A Taxonomy and Process for Structured Innovation, Creative Problem Solving and Opportunity Creating

Thesis

UNRESTRICTED

A TAXONOMY AND PROCESS FOR STRUCTURED INNOVATION, CREATIVE PROBLEM SOLVING AND OPPORTUNITY CREATING

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Abstract

Myriad problem-solving techniques exist, but the literature indicates that people and organisations lack appreciation of the range and nature of the techniques available, and do not fully understand the use, value and potential of such techniques. A more profound understanding of the role that different types of problem-solving technique can play and how they can be deployed more effectively in creativity and innovation processes would form a sound basis for the improvement of creative practices and innovation processes within organisations.

This research aims to provide the means to improve innovation and creative problem solving by using more effective matching of participants' cognitive styles to the techniques available.

In order to achieve synergy in the relationship between the techniques and their users, this research examined the contribution that techniques make to the creative problem solving cycle, and the degree of creativity they encourage was explored first through a review of the relevant literature. This resulted in a novel classification of the techniques and the cognitive skills involved in creative problem solving.

The relationship between people and techniques was investigated through a set of experiments in which individuals and groups undertook problem-solving exercises and responded to a questionnaire to evaluate their experience of the exercise. Participants' preferred cognitive styles were determined so that problem-solving techniques could be selectively assigned to align with or be opposed to their preferred cognitive styles. Results were analysed using both qualitative and quantitative approaches.

The cognitive styles provided parameters for a taxonomic framework for the techniques. An improved approach to describing personalities based on a continuum of cognitive abilities instead of a set of discrete cognitive styles was a further outcome of this work. The results demonstrate that people show significant preference for problem-solving activities and techniques that are in accord with their preferred cognitive styles. A key conclusion is that people who follow such an approach will improve their ideation productivity in terms of quantity and novelty and will gain more satisfaction from their experience than those who do not. Analysis of the purpose of creative problem solving techniques and the cognitive styles that such techniques encourage, revealed synergy between paradigms used by psychologists and those used by technologists. The synergy between paradigms established a platform for a new creative problem-solving strategy.

"...I do what I'm good at, to help you do what you're good at..."

William Patrick Moran 1931-2010

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List of Abbreviations

CPS	Creative Problem Solving
DTI	Department of Trade and Industry
EC	European Commission
IMT	Innovation Management Tool
NESTA	National Endowment for Science Technology and the Arts
SME	Small and to Medium-sized Enterprises
EIMS	European Innovation Monitoring System

1 Introduction and background to research

1.1 Innovation and importance

In 1998, the U.K. Department of Trade and Industry (DTI,1998) supported the view that competitiveness depends on exploiting distinctive valuable assets, namely, knowledge, skills and creativity. However, nine years later, at the 2007 DTI innovation conference (DTI 2007), government bodies reported that they still face the problem of reminding industry about the economic importance of innovation.

According to a National Endowment for Science Technology and the Arts (NESTA) report published in 2009 (NESTA, 2009), firms that are more innovative show higher sales growth than non-innovative firms do. The initial report stated that an innovative economy is high on the wish lists of many governments and highlighted a general lack of understanding of innovation in business processes, services, management of innovation as a system and long-term strategy.

The final report, published in October 2009, explained that a recent comprehensive review of innovation management observed there was no holistic framework. The situation was exacerbated by too many approaches and practices being confusing and contradictory. The final report drew attention to a study for the European Commission in 2006 (EC, 2006) that looked at tools, practices and approaches to innovation for small and medium-sized enterprises (SMEs). The cited European Commission (EC 2006) investigation found that, while a lot of diversity existed in terms of concept and usefulness, most of the tools available are not widely accepted by consultancies and SMEs. Moreover, although a new best practice tool for SMEs was, developed in 2006, this had gained no greater acceptance (NESTA 2009). An earlier European Commission investigation (Brown, 1996) into tools and practices used by consultancies working with SMEs had also reported a lack of understanding of innovation.

What can be described as, natural reluctance to innovate, was addressed by Sowrey (2001) when looking for reasons for companies' apparent neglect of idea generation. Criticising Midgley's assertion (Midgley, 1997) that creating ideas is relatively easy and anyone is capable of generating them, Sowrey explained that too often ideas lack potential and practicality. They can fall outside a company's remit and in general, idea generation does not attract the attention it deserves. Rickards (1985) whose appraisal is that all ideas are good ideas as they can all be improved, had earlier remarked that, innovation is misunderstood by managers; and had been for a long time.

Sowrey (2001) also explained that not enough literature had been written to describe innovation techniques and even less had been written to assess the techniques. While Parnes (1961) and Bouchard (1972) had earlier attempted to resolve this void, after a comprehensive search, Sowrey found only four studies done in the UK that could be useful to a practising manager. Interestingly, Sowrey also observed a greater preference towards analytical techniques than towards creative techniques.

1.2 Creativity as a human resource

Examining organisational culture, Rollinson et al. (1998) explained that globally, the effects of technology and industry could be so extreme, there was evidence to support the claim that eventually all industrial roles and structures would end up very similar. Rollinson et al. described this migration as convergence theory. This theory was under-pinned by the assumption that efficiency requires a high level of specialisation and for organisations to have very tight couplings of tightly prescribed roles. Such tight couplings in an organisational structure lead to rigidities that could render an organisation ill- equipped to cope with change (Rickards, 1985).

Another perspective used to describe an organisation is that of human relations. The human relations view is more biased towards effectiveness than it is towards efficiency Ott (1989). It focuses more on the how and the why people behave as they do and on issues such as ways increasing motivation and commitment. Unfortunately, creative work too often appears relegated to a particular field or occupation rather than being seen as important to a wide range of organisational roles (Byrne et al., 2009).

Also within the work place, there are many behaviours exist that influence the creative process, from group interaction to individual performance and capabilities (Byrne et al, 2009). Pidd (2003) observed that describing the human behaviours within the workplace as a plethora of conflicting views. Pidd attributed this phenomenon to the fact that every person in a workplace is unique, particularly when it comes to the way each individual 'thinks' with respect to how they 'think'. Focusing on thinking, Pidd explained some people as being full of ideas and divergent while others prefer to focus on a point, that is, they are convergent. In Pidd's view, both creative intuition and rational analysis are indeed necessary in the workplace, and stressed the need for greater partnership between these two skills is needed in order to achieve success.

Pidd (2003) suggested the natural reluctance to be creative may have links to the way people think and behave in the workplace. Lumsdaine & Lumsdaine (1995) also drew attention to this possibility. They highlighted a trend that dominant thinking styles within the workplace have changed from the 1960s through to the 1990s. The styles considered were sequential, analytical, imaginative and interpersonal. In the 1960s sequential thinking was deemed to be the key to success. In the 1970s, it was analytical, in the 1980s, an even balance between these two, and for the 1990s, imagination. Moger and Rickards (1999) observed renewed interest in creativity in the late 1990's. The scope of this renewed interest was organisational creativity while interest in individual creativity waned. Moger and Rickards considered that organisational creativity was surrounded with, many uncertainties which were not well-understood. Pidd's (2003) view too was that a fresh approach is necessary.

Working practices can often be seen as procedural, some serial, some repetitive and cyclic. As explained by Rollinson *et al.* (1998), structured working practices and arrangements can become a 'mental programme', part of the culture of the organisation thus defining the culture as 'the way we do things here'.

Such cultures can be constraining and can thereby disadvantage the long-term economic growth and financial sustainability of a company by blinkering people at all levels and stifling innovation by encouraging people to focus too much on being seen to be doing the right thing as opposed to actually doing the right thing (Rickards, 1985). For a company to survive it must be responsive to market demands and able to respond to external environmental changes. One major characteristic of such successful companies was their ability to generate ideas (Sowrey, 2001; NESTA, 2009).

To improve a company's idea generation capability, attention must be paid to increasing creative ability overall Rickards (1985). This delivers a different, more holistic, malleable and creative approach to thinking in the workplace. The traditional linear approach to innovation is now redundant as innovation is a multi-dimensional process requiring many factors (NESTA, 2008).

1.3 Changing Practice

Jones (1992) examined the practices of designers to explore whether these could usefully be adopted, exploring the possibility of their adoption by other disciplines. He concluded that there was no consensus as to what was 'best practice' in the design process, and that it was necessary to look beyond Jones commented that there appeared to be as many descriptions of what design is as there were designers. As a result, Jones resigned himself to the view that, to seek a firmer basis for our thoughts, we had better look outside the process itself.

Later, an EC study performed by Brown (1996), examined the tools and methods used by consultants, to assist SMEs in managing innovation. Brown explained that innovation management is not just about technological change, it is also about 'people' issues - culture, communication and processes -,at least as much as it is about technology.

A major benefit of innovation management tools according to Brown is their ability to engender a holistic view of innovation, and to highlight issues that often prevent firms from taking full advantage of new technologies, opportunities and structures. Examining the application of the techniques available, Brown explained:

- There is no such thing as an ideal all-purpose innovation management tool.
- The key to success is a 'best fit' combination of methodology, consultant and client.
- A 'best fit' approach must consider a firm's internal issues, resources and competencies.

Despite the existence of 'good practices', Brown (1996) identified the need to further develop innovation techniques, particularly the design of tools to suit the specific concerns of SMEs and the tailoring of tools to suit particular sectors or firms. Brown further highlighted a lack of awareness among consultants, firms and agencies, of the range, scope and potential benefits of innovation management techniques (IMT), also observed over a decade later by the EC and NESTA. (EC, 2006; NESTA, 2009)

The literature demonstrates that there are two broad perspectives on the improvement of innovation practices. On closer inspection, two perspectives seem to unfold. The first is a procedure – the perspective used by Jones (1992), in an attempt to build a library of techniques. The second perspective is people, adopted by Brown (1996) with the assertion that a best fit relationship between people and technique would be the way forward. Pidd (2003) also adopts the people perspective explaining that people are indeed unique, and that all their inherent differences, in some way, are complementary. To promote innovation these resources must be harnessed.

The importance of the people perspective emerged also in research by Benson (1989) who examined success factors for strategies used in product design. Making reference to what was described as the McKinsey 7-S model, Benson explained that this strategy had two sets of factors. The set of factors described as systemically hard, were strategy, structure and systems. The set of factors described as systemically soft were defined as skills, staff, shared-values and styles.

Investigating human motivation, Amabile et al. (1994) found that people who are intrinsically motivated (motivated by personal interest not reward) are more creative. Intrinsic motivation had also been shown to be quite sensitive to conditions in the workplace. Amabile(1985). Explaining that creativity relies on expertise, task motivation and creative thinking, Amabile (1996) further explained that creative thinking depended somewhat on personality traits and the ability to break out of preconceived perceptions.

Furnham (1995) described two discrete strategies adopted by people in the workplace: a perceptive strategy with the ability to break out of preconceived perceptions as a perceptive strategy, adopted by people who tend to emphasise concepts and relationships; and a receptive strategy adopted by people who prefer to work within preconceived boundaries Furnham described as receptive with a bias tendency for detail.

Kolb (1978) had earlier investigated the personal traits involved when people are learning and described a set of learning styles. This led to the understanding that people continuously use such styles to make intuitive decisions, consider situations from many perspectives, logically analyse and get involved in order to influence the situation under consideration. . Further investigations by Kolb(1978), Honey and Mumford (1995), Basadur et al. (1990) into learning styles, led to the understanding that each individual will be more proficient with and thus prefer only one learning style. Furnham (1995) concluded that, regardless of the problem to be tackled, each individual will endeavour to use, his or her, preferred cognitive style to approach it. Also, intrinsic qualities that define individuality make people more adept at some tasks rather than others.

This distinction between the two sets of hard and soft factors, procedures on the one hand and the intrinsic bias of people on the other, coupled with the comment made by Jones (1992, p27) that, "...the usual difficulty is that of losing control of the design situation once one is committed to a systematic procedure ..." might hold the key to improvement.

The researcher believes that focusing on exploration of the relationship between the intrinsic cognitive bias of human beings and problem solving procedures (soft and hard) is a potentially fruitful and viable avenue for further investigation.

1.4 Issues encountered in the innovation process

The Temaguide report (Temaguide 1998), described the creative problem solving as a cycle consisting of four fundamental procedures, namely, scanning, focussing, resourcing and implementing. McFadzean (2000) explained the tools used by such procedures varied in the way they encouraged people to change paradigms. As human beings, we appear to have an innate appetite to conform and follow rather than explore and discover thus illustrating our reluctance to embrace change and take full advantage of the opportunities that it offers. A strong pursuit of efficiency may also have left a legacy in the workplace making too many disciplines become too reliant on highly prescriptive steps to achieve the desired goal.

Discussing human intuition, Pidd (2003) explained that a reason for such an over reliance on procedures derived from Mintzberg (1976), who had argued that human brains employ two quite separate approaches to processing information. Mintzberg's view was that the left hemisphere preferred a rational, sequential and logical approach and the right hemisphere preferred a relational and holistic approach. Amabile & Pillemer (2011) have since explained that research in neuroscience by Bowden and Jung-Beeman (2000) revealed semantic activation of the right hemisphere can induce what they described as 'aha' moments of insight. Further research explained that when people are solving problems, activity in both hemispheres is initiated in the left hemisphere (LH) is stronger than that in the right hemisphere (RH). The strength of LH activity fades very quickly leaving the RH activity, although diffuse, to continue. This RH activity appears to relate to the experience of insight when solvers recognise solutions.

The observations made by Sowery (2001) suggested greater preference towards analytical as opposed to creative techniques might lend weight to Pidd's (2003) argument of reliance on formal processes. Rickards (1985), however, had earlier commented that only when these two approaches combine does innovation occur.

Taking into consideration the reliance on prescribed steps within the workplace, Flood & Jackson (1991) introduced the concept of methods of methods. Flood & Jackson explained it would be somewhat naive to expect to put all real world problems in a box, though it was useful to group problem contexts according to relative complexity and the relationships stakeholders have with the systems. In an attempt to classify participants, Flood & Jackson adopted categories, unitary, pluralist and coercive. They explained that when a system is deemed (by their definition), as complex and having coercive participants, complexity characterising the situations of concern hides the true sources of power of the various participants. No systems methodology currently bases itself upon the assumptions that problem contexts are complex and coercive. We do not yet possess the tools to tackle such contexts when they arise in the real world.

Participants in creative problem solving processes typically become subservient to the process itself, with their behaviour modified by the constraints imposed by the process. Moreover the process was probably originally designed to tackle a problem different from the one in hand albeit with some similarities. In the context of creative problem solving, by adopting the stance of methods controlling people as participants, one is automatically placing oneself into a state of submission to the process and thus coerced by the inherent controls of the process. The process was more than likely designed to tackle a different, or at best, a similar situation. Moreover, the values and beliefs used to design such a process can easily change, subject to circumstance and even become redundant or irrelevant.

As paradigms change, the boundary and scope of a problem solving technique may fall into conflict with the present user's interests by imposing inappropriate values and constraints. This inheritance legacy could impair the present user from doing what he or she is intending to do by only allowing the user the freedom to do what the selected method or technique will allow. In short, the ontology of the procedures and techniques has not kept abreast of the development in application.

Instead of using procedures as a tool to explore possibilities, many users, unaware of this functional fixatedness, may follow methods in good faith too rigidly, and become easily misled by the procedures and develop an unrealistic belief that the chosen procedure will automatically lead to a perfect solution.

Jones (1992) highlighted the risk of losing control of the design situation once one is committed to such a systematic procedure. It also fits neatly into Flood & Jackson's (Flood & Jackson, 1991) definition of coercive, where the users of the systemic procedures do not share common interests and their values and beliefs are likely to conflict with the design situation to hand. Our cultural reliance on formal techniques could be one of the contributing reasons or factors that underpins both Sowrey's (Sowery 2001), Brown's (Brown 1996) as well as the many comments in the literature that there appears to be a lack of awareness within industry of the range, scope and benefits of innovation management tools.

Having described the box that one is often told to think out of, Pidd's (Pidd 2003) notion of a little common sense coupled with Flood & Jackson's (Flood & Jackson, 1991) vision of a meta-strategy are both approaches that could assist designers and problem solvers combine creativity with formal techniques. This would avoid placing themselves in the uncomfortable predicament of trying to be creative while at the same time wearing a cognitive strait jacket. Byrne et al (2009) explained that one major implication of this is that leaders need to structure creative work in a way that is personally engaging and intrinsically motivating.

1.5 Research aim and objectives

1.5.1 The research problem

The tendency to rely too heavily on prescribed methods, although useful in some cases, in the realm of creative problem solving it appears to have overstayed its welcome. Awareness and understanding of the range, scope and management of innovation techniques has, among consultants, firms and support agencies become inadequate. One manifestation of this is the tendency on organisations to over-reliance on prescribed formal methods.

Brown commented that the potential benefits from using innovation techniques require much further development. A point on which many researchers concur is that the purposes and potential benefits of the various innovation techniques need to be better understood (Brown, 1996; Jones, 1992; Pidd, 2003; DTI, 1998). One symptom of this situation, pointed to by Jones, is the difficulty of losing control of the design situation by adopting a problem solving procedure. Jones suggested that the key issue is the relationship between people and techniques. Earlier research appears to have largely overlooked this perspective.

The aim of the research is as follows. This research intends to investigate the relationship between people and techniques in order to and deliver the means to improve innovation and creative problem solving by using more effective matching of participants' cognitive styles to the available techniques.

1.5.2 Justification for Research

The aim of this study is to investigate what happens in creative problem solving by exploring the behaviour of people as both individuals and groups, the types of methods available and where such methods are used as well as the thinking and skills necessary to drive them.

Establishing a clearer view of the relationships between these entities would make a valuable contribution to knowledge in this field as well as providing knowledge and techniques of use to a wide range of organisations and individuals seeking to enhance their innovation practice and performance. The research also has the potential to open up avenues of further research, for example to establish specific frameworks and guidance for practitioners.

The key ideas considered are: Brown's suggestion for tailoring IMTs (Brown 1996); Pidd's concept of conflicting personal perspectives (Pidd 2003) ; Rickards view that every idea is a good idea (Rickards 1985); Amabile's tenet on the importance of intrinsic motivation (Amabile 1994) and the view of Byrne et al (2009) that leaders should restructure creative work. These all suggest that tailoring techniques to suit the people who use them is a viable perspective. A synthesis and development of these ideas should encourage an improved and more complete perspective to problem solving.

This research proposes the means to improve innovation and creative problem solving by using more effective matching of participants' cognitive styles to the available creative problem solving techniques.

1.5.3 Research Objectives

The overall aim of the research is, as previously stated, to propose the means to improve innovation and creative problem solving by using more effective matching of participants' cognitive styles to the techniques available. This aim can be broken down into the following specific objectives.

- To investigate, analyse and report on the problem-solving methods currently available
- To investigate, analyse and report on the current knowledge about how people think
- To devise a method to investigate, analyse and define people's cognitive styles
- To devise and carry out an experiment to investigate and analyse influences the relationship between people's cognitive styles and use of problem solving methods, reporting all findings
- To devise and carry out an experiment to investigate, analyse and report on how group and individual cognitive styles being can be better employed to increase innovative productivity to enhance innovation performance
- To explore the basis of a 'new approach' to improve creative problem solving and its suitability
- To define such a strategy and explore its implications, payoffs benefits and limitations
- To evaluate and report on the application of such a strategy as an improved means of assisting idea generation
- To investigate, evaluate and report on the likely acceptance of such a new strategy
- To report conclusions about the efficacy of the 'new approach' and recommend areas for further research

1.5.4 Research direction

Comparing the cognitive activities used by people whilst learning, to those required at the different phases of creative problem solving, as described in the Temaguide (1998) report, a resemblance emerges. Similarities had been identified earlier by Basadur et al (1990) who showed them to be fundamentally the same. The ability of a creative problem solving techniques to facilitate the keeping or breaking of a paradigm, explained by McFadzean

(2000), also shows resemblance to Farnham's (1995) view of the natural abilities of people to remain within a preconceived paradigm or to break out of it. Although such similarities exist, Moger (1997) explained that investigation into the codification of techniques subject to structure and the user's cognitive style, was overdue.

Amabile (1985) explained the importance of keeping people intrinsically motivated to encourage creativity as the slightest attempt to, extrinsically motivate would, heavily mitigate creativity. Following Farnham's (Farnham, 1995) view that people will always use their own preferred cognitive styles to solve problems, perhaps it can be hypothesised that creativity is discouraged when people who execute tasks alien to their own preferred cognitive styles discourage creativity while it is encouraged by people performing tasks akin aligned to their own preferred cognitive styles would encourage creativity.

It follows that by assigning people to select phases of creative problem solving, appropriate to their preferred learning and creativity style their ideation productivity and novelty of ideas should improve. Moreover, it is possible that people who follow such an approach will feel more at ease and gain more satisfaction than those who do not.

1.6 Outline of thesis

The thesis is now outlined chapter by chapter.

Chapter 2

This chapter provides a comprehensive review of the relevant literature leading to a synthesis of ideas that provides the hypotheses to be tested through the research.

This section investigates literature on the thinking styles of individuals. This is reviewed to define what they are and examines the relationships between them. This provides the basis for exploring the relationships between learning styles, creativity and problem-solving and will assist in achieving a better understanding of the influence thinking styles have within the innovation process when it comes to creativity and problem solving.

Some techniques and methods employed in creative problem solving require group participation. Putting people together as a group introduces a different style of human behaviour. The literature on the relevant aspects of group behaviour, examines several aspects of behaviour, particularly communication, is also therefore reviewed. This helps to identify the role or influence such behaviour has in creative problem solving.

To improve understanding of the creative problem-solving process this chapter also examines how the processes and techniques have evolved as well as the perceptions that make it what it is today.

