethics Approval

Permissions For Use of Instruments

Explanatory Statement

Informed Consent

Advertising Material

Appendix C Scale Development Supplementary Statistics

Survey 1 Participant Descriptives

Survey 2 Participant Descriptives

ICSS Inter-item Correlations

Exploratory Factor Analyses: Association, Somatic/Affect, Cognition and Non-verbal Scales

ICSS Reliability

ICSS Item Descriptives – Survey 1

ICSS Factor Structures 5, 6, 8 Factors

Survey 1 ICSS Subscale Descriptives

Survey 2 ICSS Subscale Descriptives

Combined Dataset ICSS Subscale Descriptives

Combined Dataset Big Five Inventory Descriptives

Appendix D   ALPHAMAX Development Sample

Physical Sensations

Big Picture

Positive Affect

Negative Affect

Observed Non-verbal Cues

Rapid

Non-conscious

Appendix E   ALPHAMAX Cross-validation Sample

Physical Sensations

Big Picture

Positive Affect

Observed Non-verbal Cues

Rapid

Non-conscious

Appendix F   Scale Development Validation Supplementary Statistics

ICSS Subscale Correlations: Age, Education and Gender

Appendix G   Process Modelling Supplementary Statistics

Somatic Marker (Damasio) Process Modelling

X-System (Lieberman) Process Modelling

Associative System (Sloman) Process Modelling

Complete ICSS Process Models

Appendix H Multiple Mediation Supplementary Statistics

Combined Dataset Job Satisfaction Descriptives

Parallel Mediation Modelling