The conclusion of this chapter brings together the findings of the literature review to develop skills, concepts and methods found during the literature review. These findings will be used to, develop a profile of variables and perspectives to necessary to define creative problem-solving and to achieve the research objectives.

Chapter 3

Chapter 3 describes the methodology and methods used to capture and analyse the data needed in order to test the hypotheses. This data comprises principally the cognitive styles of the individual participants, and the perceptions of individuals and groups in carrying out a problem-solving exercise based on an assigned technique. The rationale for the design of the methods used is presented. The different considerations relevant to people working either as individuals or within a group are discussed.

The workbook instrument and the associated processes used as the basis of the experiments run with individuals and groups are explained. The methods used to identify, capture and measure the natural cognitive abilities and perceptions of participants are discussed. Assessment criteria, experimental considerations and procedures are, discussed and justified for both the individuals and group experiments.

Further to the actual experiments, the approach to appraisal of the approach of creative problem solving tailored to cognitive styles from the perspective of organisations and practitioners is also explained.

Chapter 3 considers people working either as individuals or within a group and discusses the considerations necessary to devise a method. It further discusses the requirements and assessment of an industry work based appraisal of the approach of creative problem solving tailored to cognitive styles.

Chapter 4

Chapter 4 presents the analysis of the data collected through the experiments in terms of responses from people working in isolation and from respondents working within a group.

Considering people working individually, the chapter examines and analyses the independence, similarities and differences between quantitative responses from two cohorts of respondents quantitatively. The initial analysis used nonparametric methods. Chapter 4 further presents the analysis of responses using parametric methods followed with a qualitative analysis of responses. Both parametric and non-parametric methods are used.

Comparison between the findings revealed some unexpected results. The dissonance caused by the unexpected results was resolved using cluster analysis and graphic analysis. The conclusion of this analysis suggested a new perspective on cognitive styles.

Chapter 4 also presents the analysis and findings from responses from people working within a group. The chapter concludes with a discussion on the interpretation of the findings and their validity.

Chapter 5

In the context of findings, chapter 5 will discuss this chapter discusses the suitability of cognitive styles as a basis for taxonomising creative problem solving techniques. The chapter discusses the appraisal of and the methods used to tailor techniques to the cognitive styles of individuals.

Chapter 6

Chapter 6 discusses the interpretation, validity, implications and limitations of the quantitative and qualitative research results in the context of each hypothesis.

Chapter 7

Chapter 7 presents the conclusions of this research, discussing their viability, implications and the limitations of adopting a best-fit approach to creative problem solving within the workplace. The chapter concludes with a discussion of the opportunities for further research towards helping a more creative work ethic and overcoming barriers to innovation.

2 Literature review

This chapter reviews the literature in three broad areas pertinent to the research objectives:
- Individual creative thinking and behaviour
- Creative thinking and behaviour in groups
- Creative problem solving strategies, tactics and frameworks

This review culminates in a set of hypotheses to be tested by experiment and in a taxonomy of techniques 'mapped' to individual learning styles that is subsequently used as the framework for the experimental investigation.

2.1 Creative thinking and behaviour – the individual

The creative problem-solving process relies heavily on the cognitive styles of an individual. This section will investigate the composition and application of the cognitive styles used to perform creative problem solving.

2.1.1 Cognitive styles

Sternberg & Zhang (2001) described cognitive style as an individual's preferred way of processing information. According to Sternberg (1997), the kernel of all the theories associated with cognitive styles, originated from C. G. Jung and published in Psychologische Typen in 1921. The psychological types identified by Jung are those used for perceiving (sensation and intuition), judging (thinking and feeling) and attitude (extroversion and introversion). Furnham (1995) remarked that this gave way to considerable interest in organisational psychology among many researchers.

Such an evolution of understanding came in two waves of discovery. The first, according to Furnham (1995), was a discovery of different cognitive and learning style preferences exhibited by people working in both academia and commercial/industrial workplaces. The second wave came because of investigations into relationships between student learning behaviour and their academic success. This came about by the observation that different students showed different preferences for different methods of teaching. According to Sternberg (1997) , Myers and Myers (Myers and Myers, 1980 in Sternberg, 1997 p 143) were one of the first to investigate such styles. Their work focused on attributes concerning communication, perception, judgement, and interpretation of information.Examining these facets, certain traits of behaviour became apparent and led to the understanding that, for:

- Communication,
  - Extroverts focus outwardly showing interest in people and environment.
  - Introverts focus inwardly.
- Perception,
  - Intuitive people perceive holistically with an interest in meaning rather than content.
  - Sensing people perceive things serially focusing on detail and precision.
  - Perceptive people are more willing to act on the information and take a gamble.
- Judgement,
  - Thinking people tend to be logical, analytical and impersonal.

- Feeling people tend to be biased towards values and emotion.
- Judgmental people are more dependent on information in the environment.

According to Sternberg (1997), this theory is probably the most widely applied, in both business and education. However, Sternberg questioned the validity of such application by introducing another theory. Citing Anthony Gregorc's "Energic Theory of Mind Styles," Sternberg explained this work followed the notion that people differ in the way they organise space and time. (Sternberg, 1997 p144)

Considering the notion of serial thinking and holistic thinking (see Table 2.1), Cross & Nathenson (1981) described this view as stemming from Gordon Pask's General Theory of Learning and Teaching (Pask, 1976 cited in Cross & Nathenson, 1981 p.13). While neither is more effective than the other according to Cross & Nathenson, Furnham (1995) independently described these two styles of thinking as two very distinct approaches to solving problems. Furnham explained that some students adopted a holistic style using examples, analogies and anecdotes to build their understanding. Other students preferred a serial or list style approach, beginning with a narrow focus concentrating on detail and logical progression, leaving the broader context to the very end.

According to Cross & Nathenson (1981), Pask and Scott (Pask and Scott, 1972 cited in Cross & Nathenson, 1981 p.13-14) conducted an experiment with half of the group receiving information in accordance with their learning style while the others received the contrary. This comparison demonstrated students who when presented with information matching their own style (serial-serial or holist-holist) outperformed those that did not. This contrast was to such an extent that the worst performers of the matched group still outperformed the best performers of the mismatched group. However, Cross & Nathenson (1981) did explain that it was unfortunate that the sample size used at that time was too small for a safe statistical generalisation.

Table 2.1 Characteristics of serialist and holist learners - Pask's comparison of these two styles. Cross & Nathenson (1981)

Characteristics of serialist and holist learners

Serialist	Holist
Proceeds by logical small steps. Tries to get every point clear before moving on to next point	Proceeds much more broadly than serialist, picking up bits of information that are not logically necessary, but which help him to remember certain facts.
Takes a straight route through teaching material with no digressing or unnecessary information.	Likes learning things in different ways. Approach ideas from different perspectives.
Studies a book page by page considering each new idea until it is understood.	Reads a book by skipping around from chapter by chapter, figure to figure with the expectation that the material will eventually fall into place.
Learns, remembers, and recapitulates a body of information in terms of string-like cognitive structures where items are related by simple data links formally, by 'low-order relations'	Learns, remembers, and recapitulates as a whole — formally, in terms of 'high- order relations'.
Teaches back in the same way as he was taught. If a serialist is asked to explain a particular concept, he reproduces the same line of argument presented to him,	Teaches back in a different way from the way in which he was taught (his own version reconstructed). If a holist is asked to explain a concept, his explanation may take many forms since his understanding of it will have been learnt in a variety of ways

People's thinking behaviour according to Sternberg (1997), is either sequential and orderly or haphazard and random. Sternberg explained that Anthony Gregorc examined the difference between such thinking styles (Gregorc, 1979, 1984, 1985 cited in Sternberg, 1997 p144) and, like Myers & Myers (Myers and Myers, 1980 cited in in Sternberg, 1997 p 143), Gregorc had devised measures of combinations of these styles. Myers & Myers used personality traits based on one's bias to feel, be extravert, judgemental and intuitive.

2.1.2 Personality

According to Amabile (1996), the skill of creative thinking depends to some degree on personality. Reflecting on the study of personality, Sternberg (1997) explained that, like cognition theories, personality theories had also received a variety of criticisms and scrutiny with varying levels of support. Riquelme (2000) explained that earlier research had suggested one possible tactic to improve creativity would be selection and training of people with particular personality traits or cognitive styles. Discussing the concept of psychology types and cognitive styles, Sternberg (1997) had earlier explained that the perspective of "types" focused more on personality than it did on cognition. Comparing cognitive styles with personality types Sternberg concluded that, "...one might be rather hard pressed to distinguish the difference between them both...".

Examining Streufert and Nogami's work (Streufert and Nogami 1989), Furnham (1995) explained that, the combined examination of styles, complexity theories, abilities and job content had introduced a considerable predictive capacity within organisations. The stance argued by Sternberg (1997) was that, using types and styles could lend risk to typecasting people into pigeonholes. While stressing such a risk, Sternberg was also quick to argue that, in reality, one cannot pigeonhole people as easily as the psychologists might like. This is because people are often more flexible than psychology theories usually give them credit for.

Across many facets of psychology, Furnham (1995) explained, individuals having a preferred way of thinking and behaving is not new to the psychologist, particularly in the way they gather, process and react to information. Puccio and Grivas (2009) showed agreement with this view by explaining that Kirton (1976) had developed a theory of creativity that focused on the cognitive styles people used to process information and express their creativity.

From a cognitive perspective there appears to be a broad consensus that an individual preferred approach to processing information and expressing creativity does exist. Furthermore, according to Amabile (1996) and Chong & Ma (2010), creativity is associated with such individual traits. Mueller et al (2011) had proved that people have ambivalent feelings towards creativity; people who are tolerant of uncertainty show positive views towards creativity, while those who are not tolerant show the contrary. Rickards (2012) explained that Amabile (1996) had earlier theorized a model of creativity to specify elements conducive to creative behaviours. Amabile's list of the personality traits associated with creativity related to, risk taking, independence, self-discipline, tolerance of ambiguity, perseverance in the face of frustration and showing small concern for social approval.

This consensus lends broad support to the researcher's hypotheses that each individual will have a preferred approach to express his or her own creativity. From a personality perspective however, Sternberg's (1997) warning that psychological theories often overlook the fact that people are more flexible than theories given them credit for, suggests a cautious note to the researcher that the shared understanding in the context type-casting is not so clear and requires further investigation before drawing firm conclusions.

2.1.3 Behaviour

The general perspective of human behaviour also seems to be in accord with Sternberg's view that the concept of activity centred styles unlike cognitive and personality theories focused more on the activities that people engage in during their educational and working life. Citing the works of Dunn & Dunn (1978) and Holland (Holland 1973 cited in Sternberg, 1997 p. 146), Sternberg explained that Dunn & Dunn's work was based on an individual having eighteen different styles that were grouped into four main categories, namely: environmental, social, physical and emotional. Sternberg questioned the necessity of eighteen styles to describe a person's ability *to learn* rather than how a person *actually does* learn. Holland, on the other hand, according to Sternberg, had specified five styles: *realistic, investigative, artistic, social and enterprising* found in the occupations and vocations that make extensive use of preferred styles of working.

According to Cross & Nathenson (1981), the concept of using polarities to model differences between styles was to identify differences between convergent and divergent thinking. Convergent thinkers focus on achieving a right answer. Divergent thinkers, by contrast, are not concerned with one absolute answer but rather use their ability to generate wide-ranging answers. Both convergent and divergent styles of thinking, Pidd (2003) explained, are present to a greater or lesser degree in all individuals. Some people show bias towards one while others are equally good at both. This supports Zhang et al's (2012) view that styles are distinct from abilities as they involve preferences, not necessarily conscious ones, in the use of an individual's abilities.

Furnham remarked on McKenny & Keane's (McKenny & Keane, 1974 cited in Furnham, 1995) two-dimensional model of cognitive styles. One dimension is used for information gathering. It distinguishes a perceptive strategy from a receptive strategy. The other is the information-valuation dimension, used to separate a systematic strategy from an intuitive strategy. Considering information gathering, Furnham (1995) described the perceptive strategy as emphasising concepts and generalisations of the relationship between the various elements. By contrast, a receptive strategy is one that focuses on each element of data in isolation ignoring any relationships that may exist. Furnham summarised these approaches: perceptive strategy is a holist's search of commonality, while the receptive strategy is a reductionist's pursuit of uniqueness.

Up until this point of the evolution of understanding, descriptions of thinking styles seem to have migrated from simple dichotomies to many points of extreme polarities. As the understanding became more profound and holistic, the concept that appears to have evolved is that people possess not just one, but many of these polarities to a greater or lesser degree with a bias towards one. This could be seen as a gradual migration in perspective from the logical *exclusive-or* to the *inclusive-and.*

2.1.4 Motivation

Amabile (1998) described creative thinking referring in terms of to how people approach problems. Solutions depend upon a person's ability to rearrange existing ideas in new combinations. This skill depends on personality as well as on how a person thinks and works. There is also the issue of what it is that the question remains, what is it that makes a person adopt and solve that particular problem in the first place.

Amabile (1996) explained that such a catalyst is task-motivation. Task-motivation depends on a person's attitude toward the task and the perceptions of his or her reasons for doing the task. People's motivation will be ignited by deep-interest or simple reward. According to Rickards (2012), evidence suggesting this difference in perspective was first observed when children displayed a greater willingness to perform tasks that had no external reward. (Amabile, 1996; Rickards, 2012) Amabile described people who show preference for the interest route as intrinsically motivated and those preferring the reward route as extrinsically motivated. Rickards explained that Amabile had developed a view that an intrinsically motivated state was conducive to creativity.

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Comparing the two orientations or styles Amabile (1985) noted that when an individual adopts an intrinsic motivational orientation, features such as novelty, complexity, challenge and opportunity for mastery of experience are preferred. When a person adopts an extrinsic motivational approach, symptoms such as predictability and simplicity emerge since the primary focus is to simply, get through the task. Amabile's conclusion was that extrinsic orientation towards work should inhibit creativity while intrinsic orientation towards work should encourage creativity. Amabile (1996) also explained that intrinsic task-motivation is quite sensitive to and easily influenced by constraints and enablers in the work environment.

2.1.5 Convergent and divergent thinking

According to Cross & Nathenson (1981), Guildford (1967 cited in Cross & Nathenson, 1981) identified the difference between convergent and divergent styles of thinking, and their presence to a greater or lesser degree in any individual, not dismissing the point that some people may show an equal bias. Describing the concept of convergent and divergent thinking as being deep-rooted in design, Cross & Nathenson described the process of designing, as moving between these two styles of thinking. Jones (1966) had used these two styles of thinking as a means to classify design methods, as did O'Dell (2001) when describing the problem-solving process and Sternberg (1997) when examining how people 'prefer to learn'.

Furnham (1995) explained that adopting a learning preference, is because we are all individually unique. All individuals naturally tend to be more adept in some abilities than they are in others. The human tendency to adopt a preferred learning style was discovered by Kolb (1978). Kolb also discovered two other styles of thinking defined as assimilation and accommodation. Sternberg (1997) offered a synopsis of such learning styles:

- **converging:** a tendency to prefer active experimentation and the abstract using deductive reasoning to target specific problems,
- **diverging:** showing a high degree of imagination with preference for concrete experience and reflective observation as while also showing a strong interest in people,
- **assimilating**: a preference towards the abstract with reflective observation applying it to a theoretical model with an aim of drawing integrated explanation from disparate observations,
- **accommodating**: prefer concrete experience and active experimentation with a tendency to take risks.

2.1.6 Thinking and doing: the concepts

As understanding of creativity, learning styles and problem solving has evolved, so too have the perspectives used to describe such an understanding. There has been a change in perspective, including a move away from the view that there are two extreme points, suggesting a person is of only one type or the other, towards the notion of a continuum or line with the inference that describing an individual as possessing a has a unique combination of competing thinking styles.

Similarly, by adding another dimension to represent "how people prefer to do things," will increase the complexity of the continuum. The graphic representation of such a two dimensional the continuum will be planar rather than linear. The reason for adding a new dimension was, according to Furnham (1995), to separate the active strategies from the reflective ones. People who adopt an active strategy show a bias to experimentation and are, according to Furnham, *doers* who are more interested in outcomes than in any theory. Moreover, activists are quick to show impatience if solutions are not immediately forthcoming. People who Furnham described as *thinkers* showed favour to a reflective strategy. They tend to observe and ponder before deciding to take action. They show more interest in theories and concept than immediate application.

To emphasize this contrast Furnham (1995; p.404) cited:

- Henderson and Nutt (1980) who found that the two styles produce distinct decision-making in managers.
- Whetton and Cameron (1984) found that active managers are likely to be more effective when a quick response is required and receptive managers are better at dealing with higher complexity and in-depth analysis.
- Mulowsky & Freeman (1979) found that managers who are more systematic than intuitive tended to implement more computer systems than those who are intuitive.

Furnham's (1995) appraisal of the work done on thinking styles, was that while much had been done albeit in many directions, some directions were overlapping while some remained distinct. The distinct polarities included perceptive thinking versus receptive thinking, systematic versus an intuitive strategy to problem solving, and active strategies versus reflective strategies. This perspective of six polarised thinking strategies increases the control space of the model from two dimensions to three. Namely,

- **Perceptive – Receptive**
  - ***perceptive***: emphasize concepts and relationships
  - ***receptive***: focus on detail
- **Systematic-Intuitive**
  - ***systematic***: to problem solving tend to rely heavily on methods and procedures
  - ***intuitive***: follow "gut feel" relying on analogies and past experience
- **Active-Reflective**
  - ***active:*** take some action usually in pursuit of finding quick fixes
  - ***reflective:*** ponder on concepts before taking action, prefer to look than take part

Furnham (1995) citing the works of McKenny & Keen (1974 cited in Furnham, 1995 p.404) and Mitroff & Kilmann (1975 cited in Furnham, 1995 p.404) concluded that, "... no matter what type of problem people face, individuals use their preferred cognitive style to approach it. Moreover, when given a choice, individuals prefer decision situations and problem types that are consistent with their own cognitive style..."

This understanding is in accord with Jones (1992) and the earlier work of Pask (1976 cited in Cross & Matheson, 1981 p.13-14). Pask found that people showed a distinct preference for styles they had already adopted while Jones explained that, "...newcomers to a design methodology often revert to more familiar, if less adequate, procedures when difficulties are encountered…".

The implication is that it is not just the strategy that an individual prefers to use when confronting a problem, but also how the individual habitually prefers to think while processing information pertinent to such a situation. Puccio and Grivas (2009) concurred with this perspective when they described Kirton's (Kirton 1974) work on the way people prefer to process information (innovative or adaptive) as cognitive styles. Sternberg & Zhang (2001) explained that strategies involve an individual conscious choice of alternatives styles often operate without individual awareness. Mueller et al's (2011) view that feelings of uncertainty may cause negative attitudes to creativity may explain the underlying reason for such a reaction.

Zhang et al (2012) investigated the variance of styles subject to demography. They explained that some researchers have argued that styles change with age and training, other researchers have argued in favour of stability. They concluded that styles do vary with age: as, people get older they become more divergent, but styles do generally remain stable over time. Longitudinal studies have demonstrated that styles remain very stable in adults. Differences also exist depending on local conditions and populations.

Kolb's (1978) discovery of the four basic learning styles and Furnham's (1995) concept of individuality, both define a person's intrinsic preference for a particular style. It suggests potential for research hypotheses that, a person who principally exercises a specific cognitive style, will show greater preference for a technique that relies more heavily on that style than others, is becoming more of a reality than a concept.

2.1.7 The Learning Styles Model

Kolb's (Kolb 1978) Learning Style Model identified four of styles of thinking, used when learning, namely, concrete experience, reflective observation, abstract conceptualisation, and active experimentation. This model focused on two of the cognitive polarities described earlier as abstract-concrete and active-reflective. Kolb described the behaviours shown by people who adopt such styles as those who would naturally:

- feel more than they think with a tendency to be intuitive decision-makers and are keen on exploring new theories to see if they work in practice. These people prefer concrete experience. Honey & Mumford (1995) called them, *pragmatists.*
- observe rather than take part while showing an appreciation for different points of view and ponder from many perspectives as, reflective observers. Honey & Mumford called them, *reflectors.*
- think more than they feel adopting a logical approach to problem solving as people who prefer abstract conceptualisation. Honey & Mumford called them *theorists.*
- take an active role in influencing others as well as situations and welcome practical applications as people who prefer active experimentation. Honey & Mumford called them, *activists.*

Furnham (1995) described Kolb's (1978) model as, a bipolar dimension of cognitive processing. This is the active- reflective dimension, which separates the direct participation from the detached observation while the abstract-concrete ranges deal with the conceptual to thebe tangible. The description offered by Honey & Mumford (1995) is a convenient way of describing differences in learning preference. The doing orientation overlapping with a combination of Activist and Pragmatist and the thinking orientation overlapping with Reflector and Theorist, all neatly mapped onto the stages of each loop of the continuous learning cycle.

Each stage of this four-stage learning cycle, Furnham (1995) explained, will require the combined use of these different abilities. People combine their preferred information gathering and processing experiences by focusing them appropriately at a specific stage of the learning cycle. Moreover, Furnham gave additional support to Kolb's (Kolb 1984) work on learning styles by explaining that research done by Atkinson G., Murel. P., & Whiters M

(1990) and Atkinson (1998) supported Kolb's work and identified links between learning styles and career.

Considering brain dominance, Honey & Mumford (1995) explained that some work tended to the view that there are two styles: right-brain (intuitive, spontaneous, qualitative) and left-brain (factual, analytical and quantitative). Right-brain dominance tends to overlap with a combination of Activist and Pragmatist while left-brain dominance overlaps with Reflector and Theorist. Pidd's (Pidd 2003) discussion on Mintzberg's (1976) idea that the left side of the human brain preferred linear sequential processing while the right prefers simultaneous processing, concluded that such a model had been shown by Damasio (1995 cited in Pidd, 2003, p. 50-56) to be quite misleading and should only be seen as metaphorical not factual.

2.1.8 Relationships Between Learning Styles

In the Learning Style Inventory, Kolb explained that concrete experience and abstract conceptualisation were negatively correlated the same being true for active experimentation and reflective observation. These phenomena justified the creation of the two-dimensional model with Abstract/Concrete as one dimension and the Active/Reflective the other. On the premise that all humans possess all these learning styles to varying degrees, it led neatly to Kolb's concept of the pragmatic-reflector, the reflective-theorist, the theoretic-activist and the active-pragmatist. Examining the combined effect of Kolb (1978)'s four learning styles both Honey & Mumford (1995) and Basadur *et al* (1990) offered similar descriptions. These are summarised in Table 2.2.

Table 2.2 Definitions and effects of combined use of different learning styles

Kolb (1978)	Honey& Mumford (1995)	Basadur *et al* (1990)
The Pragmatic -Reflector people who have a bias to feel more than they think yet would rather observe than take part i.e. are highly reflective are divergent in their thinking.	***Divergers*** are very good at observing situations from many angles have a broad range of interests. They are imaginative and sensitive to feelings.	***Conceptualisers*** have a strong preference for problem defining and generating ideas.
The Reflective - Theorist people who would rather observe than take part *and* who also think more than they feel i.e. are good at thinking in both a reflective and theoretic manner	***Assimilators*** are best at understanding a wide range of information and putting it into a clear logical form .They prefer concepts and logical soundness to practical value and excel at inductive reasoning.	***Optimisers*** as they have is strong preference to solving well defined problems.
The Theoretic Activist people who think more than they feel but also take an active role in influencing others as well as situations i.e. think/behave in both a theoretic and active manner	***Convergers*** prefer technical tasks rather than social ones and do best when there is a single correct answer to problem.	***Implementers*** prefer to work with a fixed goal and will go to extreme length to make sure the new solution to the problem is installed and working.
The Active Pragmatist people who take an active role in influencing others as well as situations yet feel more than they think i.e. are both active and pragmatic	***Accommodators*** prefer to learn hands-on and enjoy a new challenging experiences. Their major strength is in doing things. They adapt quickly to new circumstances and prefer to resolve problems in an intuitive trial and error manner.	***Generators*** have a strong preference for problem sensing and fact finding, love to get things started and intuitively find new problems and opportunities.

Kolb's discovery of the four basic learning styles and Furnham's concept of individuality, defined by a person's intrinsic preference to a particular style, suggests support for the research hypotheses. The work of Kolb (1978), Honey & Mumford (1995) and particularly that of Basadur et al (1990) goes further, adding support by showing preference to particular types of activity found within creative problem solving. The idea suggests that a personal intrinsic preference for a cognitive style will encourage greater preference for a technique that relies more heavily on that cognitive style – a hypothesis to be tested in this thesis.

There is much knowledge of cognitive styles, their role within creative problem solving and personal preferences all suggesting support for the personal preference argument within the hypotheses. However, a standard list defining techniques by the cognitive activities that they rely on does not yet exist. The information presented thus far suggests that a framework for techniques based cognitive styles would prove useful.

2.1.9 Paradigmatic Styles

The Paradigm Concept

Before examining paradigmatic styles, it is worthwhile pausing to examine the concept of the "The Paradigm" itself, introduced by Thomas Kuhn. The paradigm, as described by Kuhn (1996), is an accepted model or pattern. The role of a scientist, according to Kuhn, is neither to look for unknown phenomena nor is it to invent brand new theories, it is to provide articulation of those theories that a paradigm already supplies.

A brief synopsis of Kuhn's definition of the concept of the paradigm was offered by Vasquez (1998) who described it as, "...on the one hand, the entire constellation of beliefs, values, techniques, on the other hand, one sort of element in that constellation...." McFadzean (2000) described a paradigm as an individual's mindset.

To envisage this dynamic behaviour of the changing and growing paradigm, described earlier by Kuhn, consider a system boundary described by Checkland (1993) as a distinction made by the observer. Such a distinction marks the difference between an entity the observer takes to be the system and its environment. A paradigm is the entire scope of rules and understanding pertaining to all elements within the boundary used to define the system of interest.

The opinion of the researcher is that, paradigms can be restrictive to both vision and understanding. This comes about by placing too much confidence in a particular paradigm. Often a paradigm developed for one set of phenomena is ambiguous in the context of another. This ambiguity of understanding will stimulate the need to investigate alternative ways of applying an existing paradigm to a new area of interest.

From this, albeit brief, description of paradigms, it is apparent there are two activities associated with them. The first activity is, seeing a new phenomenon and making rules to describe it. The second activity is adhering to the rules of an adopted paradigm, a trait described by Farnham (1995) as being perceptive or being receptive.

The Cognitive Styles Used

Some people naturally accept and adhere to the rules of a paradigm. Some people will prefer not to, by showing their aptitude to see things differently. Such thinking is often called thinking inside the box and thinking outside of the box. It is possible that considering the learning style and preferences of an individual, this raises the intriguing possibility that people might also show distinct preferences for different cognitive activities when dealing with paradigms.

Puccio (1999) remarked that Moger (1997) had found that the adapters and innovators show preference to different groups of problem solving tools. Ekvall (2000) also noted that research engineers showed more sensitivity to restrictions and may contain more innovators than adapters. Interestingly, Rickards & Gimenez (1994) earlier claimed there was no evidence to link cognitive style with dealing with managerial turbulence. They describe this finding as a powerful inference that appears to challenge the popular understanding that the innovator is more psychologically and cognitively flexible than the adaptor. Mueller et al, (2012) explained that when a person faces uncertainty, regardless of how open-minded that person may be, he or she will feel motivated to reduce the uncertainty and in doing so experience more negative associations towards creativity.

It is the researcher's opinion that all these views add both support and condition to the credibility of Pask's (Pask, 1976 cited in Cross & Nathenson, 1981 p.13-14) finding: that is, when confronted with risk, people will show preference for, and automatically default to, what they intrinsically know, albeit to some natural limit subject to one's own perception of that risk, commonly referred to as fight or flight.

This human reaction, explained by Mueller et al (2012) to veer towards a perceived safe and personal way of doing things when feeling at risk, suggests a degree of sensitivity, similar to those described by Amabile (1999) when a person is intrinsically motivated while experiencing change in the work environment. Farnham's (1995) offers the view that, every person has their own preferred approach to solving problems. Collectively these views suggest potential in the research hypothesis that a perceptive person will prefer techniques, which primarily rely on perceptive cognition and similarly the receptive person will prefer receptive techniques.

2.1.10 Summary

Kolb's (1978) learning styles, the work of Honey & Mumford (1995) and particularly that of Basadur et al (1990) suggests the existence of an intrinsic route used to solve problems. The consensus that people have their own personal preferred cognitive styles employed primarily for part of that route suggests to the researcher that an individual will show strength towards some problem-solving tasks but remain weak at others. Mueller et al's (2012) explanation that people facing uncertainty, make an effort to reduce uncertainty and as a result experience negative associations towards creativity, suggests how a person biased to using a particular cognitive style, will react to the discomfort when facing a task that confronts their weaker style abilities.

Moger's (1997) findings that adapters and innovators show preference for different problem solving tools, together with Ekvall's (2000) inference that innovators are more sensitive to restrictions than adapters, suggest the need to consider perspectives additional to those describing learning styles. McFadzean (2000) had earlier observed a noticeable increase in unrest as people executed increasingly perceptive tasks. Mueller et al, (2012) suggested that the sensitivity to choice of reaction is due to the way a person reacts to uncertainty. These findings and observations support Farnham's view that people are naturally perceptive or receptive and Pask's view that when confronted with risk people will automatically default to use what they intrinsically know.

This apparent consensus is represented in the hypotheses H1.1 to H1.4 (see end of this Chapter 2). Proof of these hypotheses will not only prove existence of a natural framework for cognitive styles but also, confirm such a framework is appropriate as a taxonomic framework for creative problem solving techniques.

2.2 Creative thinking and behaviour – the group

People working as a group will create an entity of higher complexity. Tadmore et al. (2012) explained, "...while it is helpful for a group to have creative members, collective creativity is more than the simple aggregation of individual creativity..." Factors contributing to such complexity include combining the cognitive styles of each individual and the many communication channels between each person within the group. Communication channels carry information that easily influences the level of cohesion and conflict within the group. This section will investigate both the causes and the impact of mutual influences between members that cohesion and conflict can have on the overall creative ability of a group.

2.2.1 Group cohesiveness and creative performance

At many levels in organisations, complex problems are resolved using groups. Craig et al (1999) explained that, although there had been considerable research into the problem-solving practices of groups, there was a lack of information about group creativity. According to Moger & Rickards (1990), advocates of creative techniques and training have overlooked the possibility that teams may have to pass through stages of development prior to reaching their best levels of performance. Researchers into the stages of team development appear to have remained silent about the relationship between creativity training and team performance., Moreover, the difference between what happens in the real world and the laboratory seem overlooked. According to Craig et al, the creativity seen in the real world, such as that found in advertising, and the creativity performed in a research context only partially overlap. Studies on simple idea generating tasks do not make allow room for the type of complex interaction between individual members of a group, which would take place in the real world.

Within groups, Craig et al (1999) explained, obstacles such as, production blocking, free riding and evaluation apprehension, occur during idea generation. However, Moger & Rickards (1999) argued that if team leaders continuously adopt the role of creativity facilitator, there is the likelihood that such ingrained tendencies of teams opposing new ideas, should diminish.

Evaluation apprehension is a form of internal censorship imposed by group members on group members. Its aim is to force everybody within the group to adhere to a group norm. This style of behaviour, according to Craig et al (1999)., is highly relevant when it comes to the cohesion of a group as it sedates feelings of evaluation apprehension and any production loss experienced by the group. Moreover, interpersonal cohesion and symptoms thereof can also influence creativity.

Further, Craig et al. explained that:

- Creative groups laughed more often, gave more verbal support and critical statements, Firestein (1990 cited in Craig *et al.*, 1999)
- Psychological safety due to cohesion also enhanced creativity, Nystrom (1979 cited in Craig et al 1999)
- This acted as a catalyst that encouraged the individual group member's ability to contribute to the group, Hackman (1976 cited in Craig et al 1999)

Focusing on Zaccaro and Lowe's (1986) work, Craig et al. (1999) argued that task cohesiveness, not personal cohesiveness, influenced additive tasks found in brainstorming. Craig et al. summarised that:

- Where cohesion was high, nominal groups generated more ideas than interactive groups.
- Benefit of cohesion on group creativity was not sufficient to counter productivity loss.
- Interpersonal cohesive groups (trained in creative problem solving) generated more ideas than similar trained non-cohesive groups.
- Group creativity is enhanced by task cohesion. The creative performance had a curvilinear relationship with the groups' interpersonal cohesion.
- Both task and interpersonal cohesion probably increase the creative performance of a group using brainstorming tasks.

Contrasting laboratory with real-world conditions, Craig et al (1999), explained that groups did not simply have the task of brainstorming ideas: they are also responsible for the project from conception to implementation. As a result, real-world creativity is far more complex than that used in simple brainstorming tasks. Craig et al., warned that while it may appear easy to conclude that both interpersonal and task cohesion might aid creative behaviour, there is little knowledge of these variables and their influences on aspects of creative performance in the real world. Unfortunately, insufficient attention had been paid to the team development necessary for best creative performance. Moger & Rickards (1990) also noted that researchers had remained silent about the relationship between creativity training and its performance.

2.2.2 Defining Cohesion in Groups

Craig et al (1999) explained that much effort had taken place to establish what variables, if any, defined cohesion. Many definitions evolved from the works of many researchers resulting in many distinct interpretations as to what cohesion actually was and how cohesion influenced group performance.

Craig et al (1999) cited the following range of observations, views, opinions, beliefs and definitions of cohesiveness:

- The result of all forces on the members to remain in the group Festinger (1950). Craig et al., (1999) viewed this definition as too qualitative and difficult to quantify.
- A process that reflects tendencies of a group to stick together and remain united to reach common goals (Carron 1982)
- Focusing team members to the group's task (Goodman, Ravlin, and Schminke 1987)
- Attracts members to the group (Evans and Jarvis 1980).
- Some definitions take particular note of group tasks whereas others describe a tendency of staying together. Relationships between cohesiveness and performance had on occasions led to contradictory results. Evans and Dion (1991) concluded that the relationships between cohesion and performance were positive while other studies, Lott & Lott (1965), Shaw (1976) and Stogdill (1972) had reached the opposite conclusion.
- Very high levels of cohesiveness as well as truly low levels were associated with poor performance and concluded that the relationship is curvilinear. Kelly and Duran (1985)

- Cohesive groups consisting of more uniformly productive members with high performance goals were uniformly more productive than those with low performance goals Seashore (1954)
- Non-cohesive groups tend to have more variation in productivity Seashore (1954)
- Cohesive groups not being committed to productivity tasks and task inter- dependence might also impact on group performance Seashore (1954)

Reflecting on this plethora of views about cohesion Craig et al (1999), explained that such confusion had led researchers to conclude that cohesion was multi-dimensional. Citing Gross and Martin (1952 cited in Craig et al 1999), Craig et al., then concluded that cohesion can be described by has only two dimensions, namely, task cohesion and interpersonal cohesion.

Having arrived at a two-dimensional model, Craig et al (1999) then explored the definitions of such dimensions, concluding that both interpersonal attraction and task commitment have an important role in defining group cohesion.

2.2.3 Effects of task and interpersonal cohesion on group creativity

Referring to earlier works and the influences that task and interpersonal cohesion had on group creativity Craig et al (1999) cited Zaccaro and Lowe (1986)'s findings and used them as a springboard to explore these influences on group cohesion further. They noted that:

- Conditions of high task cohesion and high interpersonal cohesion received higher creativity scores.
- Increasing task directed effort and decreasing interpersonal cohesion inhibited communication.
- Groups with both high task and higher interpersonal cohesion, perform the worst on creativity than the other groups.

Craig et al (1999)., explained that the pre-test data suggested both task and interpersonal cohesion were equivalent in terms of difficulty and complexity. However, when examining the work of two groups, those groups assigned to drawing mansions submitted a wide variety of mansions while groups that drew bridges seem to stick to only two styles of bridges. The reason for the poor performance of those who drew bridges was attributed to interpersonal cohesion playing too much of an important role during the idea generation stage. This was supported by citing Lott and Lott's (1965 cited in Craig et al 1999) claim that interpersonal cohesion may have negative effects on group performance due to the distracting nature interaction often has within an interpersonal cohesive group.

Craig et al (1999) explained that task cohesiveness could be the key factor for improving technical quality while interpersonal cohesion has no effect on the execution stage of the task, and concluded that:

- High task cohesion led to higher coherent scores while interpersonal cohesion had no effect on performance.
- High task cohesion led to higher complexity scores whereas interpersonal cohesion had no effect on performance.

The fact that interpersonal cohesion encouraged uninhibited communications which, in turn encouraged some aspects of creativity, came as no surprise to Craig et al (1999). However, task cohesion, by contrast, should also enhance creativity performance by increasing individual commitment to the task, not the group. The somewhat overlooked factor of task cohesion, described by Craig et al, as the cold component of group creativity, may be an even more important than is presently perceived. Craig et al conclude that ways of encouraging task cohesion required more research.

Explaining that, real-world groups could improve performance by taking into account different types of cohesion, Beal et al (2003) offered two possible ways forward. Groups whose task is to replicate, will be best served by task cohesion, while groups required to create or generate novel ideas might benefit by using both enhanced task cohesion and interpersonal cohesion. Beal et al justified these assertions by explaining that research had found that cohesive groups increased their efficiency of communication and behaviour Mickelson & Campbell(1975 cited in Beal, et al 2003); a greater team mental model of convergence Mathieu et al (2000 cited in Beal, *et al*, 2003); a greater use of transitive memory systems enabling groups to collectively encode, store, and retrieve knowledge, suggested by Hollingshead et al (1998 cited in Beal et al 2003) , Wegner et al (1991 cited in Beal et al 2003), Erber & Raymond (1991 cited in Beal et al 2003). Beal et al concluded that a group will use its resources more efficiently and will be better motivated to completing group tasks successfully.

Beal et al (2003). explained that all these factors seemed surprising since,had to a large degree they had been over-looked because most research on cohesion had focused on interpersonal attraction. This is in accord with Moger & Rickards' (1990) comment that researchers remained relatively silent about group creativity performance and Craig et al's (1999) remark that task-cohesion remains an overlooked component of group creativity.

2.2.4 Conflict and performance

Examining relationships between conflict and cognitive ability, Carnevale and Probst (1998) observed that as conflict increases, cognitive arousal increases and such increases in cognitive load encouraged better creativity. This relationship opens the interesting debate as to how conflict makes a positive contribution to the creative performance of a team.

Historically, theorists focused mainly on the negative aspects of team conflict, according to De Dreu and Weingart (2003). They explained that conflict can interfere with team performance by reducing satisfaction by creating tension that forced team members away from the present task; however, there are actually two types of conflict that could be beneficial to group performance. De Dreu and Weingart attributed the discovery of these two types of conflict to Jehn (1994, 1995, 1997 cited in De Dreu and Weingart, 2003) who had identified an iterative perspective by differentiating between task conflict and relationship conflict. Acknowledging the point that relationship conflict can impede task performance, De Dreu and Weingart (2003) argued that, it is when a group is working on non-routine tasks, addressing highly complex and non-standard issues (in terms of a usual routine) that task conflict can be beneficial to task performance.

Citing Levine, Resnick, & Higgins (1993); Nemeth (1986); Tjosvold (1997), De Dreu and Weingart (2003) explained that the works of these researchers had shown that members within a group will confront issues and take different perspectives, thereby forcing themselves to be creative. Within groups, task conflict encourages more profound scrutiny and deliberation over task information. Explaining that such activity fosters learning and as a result, new and higher creative insights should flourish from a more effective and innovative group.

Another form of conflict known as Devil's Advocacy, wheere contentious views are used to provoke debate, was also examined by De Dreu & Weingart (2003). Summarising the research done by Schwenk (1990 cited in De Dreu & Weingart, 2003), they explained that individuals exposed to the devil's advocate made a better judgement than those without such exposure. The conclusion offered by De Dreu & Weingart (Hollenbeck et al 1995, 1998 cited in De Dreu & Weingart, (2003) reinforced the point), was that a team with a degree of conflict provided more value than a team whose views were highly and positively correlated. A high degree of agreement would render the group creatively redundant.

This view that the level of creativity of a group being relative to the level of conflict (often seen as strong differences of opinion) within the group, led the researcher to the understanding that too much harmony will stifle creativity, while clashes of opinions ignite the creativity flame.

In summary, the conflict found in group working has several different facets:

- There are essentially two types of conflict - relationship and task.
- Relationship (or social) conflict can generally decrease satisfaction and interferes with task performance.
- Task conflict can be beneficial to task performance when working in non-routine environments.
- Devil's Advocacy encourages better judgment.
- Task conflict encourages groups to confront problems from many perspectives.
- Task conflict can act as a cognitive stimulant thereby encouraging flexible thinking and more creative problem solving.

2.2.5 The Influence of personal cognition on group performance

Le Pine, (2003) explained that teams of high ability outperform those with lower ability when it comes to possess the following characteristics:

- Ability to develop an effective team and systems of activity.
- Capability of learning from experience.
- Working in a changing environment, specific abilities can draw from their superior knowledge base
- Developing ability to develop acute understanding of new emerging situations
- Ability to adapt their roles and structure to new circumstances.

2.2.6 Disadvantages of group cohesion

Beal et al (2003), argued group cohesion is not all that it seems because established performance behaviours and outcomes measures do not reflect all the advantages of cohesion. Groups with few exchanges of work do not benefit from cohesion, unlike those groups whose workflow is highly interactive between group members.

Task commitment does boost performance in tasks requiring pooled team-work, whereas by contrast, interpersonal attraction does not boost performance. This was, according to Beal et al (2003) because motivation does not always require members to work together although tasks requiring pooled teamwork might reap the benefits of shared commitments. The same argument is also true for group pride. Of the six possible direct relationships between the variables (behaviour, outcome, effectiveness and efficiency), Beal et al concluded that only two correlations seem to be significant, behaviour related to effectiveness, and efficiency related to outcomes. In summary, one must remain aware of all the components of cohesion, as each can exert its own unique influence on a group's performance.

2.2.7 Impact of diversity on group performance

Diversity

Knippenberg et al (2004) defined diversity as the differences between individuals. In principle, diversity refers to an infinite number of dimensions but Knippenberg et al were keen to stress that too often it merely focuses on the gender, age, race, ethnicity, tenure, education and occupation. Knippenberg et al explained that, a many researchers believe the most important dimensions of diversity are the social and informational dimensions. The variables defined as social are those such as gender, age and ethnicity. Informational variables are used to define those aspects that are, by their very nature, less visible. Informational variables can be job related, portraying the latent functional differences between people such as education and background.

Informational variables – their influence

Le Pine (2003) explained that, as tasks change, teams need to adapt. Their composition with respect to cognitive ability will become more important in predicting team performance. For members competent at their roles, their effectiveness should promote higher team performance. Moreover, teams composed of members with high cognitive ability:

- should be better able to develop effective teams and systems of activity than teams composed of members with lower cognitive ability.
- are more capable of learning from experience than those with low cognitive ability.
- can draw from their superior base of knowledge and once this knowledge is integrated between members, an acute understanding of a new situation can emerge.
- can be more flexible.
- adapt to new situations and perform better after unforeseen circumstance.

Marks et al (2002) explained that, a group with a majority of members having high ability should lead to higher group performance as team output does primarily depend on its member's input. This strong dependency of group performance upon its member's' ability to manipulate information appears essential for tasks requiring a high degree of intellectual representation and manipulation. This is underpinned by LePine's (2003) conclusion, which should encourage groups to achieve as the more divergent the group perspectives, the more potentially surprising and more innovative the ideas. (Marks *et al*, 2002)

2.2.8 Levels of conflict and team creative effectiveness

According to De Dreu & Weingart (2003), theorists have traditionally focused on negative aspects of team conflict. Acknowledging the view that, conflict can distract team members away from a task due to tensions and reduced satisfaction, De Dreu & Weingart were keen to explain this is actually only half of the story. It was recognised that, there are two levels of conflict, which could be beneficial to group performance. In groups, conflict occurs when a group confronts issues. All group members probably take different perspectives, which, according to De Dreu & Weingart's is exactly the catalyst that is needed to arouse the level of creativity necessary to combat whatever problems the group may have to hand.

This subtle dependency of a problem solving group on group conflict was reinforced by explaining that when conflict is absent, teams may not recognise that inefficiencies exist. and, according to Schulz-Hardt, Mayer, and Frey (2002 cited in De Dreu & Weingart, 2003) , although this may appear counter-intuitive; teams made better decisions amidst disagreement than when they were in agreement. Furthermore, team members whose opinions were in conflict provided more value to the group and should the level of group conflict appear too low this can be overcome by applying devil's advocacy. Collectively, these factors encourage learning, increased performance, and raise creative insights within groups when problem solving. Like many things, this has its limits. However, too much conflict can actually make matters worse by encouraging the cognitive system of each particular individual group member to shut down as ; a natural defensive mechanism.

This behaviour was examined by Carnevale and Probst (1998) who described a snowball effect in terms of cognitive load. As conflict increases, arousal increases, which in turn leads to an ever increasing cognitive load. Increases in cognitive load can interfere directly with cognitive flexibility and creative thinking. Such impedance greatly discourages team performance. This was supported by the observations that when group members anticipated a competitive more hostile environment (high conflict), cognitive flexibility and creative thinking decreased considerably. Such subtle changes in behaviour reinforced De Dreu & Weingart's (2003) comment that, conflict actually has two dimensions, task-conflict and social-conflict. This led to the understanding that positive effects on team performance came from task conflict not social conflict.

McFadzean (2000, 2002), whist establishing the creative-continuum, observed that the more imaginative the ideas, the more uncomfortable participants became. The more group members traversed along the creative continuum, from paradigm keeping, through paradigm stretching to paradigm breaking, the greater the degree of conflict became. McFadzean stressed the need for the facilitator to be aware of the safety and psychological security of the participants while using these techniques, as the discomfort caused by their use may cause the group to show negative emotions such as aggression, anger and frustration. To cope with such a situation, McFadzean advised that, the facilitator and the group members should all have sufficient competence in people skills.

At this point, the researcher is of the view that too much group harmony will stifle creativity. This is because it runs the risk of encouraging people to adopt the habit of being seen to be doing the right thing' as opposed to making sure what they do is actually the right thing to be done (Rickards 1985).

Both task and personal conflict must be in balance with task conflict focused primarily at the task assigned to the group. At the same time, allowing for a small degree of personal conflict as we all see and understand things differently, then creativity, flexibility and group performance overall is more likely to flourish. Whereas, if the type of conflict becomes too personal and the level of conflict approaches some sort of tipping point, possibly unique to that group, then creative performance will diminish and is likely to collapse completely.

2.2.9 Openness to experience

Another essential facet that the individual group member needs in order to enhance the group's effectiveness in the task-changing context is openness to experience. Le Pine (2003) described this facet as, the personality characteristics that relate to creativity, broad-mindedness and a willingness to try new things. In order to counter any intuitive perspectives and practices of other group members, an individual needs dependency on this personality trait is highly necessary to remain creative. It is essential in order to adapt to new ways of thinking, to looking at things and doing things differently rather than blindly following tradition and becoming submissive to the peer pressures of the group. Le Pine's work highlighted the importance of open individuals because:

- They are self-monitoring, necessary for learning in a novel situation.
- Openness is positively associated with individual adaptation not just because of the self-monitoring effect, but also they tend to be more creative than receptive.
- Open people enjoy intellectual problems and are more willing to try new things.
- When teams of open people experience an unforeseen circumstance, their response is more imaginative and inventive.
- Open people have a more divergent menu of alternative methods.
- Open individuals make more suggestions, have deeper insight, have greater enthusiasm , are more communicative hence more ready to adopt, adapt and build on the ideas of other members.
- Open individuals have a willingness to consider conventional ideas and at the same time tend to be versatile.

These findings not only explain the group's creative dependency on individual open-mindedness in order to handle conflict amicably and productively but also reinforce the importance of the argument that, conflict is necessary within the group to keep it on a creative and innovative path (Le Pine, 2003)

2.2.10 Patterns of team workflow

According to Beal et al (2003) task type is a pervasive factor within organisational research. They explained that although research had revealed many characteristics, most findings concurred that the 'task' always played an important role. Unfortunately, research had at that time, overlooked any bearings that 'task' may have had on group cohesion. Beal et al attempted to rectify this oversight by emphasising that, as information exchange increased between members within a group, cohesion should evolve. This should play a stronger role in team performance subject to as the level of workflow increased.

It is the pattern of workflow that can enhance group cohesion and according to Beal et al, workflow has four basic patterns, namely:

1. The first is *pooled workflow*. This involves tasks that aggregate the individual's' performance to the team level. No interaction or exchange between members is required for this pattern of teamwork. Work does not pass through multiple members and performance is simply the sum of group members' performances.
2. The second is_*sequential workflow*. This describes tasks that move from one member to another but not in a back and forth manner. Group performance is not simply pooled but rather a function of how work progresses via each member of the group such as that of a production line.

3. The third is *reciprocal workflow*. This is similar to sequential, in that work flows from one to the other, but the flow is bi-directional such that members can exchange work in both directions.
4. The fourth is *intensive workflow*. This is described as a situation where the workflow becomes both multi-dimensional and bi-directional along each dimension between all group members. This occurs when all members of the group must communicate and collaborate to accomplish the task.

Explaining that, as the amount of information and communication between each group member increases Beal et al. recommended drawing attention to team level as opposed to individual-level programmes. This suggests that as both directional changes and the amount of work flowing between group members increases then workflow patterns migrate from pooled to sequential to reciprocal to intensive. Therefore, cohesion should gain importance as a contributor to group performance.

While Beal et al's (2003) aim was to achieve a better understanding of cohesion and group performance, they concluded that it should be seen as a behaviour measured as such and not viewed as an outcome. Moreover, group efficiency measures have a more pertinent relationship with cohesion than any measures of effectiveness.

2.2.11 Summary

The perspectives used to investigate what can influence the creativity of a group have focused primarily on group cohesion and conflict. Some investigations have suggested aptitude and ability of group members as playing some role. Unfortunately, the definition of aptitude and ability remain vague because the cognitive profiles of individual group members were not included in these investigations.

Tadmore et al. (2012) explained that it is helpful for a group to have creative members but collective creativity is more than the simple aggregation of individual creativity.
The influence that an individual's cognitive style makes to the overall group creativity has not been considered by researchers

To the researcher such an oversight reinforces provides the opportunity to examine the influence that individual cognitive styles of the individual group members have on the overall creative performance of the group and its members. Amabile (1998) explained that creative skills depend on personalities as well as how people think and work. Amabile & Pillemer (2011) explained that team creativity requires people to work together effectively and exploit their peers' skill set to the full. Presently, group creativity fails to consider what Amabile & Pillemer (2011) describe as a comprehensive view of individual behaviour.

These considerations lead to the final group of hypotheses, H1.5 – H 1.7, set out at the end of this chapter. To prove hypotheses H1.5 and H1.6, this study investigated the possibility of a the relationship between group members' cognitive styles and the preferences of such members for problem solving techniques. To prove hypotheses H 1.7, this study investigated the possibility of a relationship between group members who prefer to work with peers who have the same cognitive styles as their own.

2.3 Strategies, tactics and frameworks

This section investigates reviews the evolution of creative problem solving methods and how they are used. Investigating how such techniques are used reveals assumptions, strengths and weaknesses. The review culminates in identification of the need for, and proposition of, a new approach to categorisation of techniques that will enable the tailoring of a technique to the cognitive preferences of the person using it.

2.3.1 How creative problem solving strategies evolved

In 1950, Guildford claimed that of all psychological abstracts and publications at that time, less than two per cent had any bearing on creativity. Later, in 1970, reflecting on the progress since his initial claim, Guildford (1950 cited in Parnes (Ed), 1992) explained that it was only after pre-1955 interests in creativity remained somewhat inert, post- 1955 that, "things started to happen", an era described by Torrence & Goff (1989) as a quiet revolution. To achieve a better understanding of creative problem solving (CPS) it is important to examine the evolution of its development as a process.

According to the *Source Book for Creative Problem Solving* (Parnes (1992), Isaksen described the era, 1952 to 1994, and the evolution of the CPS process as a journey from making the creative process explicit and deliberate, to taking a descriptive approach. However, according to McPherson (1968 cited in Parnes 1992) there had been many developments in that era of which Isaksen's was but one. From this, McPherson observed that, all the processes had two distinct similarities. The similarities, according to McPherson, are that all the processes were stage based, and that. More importantly, each stage required a different type of thinking, with analytical, judicial, and creative thinking being the prime drivers of all creative problem-solving processes. According to Gilhooly (1982), the stage based perspective was attributed to Wallas (1926) in his book titled, "The art of thought" published in 1926 in which Wallas had described the stages as preparation, incubation, inspiration and verification.

Behind the scenes of Torrence & Goff's (1989) quiet revolution, developments were taking place within education in pursuit of understanding the fundamentals of how people learn (Kolb, 1978; Honey and Mumford, 1995). The contribution to knowledge, made by Kolb and later complemented by Honey & Mumford, led to the understanding of what people actually do at a cognitive level, when confronting new situations. The natural ability of people to understand the unknown was, according to Kolb, due to having learning styles. Later, Basadur et al (1990) identified a relationship between learning styles and the creative problem solving phases identified earlier by McPherson (1968 cited in Parnes 1992). This new link between creative problem solving and learning styles not only identified an opportunity but also re-affirmed Kolb's understanding that people, by and large, show a unique preference or bias to one particular style of thinking.

In the 1990s a renewed interest in creativity appeared to have met resistance while seen as unconvincing. The focus of interest around creativity moved away from the individual in favour of the group and organisation. While the group perspective might assist idea generation, the creative performance of a group does not necessarily imply anything about that organisation to which the group belongs nor does it consider the creative abilities of the individuals who make the group; one should be wary of making such hasty assumptions (Moger & Rickards, 1999).

Table 2.3 An extract from McPherson's list of CPS processes (McPherson, 1968 cited in Parnes *Ed.* 1992)

Steps	**Wallas**	**Dewey**	**Rossman**	**Guilford**	**Alex Osborn (early)**	**Osborn, Parties Creative Problem Solving**
1.	Preparation (information)	Difficulty is felt	Need or difficulty is observed	A cyclic looping model that is difficult to present in a linear fashion	Orientation	Looking at "The Mess" to find problems
2.	Incubation (unconscious mental work goes on)	Difficulty located and defined	Problem formulated		Preparation	Finding a "Fuzzy Problem"
3.	Illumination (solution emerges)	Possible solutions are suggested	Available information surveyed		Analysis	Fact finding
4.	Verification (solution tested and evaluated)	Consequences are considered	Solutions formulated		Ideation	Problem finding
5.		A solution is selected	Solutions critically examined		Incubation	Idea finding
6.			New ideas formulated		Synthesis	Solution finding
7.			New ideas tested		Verification	Acceptance finding

Returning to Guildford's earlier comments on the evolution of interest in creativity, Guildford (1970 cited in Parnes 1992) remarked that, efforts to understand creativity and do something about it, were not just happening in the United States but also in many other countries. At first sight, according to Kaufman and Sternberg's observations, it might appear that nothing could be closer to the truth, at least at the academic level. Kaufman and Sternberg (2006) had examined the global interest in creativity. They identified that the European emphasis was on primary and secondary education, personality, cognition and problem solving processes. The Far East had shown interest in cognitive methods and methods of stimulating creativity; Israel had focussed on the identification and improvement of latent talent and prodigy; India showed interest in creative behaviour and thinking; Latin America pursued the direction of cultural identity. Russia had aimed its attention at creative productivity, novelty and the recycling of existing solutions.

In spite of the plethora of lines of investigation Unfortunately the question as to, how well such theories meet the needs of the practitioners remained unanswered leaving intact Moger & Rickards (1999) earlier remained view that despite developments for organisations, the practices remained uncertain and in need a fresh approach.

2.3.2 How creative methods are shared and understood

Methods that might seem commonplace between the researchers and theorists in academia may not necessarily be the case among practitioners. The problems experienced by practitioners in industry are summarised by an observation of Jones (1992; 27):

> *"There is not much evidence that they have been used with success, even by their inventors, and there is reason to believe that newcomers to design methodology often revert to more familiar, if less adequate, procedures when difficulties are encountered*".

Due to natural communication barriers, knowledge and understanding can take time to percolate through an organisation. It can take even longer to migrate from one organisation to another. To encourage transfer of knowledge and best practices for innovation, research into the methodologies used when working with SMEs was commissioned by European Innovation Monitoring System (EIMS). This research done by Brown (1996) examined the aims and benefits of innovation management tools.

The main findings of Brown's investigation were:

1. Innovation management is not about technological change alone. It is about 'people' issues. Culture, communication, organisation and business process issues are all part of technology change - a point supported by Groth and Peters (1999) who explained that each phase of the problem solving cycle requires a completely different orientation.
2. Several of the tools examined encouraged a close connection between technology and business strategy.
3. Most of the tools reviewed focus on analysis much more than they do on decision-making, planning or implementation.
4. The tools reviewed favoured management participation more than one employee participation, despite evidence that inputs from a broad cross-section of the firm are of immense value.
5. There is adequate provision for, small to medium sized enterprises, from the tools available, but while micro enterprises (i.e. firms with up to about 15 employees), have poor provision.
6. A classification of innovation management techniques in terms of the kinds of enterprises they address, the processes they deal with and the basic nature of their methodology.

Commenting that, there is no such thing as a right answer, when it comes to innovation tools, Brown explained that the key to success is a 'best-fit' combination of the methodology, the consultant and the client firm. To help ensure client satisfaction using a best-fit approach, Brown (1996) recommended that:

- The consultancy assignment must take account of the internal issues, the circumstances, the resources available and the competencies of the firm.
- Any techniques used should help the user identify clear realistic and attainable goals with criteria for knowing when objectives have been achieved.

- Early tangible results (e.g. solving a practical problem) are often a key step to securing commitment to longer term strategic innovation.
- Indicators of a firm's overall innovative performance and success are vital. Stereotypical indicators can be used, but selections should be made subject to appropriate inputs, outputs and outcomes. It is also important that the chosen indicators be clearly understood and arrived at by consensus within the firm.

Bearing in mind Brown's (1996) conclusion that there is no, "one size fits all," prescribed process, there is an inherent need for adaptability when devising a process. This art of adapting processes to circumstance is what Pidd (2003) later called, "crafting a strategy" describing it as the detection of small changes to help emergent patterns to take a desirable shape.

Brown had recommended characteristics to help assess an innovation technique. When used for innovation Brown explained the technique should :

- Be simple in style of presentation and data collection
- Be flexible enough to allow 'best fit' with the current situation and needs
- Be designed to compare the client firm's current achievements and performance with best practice in a clear graphical and visual manner
- Be used in conjunction with basic company background information
- Compare both past and present performances with future aspirations
- Collect and compare the contrasting assessments or perceptions between diverse personnel.
- Provide action planning
- Provide links between diagnostic tools, methodologies and implementation aids
- Include success criteria
- Facilitate and ensure retention of learning within the organization
- Make provision for systematic follow-up

Explaining that there was vast scope for development when it comes to creativity, innovation, its methods, techniques and practices, Brown drew attention to a shortlist of opportunities:

- Designing and wording of tools to suit specific concerns
- Implementation
- Follow-up with clients was seriously lacking
- Tailor techniques to meet the needs of sectors or type of firm.
- Design and select techniques subject to success factors of that firm.
- There is inadequate awareness among consultants, firms and support agencies of the range of techniques available, including their potential benefits.
- Within Europe, little sharing of knowledge and experience exists across national boundaries. Greater emphasis on 'spreading the word' via publicising successful examples of innovation management and good practices should be commonplace.

Brown concluded with the comment that his review, "*... underlined the inadequacy of current understanding of innovation in smaller firms, with the exception perhaps of high technology SMEs. There is a real need for a much better understanding of the context in which SMEs operate, more analysis of the processes of innovation in SMEs, and for a deeper understanding of their innovatory behaviour...*" Brown (1996: p263)

In sum, in the extensive report about tools and methodologies, Brown (1996) had clearly identified that the understanding of creative problem solving was by no means complete, containing many gaps and shortcomings. This view is in agreement with Jones (1992) who, when examining the processes in the context of design, explained that, the usual difficulty is that of losing control of the design situation once one is committed to a systematic procedure which seems to fit the problem less and less as designing proceeds. With many strategies, tools, techniques and& tactics already in existence bespoke for particular problems, Brown stressed that despite knowledge and awareness of these entities, the questions; "what is it they actually do", "how well is this known", "how well are they adopted" and " how well are they used" remain unanswered.

In an attempt to improve this situation, Brown (1996) proposed the strategy of tailoring methods to fit the environment of the problem being investigated. Suggesting that, attention focussed, not only on innovation tools to fit the problem at hand, but also, in the interest of the person(s) using the techniques, it is indeed necessary to explore usability aspects of such techniques was a distinct paradigm shift.

This paradigm shift moves from focussing on only the technique-problem relationship to include the the people-technique relationship. This has implications which may contain many new consequences necessitating more investigation and new perspectives.

2.3.3 A framework for a strategy

With the multitude of innovation tools and techniques developed over the so called quiet revolution, despite all the inherent different features in their design, some being perceived better than others, Brown (1996) argued that in spite of the multiplicity of different tools and techniques available, when used properly the tools are very helpful and can be profitable, particularly when used for specific tasks. There will however be variance variations in the environment where the tools are used. This is due to the nature of the problems, technology, innovation skills and the preferences of the users, all being unique and combining to create a unique context.

Although remarking earlier on the importance of people involvement in creative problem solving, Brown's (1996) proposal (see Table 2.4 and Figure 2.1) was to use a classification framework focussing on the generic application of the tool. This proposal might lead to the opinion that, at this level, it does appear to fall short of Brown's original vision of including the people issues inherent within the problem solving system because the type of skills available or necessary were not discussed. However, awareness of the people issues of creative problem solving does slightly come to the fore is included when Brown comments on the skills and preferences of the operator and uses client participation as a classification variable. Later in the report, Brown did represent this point as a challenge to tool designers by explaining that the designers must be aware that the tools may need to take different forms to meet the needs of different staff at different levels of an organisation.

Table 2.4 Definition of categories of Management Processes: Brown (1996)

General strategy	Strategic management, business planning, innovation, business process reengineering
Economy	Economic analysis, financial management, accounting systems financial control system.
Production	Production technology overview, organisation of production management, different production systems.
Market	Marketing, market strategy, market analysis, sales.
Organisation	Organisational structures, management administrative & information systems, organisational change systems
Human resources	Personnel management, human resources development, building, training, internal environment and working
Product Evaluating	product mix, product improvement, value analysis, development new product development
Quality assurance	Quality management, certification, quality monitoring
Environmental	External environments, emissions, environmental audit, protection, environmental strategy, environmental certification,
Industrial	Co-operation with other companies, sub-supplier systems co-operation networking, company clusters

Name Of Innovation Management Technique: ______________________

Innovation Management Process	Aiming at Analysis	Decision making	Planning	Implementation
General Strategy				
Economy				
Production Process development				
Market				
Organisation and Administrative Systems				
Human Resources				
Product Development				
Quality Assurance				
Environmental Protection				
Industrial Cooperation				

Methodology Structure		Participation	
Highly structured		Low client	
Moderate structure		Management participation	
Loose structure		Employee participation	
External comparisons Best practices, bench marking, etc.			
Target enterprises			
Micro < 15 employees		Starters	
Small 16-50 employees		Rapidly growing	
Medium 50-500 employees		Frontline enterprises	
Manufacturing		High tech	
Trade		Service	

	Primary Focus		Secondary Focus

Figure 2.1 Classification Scheme for IMTs Brown (1996)

Brown described an innovation tool using three perspectives. The initial view was in terms of its suitability to meet the needs of the management processes (Table 2.4) and its purpose within defined as, analysis, decision making, planning and implementation.

This measure of suitability had two levels of confidence, primary and secondary. The second measure described the methodology in terms of its structure and level of user participation. The final measure described the type of enterprise the tool best served. Shortly after Brown's publication 1996, another European report, TEMAGUIDE, followed suit in 1998. This report was a joint work of many authors from different institutions. The aim of the Temaguide (1998) report was to promote the view of Technology Management as the effective tool of technological change. In order to survive, an organization has to change the design of the products and services it offers to potential customers as well as how it makes and delivers them. To do this it should:

- **Scan** the environment for signals about potential innovations.
- **Focus** attention and efforts on a particular strategy or solution
- **Resource** the strategy and prepare everything needed to make the solution feasible
- **Implement** the innovation
- **Learn** from the experience of success and failure.

The Temaguide (1998) report explained that the balance of emphasis on these five elements (Table 2.5) will vary from company to company and from situation to situation. The Temaguide (1998) approach adopts the cyclic phases of the learning cycle while using techniques directly connected with innovation. It is application oriented and can be applied to either product or process innovation.

Table 2.5 Framework for tools (TEMAGUIDE, (1998)

TM Tools *Key: X = Fully Applicable ? = Might be*	**Scan**	**Focus**	**Resource**	**Implement**	**Learn**
Market Analysis	X	?		X	?
Technology Forecast	X	?			
Benchmarking	X	?			?
Patent Analysis	X	X			
Skill Audit	?	X			?
Portfolio Management		X			?
Project Evaluation		X	?		?
Creativity	?	X	X	X	?
Intellectual Property Rights			X		
Interface Management			X	X	
Project Management			X	X	
Networking	?	?	X	X	?
Team Building	X	?	?	X	?
Change Management				X	
Lean Thinking		?		X	?
Value Analysis		?		X	
Continuous Improvement				X	X
Environmental Assessment	?	?			X

The approach used three facets to describe the tools:

- WHAT is the tool, its objectives, benefits and overall description
- HOW to use the tool, resources required, likely problems
- WHERE to get further information about the tool

The tools were described as being available to address particular parts of the overall technology management, and in principle, all the tools described by this framework, can be used by any type of company and as was also suggested by Brown (1996) they should be tuned to the particular needs and characteristics of each company. As well as describing the management tools in terms of their primary application and phase (Table 2.4) the Temaguide (1998) framework also explained that for a successful project, primary applications may need to be supported by secondary applications of other tools.

2.3.4 Users, processes and tools

According to Brown's (1996) report, small enterprises are often reluctant to use management consultants and innovation management techniques. They complain that, consultants are often , too academic, too expensive and too removed from the realities of most small enterprises. However, Brown further explained that managers working in larger advanced enterprise did not use such techniques as they considered them superficial. As the culture and needs of a start-up enterprise are vastly different from a well-established organisation, Brown (1996) argued there was a need to tailor innovation tools to the nature of the target enterprise.

Previous tailoring attempts to address the situation-technique relationship included:

- Categorization of techniques, using Wallas' four stage approach (Gilhooly, (1982)
- Categorization based on their role when confronting situations encountered on a problem solving journey (Jones, (1992).
- Categorization based on psychological, knowledge based and patterns of innovation approaches to problem solving (Zusman & Zlotin, (1998).
- Categorization of techniques based on resources available to problem solver while further improving problem solving abilities by reinvesting knowledge and skills into the problem solving system.
- Categorization of techniques based on the catalytic ability of a technique to encourage users to change paradigms (McFadzean, (1996).

Moger (1997) argued further that, codification of techniques according to structure, impact and user's cognitive style was worth investigating.

2.3.5 Strategies for classification of CPS techniques

This section reviews the key approaches that have been proposed for the classification of creative problem solving methods and techniques.

Strategy: Tactical Effectiveness - Zusman & Zlotin (1998)

Alla Zusman & Boris Zlotin (1998) performed a study to classify creative techniques. They credited Larry Miles, creator of the Value Method (a problem solving method developed for GE in the late 1940s), with a change in paradigm breaking from what Zusman & Zlotin (1998) described as "The Osborn's tradition" on psychological mobilization to operating with available knowledge. They later credited Genrich Altshuller, Altshuller (1984), for revealing another paradigm, what they describe as the patterns of invention's direction, later known as TRIZ.

Table 2.6 Paradigm list (Zusman & Zlotin, 1998)

Approach	*Strategy Includes*
Psychological mobilization	• Methods of reducing psychological inertia • Team work • Synectics • Fundamental design method • Complexity of techniques
Operating with available knowledge	• Methods of collecting and organizing knowledge about a problem and the system in which it resides • Functional analysis (enhanced and implemented in the technique of Problem Formulation) • Morphological approach (used to ensure the exhaustiveness of the ideas developed) • Morphological Analysis • Quality Function Deployment • FMEA
Patterns of invention's direction	• Evolutionary approach (Patterns/Lines of Technological Evolution) • Innovation knowledge-base approach (various knowledge-base tools) • TRIZ analytical tools
Alla Zusman & Boris Zlotin (1998)	

Zusman and Zlotin (1998) endeavoured to identify the most effective techniques covering all necessary aspects and to integrate them into a single, powerful method capable of addressing any situation. The classification for creative techniques (Table 2.7) used the type of tactic for which the techniques were designed.

Table 2.7 Tactical categorisation Zusman & Zlotin 1998

Tactical Group	***Group Description***	***Examples:***
1. Conditioning/motivating/organizing techniques	The techniques, procedures, special conditions and means belonging to; help create an environment that facilitates the removal of various mental blocks, unleashes natural creativity, etc.	Napoleon technique, listening to music notebooks, stickers, boards, flip charts, etc.
2. Randomisation	Since psychological inertia usually keeps an individual "inside the box" of his/her paradigms/perceptions/assumptions, forcing an individual to make more random attempts to solve a difficult problem were found to be very helpful. Randomisation makes the search more chaotic.	Example: Brainstorming
3. Focusing techniques	Many people have difficulty with random idea generation when no guidelines or focusing steps or subjects are offered. Special focusing techniques are used to help an individual focus on one issue at a time and avoid frustration. Focusing elements (steps) may be presented with or without any particular order (random focusing).	Attribute listing
4. Systems	A system contains a set of focusing or random steps to be followed in a specific order.	QFD
5. Pointed techniques	These techniques offer single or multi-step recommendations following a pre- determined, promising direction. This direction may be identified as useful based on intuition, experience or documented knowledge.	• Problem reversal (single step) • ARIZ (multi-step process targeting the ideal solution)
6. Evolutionary directed techniques	These techniques offer directions according to fundamental patterns of evolution.	Example: Utilization of the TRIZ Patterns/Lines of Technological Evolution
7. Innovation knowledge-base techniques	These techniques utilize structured knowledge derived from the past human innovation experience.	Contradiction Table and 40 Innovation Principles
Alla Zusman & Boris Zlotin (1998)		

Strategy: Shifting Paradigms McFadzean (1996, 1998, 2000)

McFadzean (1996) and Couger (1995) both suggest that organisations must be innovative in today's environment in order to gain a competitive advantage. According to Couger (1995), management can focus on employing people of proven creative ability. However, it is more important to enable the existing workforce to become more creative. McFadzean (1996) and VanGundy (1992) had argued that creativity is encouraged by bringing together teams to spark off new ideas. To encourage this, McFadzean suggested that classifications of techniques should be by their application. Moger (1997) agreed in principle, but argued further that the cognitive styles of the user's should also be included.

According to McFadzean (1996), Brightman (1988 cited in McFadzean, 1996) had investigated the classification of tools using intelligence, design and choice, exploration and evaluation. The classification of tools for individuals and groups had been investigated by VanGundy (1992 cited in McFadzean 1996)). McFadzean citing Brightman explained that the prime reasons for further classification of such tools were to assist facilitator and user to choose when the most appropriate technique and to help researchers when comparing who wanted to compare different techniques. McFadzean's research into what techniques make people creatively do (Table 2.8), when it comes to paradigms, resulted in produced a classification of techniques based on keeping, stretching and breaking paradigms.

Table 2.8 The Creative Continuum McFadzean (1996)

1. Paradigm preserving - no elements or relationships are introduced	c r e a t i v e	1. Classical Brainstorming does not produce very many ideas that challenge or break away from a prevailing paradigm 2. This approach produces more paradigm- preserving ideas than paradigm-breaking ideas. 3. This is because these techniques only use free association and do not encourage the participants to use their imagination to develop ideas 4. They piggyback on the ideas of others encouraging participants tend to follow a more structured process 5. Other paradigm-preserving techniques include Brainwriting, Force Field Analysis and Progressive Abstraction.
2. Paradigm stretching - new elements are introduced or new relationships are conceived. In other words, the problem space or paradigm boundary is stretched • creativity can be enhanced by looking at the problem from a variety of perspectives and by breaking old mind patterns and forming new connections and perceptions. • creativity is moving "sideways" in order to try different concepts and perceptions.	c o n t i n u u m	1. Use unrelated stimuli (dancing, singing and drawing) to promote more paradigm stretching or paradigm breaking ideas by encouraging participants to change their perspective of the problem. 2. The forced association of stimuli; 3. The use of multiple stimuli; 4. The use of a collective memory (i.e. many people working on the problem); 5. Do not use any idea-filtering or evaluation 6. Freedom for modes of expression
3. Paradigm breaking - where both new elements and new relationships are introduced. This occurs when the paradigm's boundary is completely broken by the participants.		

Tools have been categorised in accordance with their ability to achieve the paradigm changes in McFadzean's Creative Continuum. This ability to encourage paradigm shifts is largely dependent on the tactics used by the technique.

Strategy: Creative Tactics Phase and Application (Rickards, (1974)

The objective here was to help managers tackle problems that have no logically correct answer (Rickards, (1974). This strategy used the tactics of restructuring, decision making, redefining, brainstorming and synectics to a problem situation.

The techniques classification used tactics and the type of problem tackled by these tactics. Techniques would be used to varying degree, as a means of applying such tactics to different problem environments are presented in Figure 2.2.and 2.3

Techniques for individual problem-solving		*Techniques for group problem-solving*	
Class T.1	Restructuring techniques	Class T.4	Brainstorming
T.1.1	Morphological analysis	T.4.1	Osborn's methods
T.1.2	Relevance systems	T.4.2	Trigger sessions
T.1.3	Attribute lists	T.4.3	Recorded round robin ('6–3–5')
T.1.4	Research planning diagrams	T.4.4	Wildest idea
Class T.2	Decision aids	T.4.5	Reverse brainstorming
T.2.1	Weighting procedures	T.4.6	Individual brainstorming*
T.2.2	Checklists		
		Class T.5	Synectics
Class T.3	Redefinitional aids	T.5.1	Active listening/constructive group behaviour
T.3.1	Goal orientation	T.5.2	Goal orientation
T.3.2	Successive abstractions	T.5.3	Itemization
T.3.3	Analogy procedures	T.5.4	Changed meeting roles
T.3.4	Wishful thinking	T.5.5	Excursion procedures (speculation and analogy)
T.3.5	Nonlogical stimuli	T.5.6	Individual synectics*
T.3.6	Boundary examinations		
T.3.7	Reversals		

The classification of techniques and subroutines within the main classes will be used as identifiers elsewhere.

Figure 2.2 Problem-Solving Techniques and their subroutines Rickards (1974)

Environments	Techniques: Restructuring aids T.1				Decision aids T.2		Redefinitional aids T.3							Brainstorming T.4						Synectics T.5				
	T.1.1	T.1.2	T.1.3	T.1.4	T.2.1	T.2.2	T.3.1	T.3.2	T.3.3	T.3.4	T.3.5	T.3.6	T.3.7	T.4.1	T.4.2	T.4.3	T.4.4	T.4.5	T.4.6	T.5.1	T.5.2	T.5.3	T.5.4	T.5.5
Advertising agencies	○				●	●							○	○		○	○	○			○		○	○
Corporate strategy units		○			○	○														●	●	●		
Engineering	○		○		○	○					●	●		○	○					●	●	●		
Individual junior managers							●	●	●	●	●	●		○			●	●		●	●	●	●	●
Individual middle managers	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Individual senior managers	○	○				○						●							●	●	○		○	○
Invention groups	○	○			○	○		○	○	○	○	○		○	○	○	○	○		○	○	○	○	○
Market research groups	○		○		○	○			○	○	○		○	○		○	●	○	○	○	○		○	○
OR/Management science groups	○	○	○	○	○	○						○		○			○	○	○	○	○		○	○
Product managers	●	●	○	●		○	●	●	●	●	●	●		○					●		○		○	○
Production departments				○	○	●	●	●	●	●	●	○		○	○			○			○		○	○
Personnel counselling					●					○	○		●	○						○	○	○	○	○
Public service administrators						●				●	●	●		○						●	●	●		
Technical managers	○			○	○	○	○	○	●	●	●	○		○	○	○	○	○		○	○	○	○	○
Think tanks	○	○			○	○	●	●	●	●	●	●		○	●	●	●	●		○	○	○	●	●
Training departments				●	○	○		○		○	○			○						●	○	●	○	○
Value analysis	○		○		○	○				●		●		○	○	●	●	○			○		○	○
Venture groups	○	○	○			○						●		●						●	○	●	○	○

Key
○ Subroutine known to be applicable in the given environment
● Subroutine thought to be potentially applicable in the given environment

T.1.1, etc. See Figure 1:1 for key to the various subroutines

Figure 2.3 Current and potential use of techniques in various management environments
Rickards (1974)

Strategy: Techniques by Role (Jones, 1992)

Jones investigated the unease found amidst problem situations and the choices of techniques. Intrigued by the pertinence of the technique and designer's intuition when selecting a technique, Jones (1992: p75) posed the question, "...Is it necessary to have tried out or at least to have understood a method before one can say whether or not its use in a particular case would be promising or a waste of time?"

The approach of Jones' investigation was to classify the techniques according to their role used on a journey of transformation from initial requirement or problem to the desired outcome. The paradigm, pursued by Jones (see Figure 2.4) was that the classification types of design methods used would culminate into a problem solving strategy. Jones believed this approach was appropriate because *"... each design action can consist of whatever the designer chooses... some actions will be new methods ..., some will be traditional actions ..., while others may be novel procedures that the designers invent for themselves... When a design method is, by itself, sufficient to solve a design problem, it is called a strategy, but most of the new methods are insufficient to do this and are classified as actions out of which complete strategies can be composed..."* Jones (1992: p74)

Examining the techniques' strengths and weaknesses revealed that some techniques were *convergent* implying *"...a reduction of the uncertainty generated at earlier stages..."* and that there is an underlying *"...big weakness of methods in that they all presuppose a fixed problem structure and are therefore insufficiently flexible for novel design situations..."* Jones (1992: p82) In contrast to that, Jones also explained that some techniques were *divergent.* Those techniques that were divergent, Jones (1992) described as intended to generate doubts, to encourage and enable the design situation to be explored, seek alternatives and promote discovery of what is critical and sensitive.

While Jones did explore the roles and application of techniques when tackling problems, unfortunately, Jones did not appear to consider the other side of the problem solving action, that is; the relationship between the user and the technique. As a result, although Jones considered the concept of divergence and convergence, Jones' strategy seemed to presuppose that the technique did the thinking, not the person. It appears to the researcher that Jones could have been victim of the trap of adopting the paradigm or world-view of the user and seeing all through the eyes of the user and not the eyes of an independent observer. This may have camouflaged the human contribution to the problem solving process. Jones drew comparison between systems-designing and planning, commenting that "*...the designing of systems entails the ability to envisage and evaluate many alternative products simultaneously: we may thus conclude that the methods appearing in the system-design zone of the chart enable the system designer to juggle with many more alternatives at one time and thus to generate a new system...*" Jones (1992: p83)

OUTPUTS → INPUTS ↓	2 Design Situation Explored	3 Problem Structure Perceived or Transformed	4 Boundaries Located, Sub-solutions Described and Conflicts Identified	5 Sub-solutions Combined into Alternative Designs	6 Alternative Designs Evaluated and Final Design Selected
1 Brief issued	3·1 Stating Objectives 3·2 Literature Searching 3·3 Visual Inconsistency 3·4 Interviewing Users 4·1 Brainstorming	3·2 Literature Searching 3·3 Visual Inconsistency Search 3·4 Interviewing Users 4·1 Brainstorming 4·2 Synectics	3·3 Visual Inconsistency Search 4·1 Brainstorming 4·4 Morphological Charts	3·3 Visual Inconsistency Search 4·1 Brainstorming 4·2 Synectics	2·1 Strategy Switching 2·2 Matchett's FDM
2 Design Situation Explored		3·1 Stating Objectives 3·9 Data Reduction 5·1 Interaction Matrix 5·2 Interaction Net 5·8 Classification 6·4 Specification Writing		5·4 System Transformation 5·6 Functional Innovation 5·7 Alexander's Method	
3 Problem Structure Perceived or Transformed	3·2 Literature Searching 3·5 Questionnaires 3·6 Investigating User Behaviour 3·7 Systemic Testing 3·8 Selecting Measurement Scales 3·9 Data Logging		1·5 Boundary Searching 3·7 Systemic Testing 4·1 Brainstorming 4·4 Morphological Charts 6·2 Selecting Criteria 6·3 Ranking and Weighting 6·4 Specification Writing	4·1 Brainstorming 4·2 Synectics 5·4 System Transformation 5·5 Boundary Shifting	1·1 Systematic Search 1·2 Value Analysis 1·3 Systems Engineering 1·4 Man-machine System Designing 1·5 Boundary Searching 1·6 Page's Strategy 1·7 CASA
4 Boundaries Located, Sub-solutions Described and Conflicts Identified		4·2 Synectics 4·3 Removing Mental Blocks 5·3 AIDA 5·4 System Transformation 5·5 Boundary Shifting 5·6 Functional Innovation 5·7 Alexander's Method		4·1 Brainstorming 4·2 Synectics 4·3 Removing Mental Blocks 5·3 AIDA	5·3 AIDA
5 Sub-solutions Combined into Alternative Designs					1·2 Value Analysis 3·5 Questionnaires 3·6 Investigating User Behaviour 3·7 Systemic Testing 3·8 Selecting Measurement Scales 3·9 Data Logging and Reduction 6·1 Checklists 6·2 Selecting Criteria 6·3 Ranking and Weighting 6·4 Specification Writing 6·5 Quirk's Reliability Index
6 Alternative Designs Evaluated and Final Design Selected					

Figure 2.4 Input-Output Chart for selecting design methods Jones (1992)

Making the distinction between system designing and the planning of socio-technical innovation, Jones explained that the divergent and transformational methods of the upper zone of the chart (figure 2.4) were essential for technological changes suitable for newly emerging forms of society and not merely the existing social organizations. Assuming these implications were correct, Jones then concludes that while system designers should seek a new set of products to fit an existing society, the planners of technological change should seek to develop new systems to facilitate social evolution.

The approach suggested by Jones resembles the Temaguide (1998) view that techniques have a secondary purpose of supporting other techniques. It also has similarities with the views of Rickards (1974), Brown (1996) as well as Temaguide (1998) when considering working on different types of sub-problems within the encompassing big problem.

Strategy: Ease of Use - O'Dell (2001) citing OU B822
O'Dell's (2001) model gives an holistic overview of creative problem solving. It takes into account: the person(s) doing the thinking, aspects of ability, aptitude and conditions that can influence creativity. It also considers: the divergent and convergent thinking necessary to complete a four stage linear process; the efforts to resolve the problem to deliver the product; and the organisational culture and communication, described as the press and the tools.

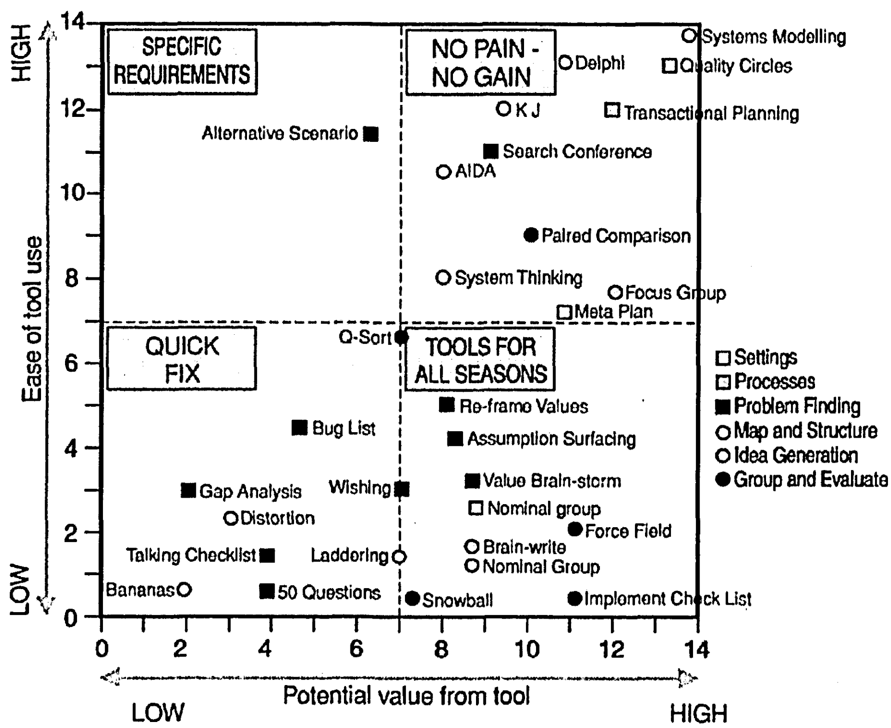

Figure 2.5 The Ease/Value Matrix O'Dell (2001)

Like McFadzean (1996, 2000), O'Dell (2001) also considered the effectiveness versus effort dilemma faced by every potential technique user. To help the decision maker O'Dell cited *The Ease of Use Matrix (Figure 2.5)* from the OU B822 creative management course. Examining the boxes "Quick-Fix" and "No-Pain No-Gain", this approach further resembles McFadzean's concept of categorising by the techniques ability to help change paradigms.

Synopsis of other Publications on Techniques & Strategies
Allison's (1993) suggested a tool selection matrix based on situation to hand. It also included a matrix describing the techniques as descriptive and/or analytical as well as its the suggested appropriateness for planning and creativity. Reid (2006) appeared to serve one purpose, aimed to improve the reader's problem solving and creative abilities. The approach encouraged greater awareness to use of creativity for more ambiguous and complex problems by categorising levels of complexity Using, levels of complexity, described by the author as territories, where there is: little or no uncertainty, low to moderate ambiguity, moderate to high ambiguity and persistent ambiguity., it encouraged greater awareness to use of creativity for more ambiguous and complex the problems. Clegg and Birch (2002) also focussed on improving the readers problem solving and creative abilities. Although not direct, the

approach was to train the reader to follow the four-stage process of defining, ideating, selecting and implementing ideas.

Higgins (1994) listed techniques in accord with their appropriateness to the phase of the overall problem-solving process that what resembles Abrader et al's (1990) eight-phase process. Higgins described the process as, analysing environment, recognizing problem, identifying problem, making assumptions, generating alternatives, choosing alternatives, implementing and control.

2.3.6 Patterns of approach

Table 2.9 compares the approaches to creative problem solving considered in section 2.3. Patterns emerge that indicate the beliefs and perceptions of creative problem solving at that time. The approaches adopted are classified in table 2.9 according to the dominant characteristics and perspectives used.

Table 2.9 Similarities of Approach

	Phase	Appropriateness	Linear	Technique Typology	Ease of Use	Application	Psychological-resources	Systemic Levels	Cyclic	Re-Invest Knowledge	Situation Complexity	Paradigms
Brown (1996)	x	x	x		x	X		x				
Jones (1992)	x	x	x						x			
Higgins (1994)	x	x	x									
Allison (1993)	x	x	x	x								
Clegg & Birch (2002)	x	x	x	x	x						x	
Ried (2006)	x	x	x		x							
Zussman&Zlotin (1998)	x			x			x					
Rickards (1974)	x			x		X						
TemaGuide (1998)	x					X		x	x	x		
Mc Fadzean(1996,2000)				x			x				x	X
O'Dell/OU (2001)					x		x					

From a process perspective, it appears to the researcher that a linear phase based approach is the dominant type. Those techniques bespoke to situations are less frequently used. From a problem perspective, the overall context of application seems lacking. From a person or user perspective, there is an unfortunate lack of consideration for technique usability while the importance and role of psychological resources necessary to drive the problem solving process remained at an awareness level.

Complexity and the lack of ease when using techniques was not given much weight. The concept of paradigms to address complexity seems new to the agenda. On closer inspection, using paradigms appears to have possible support from psychological resources via the circular link between paradigms, complexity, ease of use, and psychological resources.

2.3.7 The need to consider the people-technique relationship

The Innovation Process or Cycle

Re-examining McPherson's (McPherson cited in Parnes, 1992) comparison of descriptions for creative problem solving (Table 2.10, discussed earlier in section 2.3.2, Table 2.3) suggests concurrence of opinion when it comes to describing the transition through the stages of the creative problem solving process.

Table 2. 10 A sample of McPherson's creative problem solving process cited in Parnes, 1992

Steps	Wallas	Dewey	Rossman	Guilford	Alex Osborn (early)	Osborn, Creative Problem Solving
1.	Preparation (information)	Difficulty is felt	Need or difficulty is observed	A cyclic looping model that is difficult to present in a linear fashion	Orientation	Looking at "The Mess" to find problems
2.	Incubation (unconscious mental work goes on)	Difficulty located and defined	Problem formulated		Preparation	Finding a "Fuzzy Problem"
3.	Illumination (solution emerges)	Possible solutions are suggested	Available information surveyed		Analysis	Fact finding
4.	Verification (solution tested and evaluated)	Consequences are considered	Solutions formulated		Ideation	Problem finding
5.		A solution is selected	Solutions critically examined		Incubation	Idea finding
6.			New ideas formulated		Synthesis	Solution finding
7.			New ideas tested		Verification	Acceptance finding

A similar model, offered by Basadur et al (1990) was also based on an eight phase innovation cycle: problem finding, fact finding, problem defining, generating potential solutions, evaluating potential solutions, planning for action, gaining acceptance, taking action. This was similar to the model offered by Higgins (1994). The model is shown in Table 2.11. The cumulative outcomes of these phases are input directly to the beginning of a new cycle of the process, the environmental analysis phase, to reiterate the creative problem solving cycle as new problems are met and new changes are required in the evolved new environment.

Table 2. 11 Eight Phase Approach Higgins (1994)

Phase	Purpose
Analysing the Environment	Recognise or pre-empting problems and opportunities.
Recognising a Problem	Start with only a vague feeling that something is wrong or an opportunity exists when a gestation period seems to occur in the subconscious for the instinctive information to register at the conscious level.
Identifying the Problem	Establish the objectives of the problem-solving exercise by determining what evidence or feedback will be necessary to determine the success of the solution and to what degree. Effort should be made to ensure resources are focused on the solving the real problem not just eliminating symptoms.
Making Assumptions	When making assumptions it is necessary to include a, "future factor", because, by the time be solution is implemented the environment into which you are placing your solution may well have changed.
Generating Alternatives	This stage is when most creativity takes place. Activities are both intuitive and rational and most people reach their highest levels of creativity at this stage. However, at this stage quantity of ideas rather than their quality is of prime importance.
Evaluate	When evaluating alternatives it should be done with reference to criteria established during the problem identification phase. A key part of this phase is to explore and determine possible outcomes of the various alternatives.
Implementation	A clear idea of what the solution to a problem is should now be in place and a specific goals with a realistic deadlines should be put in place while gaining support from all affected parties to help reach the solution.
Control	Evaluating the outcomes of the implementation is the final stage of a process. The aim is to determine both the success of the selected solution while recognising any deficiencies. This phase often requires objective thinking intellectual courage and self-confidence.

The Creative Continuum

Stressing the importance of creative problem solving techniques to encourage innovation in organizations, McFadzean (1998, 2000) introduced a concept identified as "The Creative Continuum" – a sliding scale between keeping a paradigm and breaking one. This sliding scale describes paradigm preserving as one extreme, which does not necessarily encouraging participants to be creative. The other extreme, paradigm breaking, does encourage a high degree of creativity using many perspectives. Citing Newell et al (1962), McFadzean argued that problem solving is creative, subject to the problem being vague, the thinking being radical and the outcome being novel. This type of problem requires high motivation, persistence and time. McFadzean further explained that creativity also occurs when a new relationship between existing elements and/or new elements are added to a system Also, according to McFadzean creativity can be encouraged by a change in an individual's mindset or paradigm.

The role of Thinking Styles in the Cycle

Furnham (1995) described Kolb's (1978) four stage learning cycle as the acquisition of concrete experience, which gives way to reflective observation. Then theory building or abstract conceptualisation occurs, followed by testing then occurs through active experimentation. The learning cycle then begins again as the experimentation itself yields new concrete experiences. Furnham explained that each stage of the process requires a different skill but as individuals are more competent at some abilities than they are at others their preferred learning style will probably be used. This view was supported by Mueller et al (2011) who found that people who are tolerant of uncertainty show positive views towards creativity while people intolerant of uncertainty show the contratry. Comparing the skills naturally possessed by people of different learning styles with the tasks encountered in each phase of the innovation cycle (Table 2.12), we can see learning styles are the natural driving force of each phase of the innovation cycle.

The role of Thinking Styles in the Continuum

Citing Smith's (1995) description of paradigms as a set of shared assumptions, perceptions, and explanations of the world, McFadzean (2000) described a paradigm as a change in an individual's mindset. A new way of seeing things, seems to strike accord with McFadzean perception of a paradigm.

In this context, it is worth referring to Furnham (1995) who explained that, perceptive people tend to emphasise concepts generalisations and relationships while those who are receptive focus on detail. Foxhall (1987) agreed, as did Kirton (1998), with the explanations that adaptors see newness within an existing frame of reference, and innovators see novelty as a break from that paradigm.

It is the view of the researcher that perceptive and receptive thinking styles have been somewhat overlooked. They should assist in gaining a better understanding of what it is about people, psychologically at least, that makes people stick to, change or create new paradigms.

Table 2.12 How Thinking styles affect CPS process

Creative Thinker	CPS Phase	Purpose of the CPS Phase
The Active Pragmatist prefer to learn hands-on enjoy a new challenges major strength is in doing things adapt quickly to new circumstances prefer to resolve problems in an intuitive trial and error manner. strong preference for problem sensing and fact finding they love to get things started intuitively find new problems and opportunities.	**Environmental Analysis**	recognise or pre-empting problems and opportunities
The Pragmatic - Reflector very good at observing situations from many angles a broad range of interests. Imaginative sensitive to feelings strong preference for problem defining strong preference for generating ideas	**Problem Recognition**	Realise instinctive information at the subconscious level to be firmly registered at the conscious level
	Problem Identification	determine what evidence or feedback will be necessary to determine whether the problem has been solved or to what degree focus on the solving the real problem not just eliminating symptoms
The Reflective -Theorist best at understanding a mass of information good at putting it into a clear logical form. prefer concepts and logical soundness excel at inductive reasoning. strong preference to solving well defined problems.	**Making Assumptions**	keep the future in - by the time be solution is implemented the environment may have changed.
	Generating Alternatives	Identify & formulate useful options Be both intuitive and rational. Quantity of ideas rather than their quality is of prime importance
The Theoretic Activist prefer technical tasks rather than social ones Do best when there is a single correct answer to problem. Prefer to work with a fixed goal will go to extreme length to make sure the new solution to the problem is installed and working.	**Evaluate**	Evaluating alternatives - done systematically relative to criteria established during the problem identification phase. Explore and determine possible outcomes of the various alternatives.
	Implementation	plan specific goals with a realistic deadlines for the solution. Gain support from all affected parties to help reach the solution.
The Active Pragmatist prefer to learn hands-on , enjoy a new challenges, major strength is in doing things, adapt quickly to new circumstances, prefer to resolve problems in an intuitive trial and error manner. strong preference for problem sensing and fact finding they love to get things started intuitively find new problems and opportunities.	**Control**	evaluating outcomes, determine both the success of the selected solution, recognising any deficiencies, requires objective thinking intellectual courage and self- confidence, outcomes of this phase are fed directly back to the beginning of the process, the environmental analysis phase, to reiterate the creative problem solving cycle.
(Kolb, 1978; Honey& Mumford, 1995, Basadur *et al*, 1990)	(Basadur *et al*, 1990;Higgins,1994)	(Higgins,1994)

2.3.8 The need for a New CPS Strategy

Goleman (1999) described the act of innovation as both cognitive and emotional, with creativity relying on many competencies to overcome all levels of emotions and distractions. Such distractions can often be symptomatic of what Goleman described as, Amabile's (1988) killers of the creativity required to drive innovation. Amabile's creativity killers were described by Goleman as: surveillance (killing all sensces of freedom to think), evaluation (too critical too soon too intense), over-control (micromanaging every step of the way) and tight deadlines (often induce panic). Tidd, Bessant & Pavitt (2001) explained that in order to surmount such innovation killers organisations often need key people to champion innovation.

A positive cultural attitude to innovation, training is important according to Tidd, Bessant & Pavitt (2001) who explained that surveys of people seeking employment, have suggested opportunities for personal development of innovation skills ranked higher than financial rewards.

Amabile (1998) explained that creative skills depend somewhat onf personalities as well as on how people are motivated, think and work. Amabile & Pillemer (2011) explained that team creativity requires people to work together effectively and exploit their peer's' skill sets to the full. While a positive open climate can, according to Van Grundy (2004) do much to bring out creative ideas, Flood & Jackson (1991) argue that without a diversity of methods to resolve situations, people would be confronting a greater number of highly complex messes.

Taxonomies organise such methods and approaches, revealing their strengths and limitations thus enabling informed choice of how things can be achieved. Van Grundy when justifying the reasons for his taxonomy of techniques explained that a facilitator or problem solver may face different creative challenges where many ideas are required very quickly or on occasions time may take a lower priority with attention focused at novelty. The facilitator may also want to make their own judgement about the people they are facilitating. Describing categories as ranging from taxonomic and formal to ad-hoc, Barsalou (1983) explained that people naturally use such structures to achieve their goals.

Explaining that the human conceptual system probably evolved to support human action in the environment, Barsalou (2000) further explained that, people inherently describe situations using many subjective perspectives, concepts and cateagories. The importance of such a situation can be recognised by the concepts and properties used to describe it. Such concepts include taxonomic concepts (similarity or neighbouring concepts), entity (descriptions of features), situational concepts (physical setting and location), introspective concepts (personal or subjective views). Barsalou (1983) showed that using taxonomic as opposed to ad-hoc cateagories encouraged greater consistency of instance -to-concept association in the human memory.

At present, according to Amabile & Pillemer (2011), creativity fails to consider a comprehensive view of individual behaviours. By taxonomising such behaviours with and techniques, the researcher is of the opinion that the provision of such a structure will discourage the anti-innovation practices of over surveillance, over evaluation, over-control, unrealistic deadlines and facilitate better learning and practice of creative problem solving.

Nesta (2008) explained that the process of innovation is multi-dimensional, containing many facets for which Brown (1996) had a vision of a best-fit policy for innovation tools and techniques. Higgins (1994) and McFadzean (2000) had independently categorised innovation techniques. Higgins chose to focus on the application of the technique to the phase of the innovation cycle. McFadzean focussed on the ability of the technique to encourage the user to be more creative.

Basadeur et al (1990) had earlier established links between, Kolb's (1978) learning styles and the phases of creative problem solving while Furnham (1995), Foxhal (1987) and Kirton (1988) had all concurred that perceptive people emphasise concepts while receptive people focus on detail. Amabile (1996) had also explained the importance of an individual's intrinsic task-motivation while emphasising its sensitivity to constraints.

By combining Higgins'and McFadzean's complementary perspectives with the importance of cognitive styles in creative problem solving, and not ignoring people's natural reluctance to change their preferred style of thinking, – the researcher is of the opinion that a new more holistic paradigm of creative problem solving begins to emerge. This perspective opens the opportunity to tailor the use of problem solving techniques to the cognitive preferences of then individual. This new ability should help control the conditions that intrinsic task-motivation is sensitive to and satisfy the view offered by Puccio (1999) that, knowing an individual's preference for aspects of creative problem solving can help them develop both talent and coping strategies for dealing with processes they dislike. While in keeping with Pidd's (2003) concept of crafting a strategy, using the problem-solving process as a framework and knowing the cognitive styles available (Table 2.13) should, if used correctly, enable facilitators to craft their own strategies, satisfy Browns' vision of a best-fit policy for innovation tools and control the conditions to promote what Amabile (1996) described as, intrinsic task-motivation. By providing a framework and an environment where people can focus their minds and use their cognitive styles comfortably and fearlessly, this approach will help encourage people to be more enthusiastic towards creativity.

Table 2.13 The New Strategy; Moran (2010)

Cognitive Style				Receptive Thinking		Perceptive Thinking
				Paradigm		
Learning Preference	Creative Style	CPS Phases		Keep	Stretch	Break
Intuition Thinking	Pragmatist Concrete experience	Active Pragmatist	Analyse			
		Pragmatic Reflector	Recognise			
Reflection Thinking	Reflector Reflective Observation		Identify			
		Reflective Theorist	Assumptions			
Systematic Thinking	Theorist Abstracts &concepts		Alternatives			
		Theoretic Activist	Evaluate			
Active Thinking	Activist Active experience		Implement			
		Active Pragmatist	Control			
Furnham (1995)	(Kolb,1978), (Honey& Mumford 1995) Basadur *et al*	(Kolb,1978), Honey & Mumford (1995) Basadur *et al*	(Higgins, 1994)	Furnham (1995) Kuhn (McFadzean,2000)		

2.4 Conclusion

Having investigated the cognitive styles of an individual, group behaviour and strategies used in creative problem solving, the consensus of these the first two sections literature review suggest potential for the research hypotheses concerning cognitive preferences of individuals working alone or as a group. The latter reinforces the need to prove the hypotheses thus enabling cognitive styles to have appropriate and optimum impact when using techniques.

Experimental proof of these hypotheses will not only provide evidence of the existence of a natural framework for cognitive styles but also, confirm that such a framework is appropriate as a taxonomic framework for creative problem-solving techniques.

According to Amabile (1985, 1996), creative thinking depends on personality traits and the ability of a person to break out of preconceived perceptions with a person's intrinsic motivation being pivotal to the success of his or her creativity. Mueller et al, (2012) proved that when people are being creative thereby facing risks, they will automatically make an effort to reduce the uncertainty and as a result they will experience negative associations towards creativity. This suggests that a person, intrinsically biased to using a particular cognitive style, will react negatively to a task perceived to be confrontational to their weaker cognitive style preferences and abilities.

It is the researcher's proposition that proving the hypotheses will create the foundation for devising a new framework the use of which will offer people the opportunity to work creatively within a perceived safety zone. The perceived stability offered by such an approach will nurture the personality traits identified by Amabile (1998) hence promote risk taking by reducing fear, make it easier to persevere in the face of frustration and encourage intrinsic motivation of the people involved. This will encourage a greater willingness to be creative, focus more on the task and be more creatively productive.

By providing people with a framework and an environment to enable them focus their minds and use their cognitive styles in a way they enjoy and feel comfortable with, this approach will help promote creativity.

2.4.1 Research hypotheses

In order to achieve technique codification in relation to structure and cognitive styles the hypotheses tested within this thesis are:-

H0 = Participants assigned to a technique that is not in accord with their preferred cognitive styles will not show a significant preference for the assigned technique.

H1= Participants assigned to a techniques that is in accord with their preferred cognitive styles will show a significant preference for the assigned technique.

H1. 1. FOR THE INDIVIDUAL, FROM A USABILITY PERSPECTIVE: participants will show a noticeable preference for techniques that will be in accord with their individual preferred learning styles.

H1. 2. FOR THE INDIVIDUAL, FROM A PERFORMANCE PERSPECTIVE: participants will show a noticeable preference for techniques that will be in accord with their individual preferred learning styles.

H1. 3. FOR THE INDIVIDUAL, FROM A USABILITY PERSPECTIVE: participants will show a noticeable preference for techniques that will be in accord with their individual preferred creative styles.

H1. 4. FOR THE INDIVIDUAL, FROM A PERFORMANCE PERSPECTIVE: participants will show a noticeable preference for techniques that will be in accord with their individual preferred creative styles.

H1. 5. FOR THE GROUP, MEMBERS' HAVE THE SAME LEARNING STYLE, FROM A USABILITY PERSPECTIVE: preferences for specific technique will lie in accord with the individual group member's preferred learning style.

H1. 6. FOR THE GROUP, MEMBERS' HAVE THE SAME LEARNING STYLE, FROM A PERFORMANCE PERSPECTIVE: preferences for specific technique will be in accord with the individual group member's preferred learning style.

H1. 7. FOR THE GROUP, ALL MEMBERS' HAVE THE SAME LEARNING STYLE PREFERENCE: a bias of preferences will exist in favour of working with peers who have the same learning style.

3 Methodology

The previous chapter has explored the theories underpinning creative behaviour, a plethora of influences came to the fore. Identification of phenomena within an innovative system environment has so far suggested the possibility of a new strategic approach. In order to generate and master modern theories a better understanding of existing theories inherent within the present system is required. To achieve meaningful evaluation of new theories and application, further collaborative action with interested parties will be required. This chapter will describe the concepts, actions and analysis required to realise a new, innovation strategy.

This chapter explains the overall approach and the detailed procedures used to test the hypotheses developed in chapters 1 and 2. These require investigation of how individuals and groups respond to the use of creative problem-solving techniques with respect to both people's perceptions of their experience of using the techniques and the problem solving performance that results. The main approach adopted is experiment, with analysis of the results using both quantitative and qualitative approaches.

The chapter covers first of all the frameworks for the categorisation of techniques and learning styles, summarising the main sources from which the frameworks have been derived that are discussed in chapter 2. It then goes on to explain the experimental approach and in particular the workbook used to capture the data. The methods used to analyse the data are then identified, further detail being provided in chapter 4. Finally the approach to building the taxonomy of techniques is described and comments given on the ethical aspects of the methods used.

3.1 Frameworks for analysis

3.1.1 Strategies, methods and techniques

Traditionally there appears to be a strong adherence to a shared paradigm when it comes to describing the creative problem-solving process - a journey via a series of sequential techniques, from a starting point of a confusing problem, to the destination of a clarity and understanding. The techniques offer tools to tackle distinct situations encountered on this journey. This paradigm became a foundation, encouraging the philosophy and practice of building problem solving processes from available techniques bespoke to resolving particular types of problems.

Many examples in the present literature suggest the existence of a strong human habit of asking the questions of the type "What does it do?" and "Where can it be applied?" In contrast to: "How does it actually work?"

Such a simple, yet fundamental action of looking at instead of looking in, could have stymied development and understanding of creative problem-solving for quite some time. The serial approach sufficed, until questions concerning creative productivity in terms of quality and quantity of ideas and solutions came to the fore. Such unrest encouraged a paradigm shift from following a prescribed process to controlling it. In order to achieve control, greater profundity in understanding was necessary and the, "How does it work?" question, was finally asked. This opportunity, led to McFadzean (2000,2002) finding The Creative Continuum, a sliding scale between keeping and breaking a paradigm and provoked the understanding that different problem-solving techniques encourage distinctive creative performance.

3.1.2 The participants

Individuals

For the individuals involved in a creative problem-solving process, Pidd (2003) explained: that there is an ignorance of the phenomenon that every person is unique hence thinks and behaves differently from everyone else. This perspective helped encourage the question: "What attitudes and skills are necessary to perform creative problem solving?" Sternberg explained there are essentially six styles of thinking used in problem-solving and, every individual possesses all six of these thinking styles to a greater or lesser degree. People have their own instinctive bias towards a particular set of styles. It is this bias that defines one's personality. These styles of thinking, or as Sternberg puts it, strategies, do actually have their own inherent polarities and orthogonal space as shown in table 3.1. Although not in chronological sequence and quite independent of the work of Sternberg (1997); Honey & Mumford (1995), Basadur et al (1990) and Kolb (1978), also helped identify the roles or activities a person is likely to prefer doing when involved with solving problems or learning.

Table 3.1 Thinking Styles & Strategies

Polarities	Strategies	
Perceptive - Receptive[a]	Those following the **perceptive** [a] strategy tend to emphasise concepts generalisations and relationships	Those following a **receptive** [a] strategy focus on detail.
Systematic - Intuitive[a]	Individuals who follow Sternberg's **Systematic** strategy to problem solving tend to rely heavily on method and procedure **The Reflective - Theorist**[b] **(Assimilator**[c]**, Optimiser**[d]**)** • Understand & consolidate vast data into clear logical information • prefer concepts and logical soundness • excel at inductive reason • prefer well defined problems	Those who follow Sternberg's **Intuitive** strategy approach problems using "gut feel" relying on analogies, unusual relationships and past experience to determine a solution. **The Active Pragmatist**[b] **(Accommodator**[c]**, Generator**[d]**)** • prefer to learn hands-on enjoy new challenge and opportunities. • major strength is in doing things • adapt quickly to new circumstance • prefer to resolve intuition trial and error • strong preference for problem sensing and fact finding
Active - Reflective[a]	Those who follow Sternberg's **active** strategy are more inclined to experiment or take some action, usually looking for quick fixes. **The Theoretic -Activist**[b] **(Converger**[c]**, Implementer**[d]**)** • prefer technical to social tasks • best when there is a single correct answer • prefer to work to a fixed goal • go to extreme length to make sure the new solution is installed and working	Those who follow Sternberg's **reflective** strategy, tend to look & ponder rather than take part, focusing on concept rather than practical application **Pragmatic – Reflector**[b] **(Diverger**[c]**, Conceptualizer**[d]**)** • good observers use many angles • broad range of interests. • imaginative • sensitive to feelings • strong preference for problem defining and generating idea

a Sternberg, 199,7 b Kolb, 1978, c Honey & Mumford, 1995, d Basadur et al, 1990

Despite the identification of indicators to help portray a person's problem-solving bias, little information seems available as to how to harness this resource to help drive the innovation process to its full potential.

Groups

Craig et al (1999) and Zaccaro and Lowe (1986) examined how group cohesion and conflict are likely to influence the creative behaviour of a group (tables 3.2 & 3.3). While effort was made to understand the influence of intellectual ability on a group's creative behaviour, little evidence is available to explore what influences the learning styles or creative styles of group members either individually or as a collective. Considering the premise that a group of divergent thinking people will be collectively divergent, the question remains, does this depend heavily on the group dynamics (table 3.2) such as conflict and cohesion? Works done by Beal (2003) and LePine (2003) examined how well acquainted typical problem solvers are with each other and their task.

Table 3.2 Influences of group dynamics

Cohesion	Task and Interpersonal	• High task and high interpersonal cohesion conditions receive higher creativity • High task and high it interpersonal cohesion combined facilitated creative performance by increasing task directed effort and decreasing inhibited communication by removing communication barriers. • At high task higher interpersonal cohesion combined actually perform the worst on creativity than the other groups.
Conflict	Task	• Task conflict can be beneficial to task performance in non routine environments • Task conflict encourages members to confront problems from many perspectives • Task conflict can act as a cognitive stimulant thereby encouraging flexible thinking and more creative problem solving.
	Interpersonal	• Relationship (or social) conflict can generally decreases satisfaction and interferes with task performance • Devil's Advocacy encourages better judgment.

While a group of people may be encouraged to be cohesive on a personal level to promote creativity, they should also be encouraged to focus collectively on their task or mission. Treating your task as the enemy and avoiding interpersonal conflict also encourages better group creative performance.

Table 3.3 Influences of Familiarity with Tasks and Peers

Task familiarity	• moderates the relationship between team ability and team performance.
Task unfamiliarity encourages teams composed of members with high cognitive ability to be more ...	• able for developing effective teams and systems of activity • capable of learning from experience • able in a changing environment • able to draw from their superior knowledge • able to integrate knowledge between members • able to develop acute understanding of new situations • able to give the team the potential to be more flexible • able to perform better after unforeseen circumstance • able to adapt their role structure to new circumstance
Communication	• extroverts are outwardly focused showing an interest in people and environment • introverts are more inwardly focused

3.2 The Problem to Hand

Having explored theories, which underpin creative behaviour, a plethora of influences came to the fore, some complementary some conflicting. Jones (1992) proposed a culling strategy based on identifying the strengths as well as the weaknesses of traditional methods, stating that, "...new methods that have appeared so far are only partial solutions for modern design problems. If this is the case, we should look more closely at the reasons for abandoning old methods before developing any newer ones. In this way, we may find what it is best to discard or retain some features of traditional design procedures. Perhaps we can ..."
To achieve such a strategy, it will be necessary to examine new and distinct concepts. Concepts such as, the method of methods introduced by Flood & Jackson(1991) which groups different systems of methodologies with that end in mind; alternatively, the possible remedy suggested by Pidd (2003) of reducing the over-reliance on formal reason and rational analysis. Perhaps Jones' (1992) suggestion of finding what it is about a technique that is best to discard or retain might satisfy Brown's (1996) vision of tailoring techniques to the needs of the user. Such a meta-strategy could realise Pidd's vision giving facilitators the necessary tools to 'craft their own strategy'

3.3 The Approach

Identification of phenomena within an innovative system environment has so far led to a possible strategy or process. In order to generate and master new theories necessary to realise a strategy, one must get more meaning and better understanding from existing theories inherent within the system. It will be essential to ascertain the usefulness of such theories, actual or perceived, in both the practical and theoretic world.

In order to achieve that goal and make some meaningful evaluation of the application of new theories, further collaborative action with interested parties will be required.

Traditionally, research methods embrace a qualitative or quantitative approach. Quantitative approaches give some indication of likelihood or degree of confidence as to what response to some causal event or condition may be expected. Using a quantitative approach may be beneficial when describing the behaviour of a known system but French (1989) explained the long-term frequency of a system in a specific state in identical experiments is the important issue. Otterson (2000) concurred by explaining the clinical perspective of repeatedly observing a system in a 'particular state' would require careful preparation, execution and caution. Such an approach also implies that all influencing factors are both, identified and controlled. Further, by adopting such an approach, there is the additional risk of overlooking the "why" and the "how." A causal condition may have evolved into a particular response when, some other unmeasured influencing factor is, in fact, responsible for that result.

Checkland and Scholes (1990), explained that when confronting a new subject in contrast to a well defined one, the only way to develop this new subject was by interaction with real problem situations in an 'action research' mode. Such work cannot test hypotheses in the classic manner of scientists in laboratories; therefore, it is essential to use an intellectual framework to make sense of both the situation and the researcher's involvement in it. It is with reference to the declared framework that lessons can be defined. Using a framework will give the action researcher two hopes: it will aid insights concerning the perceived problems, and the experience of using the framework will enable it to be gradually improved.
According to Otterson (2000), placing the problem solver into the problem and thereby being part of the problem situation itself is a catalyst to encourage learning by doing. This in turn

would have some noticeable effect on the solver's own judgement of their problem-solving ability. This approach reflects the subjective experience of a problem solver who can never be objectively divorced from the problem situation and their personal knowledge.

3.4 Establishing a framework

The situation of never being objectively divorced from the problem situation and their personal knowledge occurs in decision-making, when, without the benefit of hindsight or experience, the traditional approach, what French called the frequentist, is quite unsuitable for modelling the uncertainty present in the majority of decision problems. A possible route over this frontier is that of, "Subjective Probability." This is a representation of an observer's degree of belief that a system will adopt a specific state. Such degrees of belief can be tailor-made encoded judgements and beliefs about the relative likelihood of particular possibilities. According to Checkland and Scholes, the action learner is part of such a system with a readiness to use their experience itself with lessons learnt through conscious reflection, which according to Otterson, has a noticeable effect on the solver's own judgement of their problem-solving ability. (French, 1989; Checkland and Scholes, 1990; Otterson, 2000)

All these factors suggest, the observer's degree of belief (while in a particular state) as to how the observer is likely to perform when given a new task, as a candidate for measurement. French explained that a decision maker's feeling of relative likelihood should be transitive. This insistence on transitivity together with some other consistency properties implied that the decision maker's beliefs could be modelled by numbers P(s1), P(s2), etc. such that P(s)> P(s') if and only if he believed *s* to be more likely to transpire than *s'*.
These numbers were called subjective probabilities s and s' representing, for example, the degree of belief of a participant's own ability (both *pre* and *post*) to execute a particular task. At this point, it appears that a qualitative route may be pursued which in turn employs some sort of quantitative technique to measure change. However, French argued that to suggest the existence of subjective probabilities is all very well but to use them; we need to know more than their existence and need to be able to assess them. (French, 1989)

When assessing a degree of belief or subjective probability, French (1989) cited Moore and Thomas (Moore and Thomas, 1973) for describing such a concept as, educated guesses based on the best information currently available. French, however, was quick to point out that there is more to it than just that. Using board games as a vehicle, French explained that while randomness plays its part in games and circumstances, it is also the changes in these influences of randomness that insidiously affect the 'thoughts and feelings used while making decisions within systems. Such influences can render an individual's judgement cloudier and subjective as the level of perceived uncertainty increases.

In the real world away from any laboratory, there is no such thing as a prescribed scale by which to measure performance. Even when tick-boxes and pre-conceived ordinal sets are drawn up, the choice as to which set is used or what box is ticked is completely subjective and relative to its own context. The use of any scale is merely a language in an attempt to, objectively describe, the behaviour within that field of interest. By adopting such a perspective, the measure of a *shift in beliefs*, subject to incremental experience, should satisfy the Checkland and Scholes (1990) premise that, the framework will yield insights concerning the perceived problems. This in turn should lead to practical help within the situation and any experience while using the framework will enable gradual overall improvement.

3.5 Data required

A series of experiments was designed in which participants were asked to work through problem-solving exercises using techniques assigned to be either aligned with the participant's preferred learning style or opposed to it. Participants' performance and their perceptions of their experience of using the techniques were evaluated after the exercise.

It was therefore necessary to identify techniques as aligned with the various learning styles so that they could be assigned appropriately. It was also necessary to determine the preferred learning style of the participants so that they used appropriate techniques for the exercise. Their awareness of creative problem solving techniques before starting the exercise was also investigated.

A workbook was designed to include all the necessary data capture instruments and as a convenient way to present the experiment to participants.
To gain insight and understanding about people's cognitive experiences when using creative problem-solving techniques, it was necessary to establish the context and perspective that people will naturally adopt when making their appraisals of the techniques. To appraise the techniques it was essential to configure the questions to use to appraise the techniques in a way that would encompass these natural perspectives. The perspectives of interest are those invoked by peoples' cognitive styles.

- **To capture the data necessary to determine a respondents' natural cognitive styles and their appraisals of the techniques they were presented with a workbook. The workbook contained sections as follows:**to capture of the preferred cognitive styles of the respondent,
- to capture of the respondent's level of awareness and appreciation of the potential of CPS,
- a selection of problems to solve,
- a series of CPS tools to use
- questionnaires for the respondents to appraise the techniques and a final appraisal of their experience overall.

A copy of the workbook is available in Appendix 1 and further details of its design are provided below.

3.5.1 Workbook composition

Capture the respondents' style preferences

Capture of the respondents' cognitive styles used a Likert style questionnaire. The questionnaire asked each respondent to list in order of preference, 1 to 4, the activities, they were likely to use when learning and their attitude to change and new experiences. While the preferences were listed 1 to 4, for analysis, the weight of importance associated with each preference was its reversed. The questionnaire was based upon the Hey-McBer publication of Kolb, Oslund & Rubin's (1995) shortened adaptation of Kolb's full learning style inventory together with Sternberg's (1997) assessment of personal bias towards being sensual or intuitive, what Furnham (1995) calls receptive or perceptive.

Capture pre- exercise understanding of Creative Problem Solving

Likert-style questionnaires were used to capture the data that described the respondent's level of awareness of creative problem-solving and its use. Respondents were asked to select one problem from set of hypothetical problems. In the case of groups, the option of working on their own problem was also included.

The problem-solving process

To investigate and compare the reactions of unique respondents, each possessing their own distinct cognitive style, to the stimuli of different types of technique the problem-solving process had three phases, problem-identification, idea-generation and idea-evaluation.

Each phase had two techniques to help generate ideas. The first type of technique, designed to help the respondent to keep a paradigm, the second technique type, to encourage the respondent to be more imaginative and stretch their paradigm. The techniques used are in Table 3.1. Each technique had its own Likert style questionnaire to for the respondent to assess to what degree the technique helped the respondent diverge, assimilate, converge and perceive.

Technique compatibility for individuals and groups

Techniques were selected to be usable by both individuals working alone and within a group. The reason for this choice was to enable comparisons of performance between a group of individuals all with the equivalent learning style and a selection of same styled individuals, working in isolation. It was necessary to use techniques in this way to remove as much randomness and noise as possible. The techniques used are given in Table 3.4.

Capture post- exercise understanding of creative problem solving

Upon completion of the exercise and appraisal of the techniques, the respondents were re-presented with the pre- exercise questionnaire used earlier to capture their level of confidence in creative problem solving post- exercise.

Table 3.4 Description of the Techniques used.

	Paradigm Keeping Techniques	**Paradigm Stretching Techniques**
	Paradigm Keeping Techniques: Will not embarrass people, they will make people look from different angles and perspectives, using little or no imagination they encourage similar ideas. (McFadzean, 2003)	**Paradigm Stretching Techniques:** Make people look at problem from different angles and perspectives, help identify new relationships to develop novel ideas, use unrelated stimuli, needs a bit more imagination than paradigm keeping techniques. (McFadzean, 2003)
Problem Identification	**Force Field Analysis** is a paradigm keeping technique for problem identification. Designed to help the user identify the driving and restraining forces and assess the strength of such forces. The identified forces are used as catalysts to generate ideas to reduce or invert restraining forces and exploit, encourage or enhance positive forces. (McFadzean, 2003; Higgins, 1995; Allison, 1993)	**Spider Maps** is a technique, also known as a spray diagram or Mind map, popularised by Buzan (1974) in the book, "Use Your Head." It is very simple to use. It can be used for problem identification, *idea generation* and implementation. It encourages use of imagination and identification of relationships and new perspectives) The user writes the main topic in centre of a page, draws legs from the main topic associated with sub topics. This is repeated using each sub-topic to create sub-sub- topics. The user stands back and reflects looking for plausible links, associations and relationships between all topics at all levels. The user reviews and redraws the mind map, if required. (McFadzean, 2003; Buzan, 1974)
Idea Generation	**Word Diamond** was designed to develop ideas from a problem statement. Key words from the problem statement are combined. Each unique pair, trilogy or foursome of words is used as a catalyst to create more new ideas. This activity is repeated until all combinations of key words have been used. (McFadZean, 2003; Van Grundy, 1992 cited in McFadZean, 2003; Van Grundy, 2005)	**Wishful Thinking** is used for idea generation, encourages imagination and helps stretch paradigms. The user is invited to: make a brief statement describing the problem, assume everything is possible, make a fantasy list of what the solution entails, make links from the fantasy list back to the original problem definition by using phrases of the form "...this is/could be possible if we ..." as creative catalysts. (McFadzean, 2003)
Idea Evaluation	**Goal Orientation** is a technique developed by Tudor Rickards, to encourage users to clarify their objectives. The user is asked to describe their problem or aim then express his or her views regarding the problem. Questions are then asked to identify, what needs to be achieved, what perceived obstacles may prevent such a goal and what constraints the user must work within to accomplish their goal. The user is asked to redefine their original problem in the context of this new information. (McFadzean, 2003; Rickards, 1974 cited in McFadzean, 2003)	**Pugh Matrix** was designed to develop win/win solutions by optimising payoff against cost for each idea and encouraging more effective problem definitions. It can be used for problem identification, idea generation, evaluation and choice. The user is invited to: define the problem. Using a matrix the user is then invited to: list all alternative solutions, list criteria by which the effectiveness of each alternative solution will be measured, using each criterion judge and score the perceived outcomes of each alternative solution. Finally, the user is asked to develop a new solution that will maximise on all or most of the positive outcomes while minimising the negative outcomes. (McFadzean, 2003)

3.6 Experimental procedure

3.6.1 The individuals' exercise

The overall exercise presented to the participants was in the form of the workbook described earlier. To capture indications of the respondent's cognitive styles a series of self-assessment questions was used. The questions presented to the respondent gave a choice of preferred reactions to specific experiences. The questions asked respondents to list in a hierarchical form his or her first, second, third and fourth preferable reaction. To improve the quality of the data capture questions were re-phrasing and randomly repeated.

To capture the respondent's degree of belief of their experience of the technique used as to how much and in what way, the technique assisted that respondent in his or her creativity a set of questions appropriate to the type of technique just encountered was presented. Each set of questions presented to the respondent used a simple Likert scale for responses.

The problem solving section had three phases. The first was divergent, the second assimilative and the third convergent. No accommodative exercises were presented to the respondent, as the problem solved by the respondent was for experimental reasons hypothetical. Each phase of the problem solving experience had two parts. The first phase used a paradigm-keeping technique the second used a paradigm-stretching technique.

A questionnaire was used for ascertaining the individual's pre- and post- perceptions of the usability of creative problem-solving and its potential to improve performance used a questionnaire. This questionnaire asked the respondent to give his or her vote of confidence as to rate how well creative problem-solving could help them and their industry.

3.6.2 The groups' exercise

The group exercise allowed the groups to solve their own problem. The data capture for groups was similar to that used for individuals, except only paradigm-keeping techniques were used. This exercise also required the assistance of the researcher as a facilitator.
To capture each respondent's degree of belief as to how much and in what way, a technique assisted that respondent (in this case group member) in his or her creativity; a set of questions appropriate for the type of technique just encountered was presented. Each set of questions presented to each respondent used a simple Likert scale for responses.

3.6.3 The procedures

For establishing hypotheses 1, 2, 3 and 4:

- Initially, participants completed a questionnaire to capture the data necessary to determine their individual thinking style profile.
- The participants were presented with a problem to solve.
- To arrive at a solution, a series of phases were traversed.
  Each phase required the use of a set technique which in turn relied on a particular thinking style.
- Data was collected both pre-, and post-, each experience.
- Comparisons of data both pre-, and post-, experience were used to measure what influence, if any, the technique had on the participant.
- The exercise was repeated twice by each respondent for each phase.
  - The first used a paradigm keeping technique
  - The second used a paradigm stretching technique

- The respondent's individual subjective probabilities ware used to determine their preference to the particular working, learning and creative style appropriate to that phase.
- An overall analysis of the observations was made about the data collected to determine any conformity in behavioural patterns.

For establishing hypotheses 5 and 6:

- Participants initially completed a questionnaire to capture the data necessary to determine their individual thinking style profile.
- Participants were assigned to a group subject to their learning style.
- Each group was presented with a problem to solve.
- To arrive at a solution a series of phases was traversed.
- Each phase requiring the use of a set technique, which in turn relied on a particular thinking style.
- Comparing data both pre and post experience was done to give indication as to what influence the technique had on the participant.
- Each exercise used a paradigm keeping technique.
- The respondent's subjective probabilities were used to determine their individual level of preference to the particular working, learning and creative style appropriate to that phase.
- The respondent's subjective probabilities were compared as a group to determine their group preference to the particular working, learning and creative style appropriate to that phase.
- An overall analysis of the observations was made on the data collected to determine any conformity in behavioral patterns.

For establishing hypothesis 7:

- At the outset, each participant was presented with a questionnaire to capture data to determine the individual's thinking style profile.
- The participants were assigned to a group.
- The group of participants were presented with a problem to solve.
- To arrive at a solution a series of phases will were traversed.
  Each phase required the use of a set technique which in turn relied on a particular thinking style.
- Data was collected both pre- and post- each experience.
- Comparisons of data both pre-, and post-, experience were used to indicate to what influence the technique had on the participant.
- Each exercise was a paradigm keeping technique.
- The respondent's distinct subjective probabilities were compared individually to determine their preference to the particular working, learning and creative style appropriate to that phase.
- The respondent's subjective probabilities were compared as a group to determine their group preference to the particular working, learning and creative style appropriate to that phase.
- An overall analysis used the data collected to determine conformity of behavioural patterns.

3.6.4 Experimental considerations

Participant Selection

The participants to be recruited needed to have at least some awareness of problem solving techniques sought, will have had, at best, some experience, or at worst, some awareness of solving. Creative problem-solving has a wide field of application in both hard and soft professions ranging from engineering to the service.

While a broad spectrum of opinions and perspectives is necessary to increase understanding, there is no reason to focus too much on professional disciplines or application. The focus of interest was the human activity performed while executing creative problem solving.

Effort was made to recruit a statistical sample of volunteers. It was also anticipated that such a sample might not be achievable. To avoid this risk, it was decided that the initial phase of analysis would be non-parametric not parametric and to establish evidence of repeatability the experiment would be repeated.

Technique Selection

All the creative problem-solving techniques used for this investigation are listed in table 3.4.

Negotiating Research Relationships

Considerable time and effort needed to be put into recruiting participants. A considerable commitment was needed from them because of the non-trivial nature of the workbook exercise. A sample of committed participants was sought both directly and indirectly. For organisations, it became very apparent that they were only interested in the findings showing every excuse and tactic to avoid participation. A softly-softly approach was thus adopt ed to locate and involve interested parties.

To the outsider, this approach may appear somewhat insidious but unfortunately necessary. Befriending groups of people was essential to establish some degree of trust between participants and the researcher. Such an approach helped encourage both interest in the project and a willingness to take part, for reasons of interest and curiosity, with no inherent reason to exploit.

Site Selection and Location

The location sought must be easily accessible, safe and comfortable for all participants. The individuals' work required no direct facilitation from the researcher. The location used by the individuals was that of their own choice and unknown to the researcher. For groups, the location chosen by the groups was their local venue. For the acceptance survey, each location remained the choice of each participant.

3.6.5 The purpose of the experiment

As explained earlier, the process of creative problem solving is phase-based, from problem definition through to the final phase of implementing an accepted solution. The techniques available are somewhat bespoke to the phases of the process. Moreover, while a group of techniques may fit the remit of that phase, Mc Fadzean (1996) showed that some techniques also be more adept at encouraging greater levels of creativity than do others.

An individual perspective

Comparing data that are representative of both pre- and post- experience should yield some measurement as to what level of influence a technique had on its user. Repeating the exercise for each phase, the second time using a technique designed to promote higher levels of creative outcomes, this comparison will help establish any differences techniques may have when it comes to encouraging creativity. An individual will traverse through the complete set of tasks. Each task will use a different technique. Each technique will have its own purpose within the problem-solving process overall, but will rely upon the use of different thinking styles of the respondent.

As people have their individual thinking style preferences, it appears reasonable to anticipate that everyone will show their own preference to certain techniques. It is anticipated that preference for a specific technique will be in accord with an individual's preferred thinking style. It is further expected that an individual's perceptions with respect to performance will be in accord with the individual's preferred thinking styles. Comparisons will be made of the assessments of perceived performances and individuals thinking styles. A more generic insight into the relationships between personal preferences and thinking styles, techniques and perceived outcomes will be sought. These anticipated behaviours will form the basis of the hypotheses.

Group perspective

The aim of this experiment is to gain insight as to how a group of people who have the same or very similar thinking styles will perceive their collective experience in comparison with a group composed of people whose thinking styles are varied. Comparing the data both pre- and post- experience should yield some measurement as to what influence the technique and group peers may have on the participant. There may be relationships between cohesion, conflict and the individual's preferences. Although not sought at this stage, if findings support the above, further research will be recommended.

3.6.6 Appraisal by industry

To capture appraisals as to how industry perceived the application and potential of a cognitive best-fit approach a short questionnaire (available in Appendix 1) was used. The respondents were briefed on the concept of the problem solving cycle, paradigm shifts, techniques and links to learning styles and levels of perception. The respondents were given a short questionnaire to describe their role within industry and his or her level of belief in the application of this cognitive best-fit approach.

3.7 Methods used for data analysis

3.7.1 Analysis of cognitive preferences

Determination of a person's cognitive style is based upon the calculations used in Kolb's (Kolb 1978) Learning Style Inventory. The LSI compares preferences for Reflective Observation (RO) with Active Experimentation (AE) and similarly, Concrete Experimentation (CE) with Abstract Conceptualisation (AC).

The differences of each comparison indicate the preferential bias' these were as co-ordinates to identify a person's learning style. Using AC-CE and AE-RO as polarities of orthogonal axes, LSI represents learning styles using the quadrants, Divergers (AC-CE > 0, AE-RO > 0), Accommodators (AC-CE > 0, AE-RO <0), Convergers (AC-CE < 0, AE-RO < 0), Accommodators (AC-CE > 0, AE-RO> 0).

Calculations to determine bias for perceptive thinking compares personal preference for logic and creativity. The differences indicate a person's bias to a perceptive or receptive thinking style. An illustrated example showing the spreadsheet content and the calculations for personal preferences is in Appendix 2.

3.7.2 Analysis of the responses

Non-parametric, parametric, qualitative and graphical methods were used to analyse of the response data. Due to small sample sizes and unknown statistical distributions, non-parametric methods were initially used. Investigation and determination of probability distributions used a series of Anderson-Darling Tests and Re-sampling. Student t-tests were used for comparisons of re-sampled data after distributions were confidently identified.

Unexpected variance in responses led to further investigations for similarity. This required a qualitative examination of the data involved tables for comparison of numeric data and hermeneutic analysis of the textual data.

To investigate, detect, illustrate, and identify reasons for clustering of response similarities of people of different cognitive styles, the analysis used contour plots, scatter plots, cluster analysis, dendrograms and matrix plots. The contour plots illustrated the overall cognitive profile of the respondents. The scatter plots illustrated how each respondent reacted to each technique. The dendrograms coupled with cluster analysis helped investigate, identify and illustrate the existence of shared preferences for techniques, or attributes thereof, between respondents with learning styles identified as different but such differences in the attribute used to define cognitive style could be minimal. The matrix plot gave an overall comparison of all the respondent's reactions to the stimuli of the different types of techniques.
The analysis criteria used throughout the experimentation is in Table 3.5.

Table 3.5 Criteria for Analysis of Response Data

Test & Technique	Circumstance	Data & Type	Output	Purpose	References
Non Parametric Mann-Wittney U-test	Independent Small Sample	Observed Data. Ordinal	Probability	Compare data from two independent samples to see if they come from same population. Non-parametric t-test.	Greene & D'Oliveria (1999) Chatfield.(1995) Billiet (2003)
Chi-squared test χ^2	Check for repeatability & independence between between samples of people with same styles.	Observed Data. Ordinal	$\chi^2_{obs} > \chi^2_{tab}$ (sig)	Tests for significance of differences between two independent samples	Chatfield.(1995) Argyrous(2005) Snedecor& Cochran(1978)
Anderson-Darling Test	Check if observed data was from Normal distribution	Observed Data. Ordinal	Test initially failed as obs were ordinal & small sample	Test used to investigate how close observed data is to Normal distribution. χ^2 good fit test not appropriate as expectations unknown & small sample	Chatfield.(1995) Snedecor& Cochran(1978) Matlab 15
Re-Sampling	Need larger sample of continuous data from observed population	Observed Data. Ordinal	larger sample of continuous data from observed population	Used to assist when parametric assumptions are difficult to justify such as population mean from small samples.	Chatfield.(1995) Snedecor& Cochran(1978)
Anderson-Darling Test	Check if resample data was from Normal distribution	Resample Data. Continuous	Normal Distributions confidence 95%	Test used to investigate how close observed data is to Normal distribution. χ^2 good fit test not appropriate as expectations unknown	Matlab 15
Two sample t-test	Compare independent samples of re-sampled data	Resample Data. Continuous	Probability	To see if two independent samples come from the same population.	Chatfield.(1995)
Qualitative data comparison tables	Overlap in Normal distributions with some unexpected observations	Observed Data. Ordinal	Identified latent behaviours	Help examine for similarities and differences in behaviours of observed data	Miles & Huberman (1994)
Hermeneutic Analysis of respondents comment.	Check for parity with numeric data and look for latent symptoms	Respondents textual comments	Pointers to areas of unrest. Parity with statistical data	Overall interperate textual data	Miles & Huberman (1994) Atlat-ti
Contour Plots; Scatter plots; Cluster Analysis; Dendrograms	Investigate similarities in response behaviours	Observed Data. Ordinal	Clustered responces from people of different styles	Contour plots map the profile of all respondents for comparison. Scatter plots show all responses. Dendrograms analyse & illustrate natural clustering in responses.	Bijnen E.J. (1973) Minitab 15
Matrix Plot	Investigate similarities in response behaviours subject to stimulus	Observed Data. Ordinal	Illustration of behaviour subject to stimulus	To compare respondents reactions to stimulus	Minitab 15

3.7.3 Analysis of industrial perceptions

From an industrial perspective the perceived usefulness of this research required further investigation and analysis through presenting the concept of a technique taxonomy bespoke to cognitive style to an independent selection of managers working in a variety of industrial sectors.

Participants presented their views of the new strategy, with respect to where and how they perceive such a technique taxonomy being helpful to industry. The researcher also asked the selected sample of people for information describing their roles and the industry they worked in. This data helped gain insight into the perspectives within different roles and industries. The data collected gave a holistic understanding of the present level of acceptance of the taxonomy's cognitive style approach and potential among industrial practitioners.

A one-way analysis of variance (ANOVA) was used to compare the responses from people who were involved in different industrial sectors and worked on distinct levels of responsibility.

3.7.4 The Hypotheses

By assigning people to select phases of creative problem-solving, appropriate to their preferred learning and creativity style, their ideation productivity should improve in terms of quantity and novelty of their ideas. Moreover, people who follow such an approach will feel more at ease and gain more satisfaction than those who do not. For the sake of completeness the hypotheses presented in Chapter 2 are listed again here.

H0 = Participants assigned to a technique that is not in accord with their preferred learning styles will not show a significant difference to the assigned technique.

H1= Participants assigned to a technique that is in accord with their preferred learning styles will show a significant difference to the assigned technique.

H1. 1. FOR THE INDIVIDUAL, FROM A USABILITY PERSPECTIVE: participants will show a noticeable preference for techniques that will be in accord with the individuals preferred learning styles.

H1. 2. FOR THE INDIVIDUAL, FROM A PERFORMANCE PERSPECTIVE: participants will show a noticeable preference for techniques that will be in accord with the individuals preferred learning styles.

H1. 3. FOR THE INDIVIDUAL, FROM A USABILITY PERSPECTIVE: participants will show a noticeable preference for techniques that will be in accord with individuals preferred creative styles.

H1. 4. FOR THE INDIVIDUAL, FROM A PERFORMANCE PERSPECTIVE: participants will show a noticeable preference for techniques that will be in accord with the individuals preferred creative styles.

H1. 5. FOR THE GROUP, MEMBERS HAVE THE SAME LEARNING STYLE, FROM A USABILITY PERSPECTIVE: preferences for specific technique will lie in accord with the individual group member's preferred learning style.

H1. 6. FOR THE GROUP, MEMBERS HAVE THE SAME LEARNING STYLE, FROM A PERFORMANCE PERSPECTIVE: preferences for specific technique will strike accord with the individual group member's preferred learning style.

H1. 7. FOR THE GROUP, ALL MEMBERS HAVE THE SAME LEARNING STYLE PREFERENCE: a bias of preferences will exist in favour of working with peers who have the same learning style.

The expectation of a small sample of willing respondents was realised. No assumptions about statistical distributions were made at that time due to lack of evidence. A traditional frequentist approach using such distributions was seen as inappropriate at that time.

It would be reasonable to expect the inference that, if the majority of the respondents randomly conform to an expected style of behaviour or belief subject to a prescribed experience, coupled with evidence of repeatability, it would be reasonable to expect that the behaviour will be true for any other similar sample.

3.8 Ethical Considerations

Participants will decide without pressure or obligation to involve themselves in the investigation. This research project adhered to the following well-being and ethical policies:

Consent

- The purpose of the research was explained to all potential participants from the outset.
- Only people over the age of 18 were considered, approached or asked to participate.
- There was no pressure on any person to involve themselves in the investigation.
- Participants had the right to withdraw from the investigation at any time.

Confidentiality

- Data that can identify participants or associate them with this research project will not be processed, stored or published.
- Anonymity will be maintained and respected at all times. Only anonymous data will be used for this investigation.
- Confidentiality will be respected at all times and if required, legally agreed.

Debriefing

- When participants used this investigation as a vehicle to solve their own problems, they were presented with a confidential report of findings. Debriefing, presentation and discussion of findings took place at a meeting.

Withdrawal

- All participants were informed from the outset of their right to withdraw at any time.

Protection of participants

- In the interest of participant safety and well-being, times and venues of any activity associated with this investigation was left to the discretion of the participants.

3.9 Building A Taxonomy

Following the discussion in section 2.3.8, justifying the need for a technique taxonomy, Barsalou's (1983) proof that using taxonomic in contrast to ad-hoc categories improved instance -to-concept association in the human memory and Amabile & Pillemer's (2011) observation that creativity presently fails to consider individual behaviours, this section will explain the data, methods used and industry's perception of such a taxonomy.

3.9.1 Taxonomising the techniques

Data Requirements and Capture

Descriptions and appraisals of creative problem-solving techniques retrieved from CPS publications of academics and practitioners of high repute formed the basis of the technique sample. Assessments of such technique appraisals were collated using the rules of the new strategic framework (see table 2.13).

Analysis of Technique

According to Bijnem (1973), when confronted by a mass of data described by a plethora of variables it is often necessary to identify strong similarities between such variables. Identification of similarities and their strength can help reduce the number of variables and hence the overall complexity of the situation. Such analysis can also reveal the existence of latent structures within the mass of data.

To calculate similarity, the differences between objects are necessary. Such differences defined as linkage, measure how similar two items are when compared within the context of a shared characteristic. When calculating similarity between many objects, subject to many shared characteristics or variables, the similarity of objects resembles the calculation of a statistical standard deviation by taking the square root of the sum of squares of each object calculated linkages. Similarity is inversely proportional to linkage.

Using such similarity calculations identifies natural clusters of objects based upon the strength of similarity. This approach is known as nearest neighbour analysis and the measures of similarity it helps calculate, are used to determine levels of clustering or similarity. This information can be displayed graphically using a tree-like diagram known as a dendrogram. The nodes of the tree represent the level of similarity identified, and the branches represent the compared objects that share the characteristics used to calculate the similarity between the objects.

4 Analysis of data

This chapter will examine the data collected according to the methods and methodologies explained in Chapter 3. The data falls into two categories. First, there is data from respondents as individuals and second, there is data from respondents working within groups. The analysis of data from responses is considered separately for the two categories.

The chapter starts with a review of the data available for analysis and presents a summary of the methods used for analysis. It then moves in section 4.2 to consider the results of non-parametric quantitative analysis of the data for respondents as individuals and in 4.3 the associated parametric quantitative analysis. Section 4.4 presents the qualitative analysis of data and Section 4.5 summarises the analysis for groups of respondents considered together.

4.1 Data and analysis

The overall type and nature of the data has been presented above in Chapter 3 while details of the data collected are presented in the appendices. There is a critical distinction in the analysis is between quantitative and qualitative modes, especially for the individual data.

Essential information for the thesis presented in the appendices around the data collection and analysis is summarised here. The appendices 1-4 deal with modes of quantitative data collection and analysis, whilst Appendix 5 covers qualitative data.

Appendix 1 describes the workbook which respondents used to engage in the exercises and answer questions. In the first part of data collection the respondents' cognitive styles were captured in answers to self-assessment questions in the workbook. The questions presented to the respondents gave a choice of preferred reactions to specific experiences. The questions asked respondents to give a ranked list of their first, second, third and fourth preferences. The data capture questions were re-phrased and repeated. To capture the respondent's degree of belief as to how much and in what way, a technique assisted their creativity a set of questions appropriate to the technique was used. Each set of questions presented to the respondent used a simple Likert scale for responses.

The second part of the data gathering examined problem solving in three phases of data collection. The first was divergent, the second assimilative and the third convergent. No accommodative exercises were presented to the respondent, as the problem solved by the respondent was for experimental reasons hypothetical. Each of the three phases had two parts a Phase A and Phase B. The A phase used a paradigm-keeping technique the second B phase used a paradigm-stretching technique.

Individuals' pre- and post- exercise perceptions of the usability of creative problem-solving and its potential to improve performance were record through a questionnaire. This asked respondents to give a vote of confidence as to how well creative problem-solving could help them and their industry.

Appendix 2 presents sample data from respondents completion of the sheets in their workbook. This data was gathered over several years and represents a relatively small sample. In Appendices 3 and 4 tests are applied to the data to ascertain degree of independence and distribution. Appendix 5 presents the respondents' appraisals of different techniques mapped to types of respondent – Diverger, Assimilator, Converger and Accomodator.

The remaining appendices cover graphical representations in plots, dendograms and maps in Appendix 6. The group exercise, presented and analysed in Appendix 7, allowed groups to solve their own problem. The data capture for groups was similar to that used for individuals, except that only paradigm-keeping techniques were used. This exercise also required the researcher to act as a facilitator. Each set of questions was presented to each respondent and used a Likert scale. Additional Appendices considered clustering/taxonomic techniques and a public acceptance.

The phased data collection in workbooks, is analysed through a series of quantitative non-parametric and parametric tests which are described next. The primary data is not re-presented here and extensive sample data can be referred to in Appendix 2. This analysis presents statistical analysis of the primary data and a number of statistical tests to ascertain independence and normality. The analysis starts with non- parametric quantitative analysis of data from respondents working individually and in the following section moves to parametric quantitative analysis of distributions for the data.

4.2 Quantitative non- parametric analysis of individuals' data

Two stages of analysis were undertaken. In the first a non-parametric analysis where there was no underlying assumptions on the nature of underlying distributions in the data. In the second, presented in the next section, a parametric analysis explored possible distributions especially normality. Two tests are used for non-parametric analysis. First the Kruskal-Willis test for independence and second the Mann-Whitney test for significance.

4.2.1 Kruskal-Wallis independence test

The results of the three Kruskal-Willis test for Divergers (Dv) 2008 vs Divergers 2009, Assimilators (As) 08 vs Assimilators 09, Accomodators (Ac) 08 vs Accomodators 09 drawn from the tabulated results and analysis available in Appendix 3 are shown below in figure 4.1.

Independence between the two samples 2008 and 2009 for Divergers ($P = 0.768$), Assimilators ($P = 0.108$) and Accommodators ($P = 0.443$) should be rejected at alpha = 0.05. The Kruskal-Wallis Test compares the two samples of ordinal data and uses a chi-squared test to assess the likelihood that the two samples come from the same distribution (Argyrous G, 2005). As no Convergers were present in the 2009 sample set this independence test could not be used for that data set.

Kruskal-Wallis Test: dv08 versus dv09

dv09	N	Median	Ave Rank	Z
0	6	3.0	8.0	-0.84
1	6	5.5	10.8	0.75
3	5	3.0	9.2	-0.15
4	1	5.0	12.0	0.48
Overall	18		9.5	

H = 1.14 DF = 3 P = 0.768 (adjusted for ties)

Kruskal-Wallis Test: Ac08 versus Ac09

Ac09	N	Median	Ave Rank	Z
0	5	4.0	10.3	0.39
1	1	6.0	15.5	1.16
2	3	4.0	9.8	0.12
3	1	2.0	4.5	-0.96
4	3	4.0	12.8	1.18
5	2	2.0	6.0	-0.98
6	3	2.0	6.5	-1.07
Overall	18		9.5	

H = 5.82 DF = 6 P = 0.443 (adjusted for ties)

Kruskal-Wallis Test: As08 versus As09

As09	N	Median	Ave Rank	Z
0	3	8.0	16.5	2.49
1	4	2.5	9.5	0.00
2	3	1.0	4.5	-1.78
3	3	3.0	11.8	0.83
4	1	3.0	12.0	0.48
5	1	2.0	9.0	-0.10
6	1	1.0	4.5	-0.96
8	2	1.0	4.5	-1.40
Overall	18		9.5	

H = 11.77 DF = 7 P = 0.108 (adjusted for ties)

Figure 4.1 Kruskal Willis tests comparing divergers, accommodators and assimilators across 2008 and 2009 samples

4.2.2 Mann-Witney U-Test (alpha=0.05) for significance of respondents' cognitive experiences when using a paradigm keeping technique

The Mann-Witney U-Test (alpha=0.05) is used first to test significance of results when using a 'keep paradigm' technique. It is then used to test significance for cognitive experiences when using a 'stretch paradigm' technique. Results are presented in Tables 4.1. and 4.2. derived from Appendix 3.

Keep Paradigm Technique alpha = 0.05	**2008 Significance levels. Learning Style (*Cognition*)**					
	In Accord	**Not in Accord**				
		Diverger	**Assimilator**	**Converger**	**Accommodator**	**All**
Diverge	**Diverger**		0.4339	0.0708	0.5	**0.2351**
Assimilate	***Assimilator***	0.5		?	0.1038	**0.3732**
Converge	***Converger***	0.2047	0.0547		Can't test equal data	**0.0135**

Table 4.1 Respondents Assessment of Techniques that Keep Paradigms

Keep Paradigm Technique alpha = 0.05	**2009 Significance levels. Learning Style (*Cognition*)**					
	In Accord	**Not in Accord**				
		Diverger	**Assimilator**	**Converger**	**Accommodator**	**All**
Diverge	Diverger		Can't reject W < 65	Null		
Assimilate	*Assimilator*	0.0885		Null		
Converge	*Converger*	Null	Null	Null		

Table 4.2 Respondents Assessment of Techniques that Keep Paradigms

Examining the 2008 appraisals of techniques from a learning-style cognition perspective, both the Divergers and Assimilators were significant in showing preference to techniques that were in accord with their learning style while Convergers did not. However, on closer examination, when comparing the Convergers appraisal of a convergent technique to the Divergers, Assimilators and Accommodators appraisal, the data offered by all the Accommodators was equal in this instance. This stalemate of opinions could, in this instance have influenced the appraisal comparisons of the convergent technique.

Examining the 2009 appraisals of techniques from a learning-style cognition perspective, both the Divergers and Assimilators were significant in showing greater preference to the technique that was in accord with their learning style. There were no Convergers present in the 2009 sample. In both the 2008 and 2009 experiment, there were no accommodation techniques under scrutiny as all exercise problems were predefined.

4.2.3 Mann-Witney U-Test (alpha=0.05) for significance of cognitive experiences when using a paradigm stretching technique

The Mann-Witney U-Test (alpha=0.05) is then used to test significance of results for cognitive experiences when using a 'stretch paradigm' technique. Results are presented in Tables 4.3. and 4.4. derived from Appendix 3.

Stretch Paradigm Technique *alpha = 0.05*	**2008 Significance levels. Learning Style (*Cognition*)**					
	In Accord	**Not in Accord**				
		Diverger	***Assimilator***	***Converger***	***Accommodator***	***All***
Diverge	*Diverger*		Cannot Reject	0.0532	0.1974	0.1709
Assimilate	*Assimilator*	Cannot Reject		Cannot Reject	0.2474	Cannot Reject
Converge	*Converger*	0.0495	0.0041		0.0041	0.0016

Table 4.3 Respondents Assessment of Techniques that Stretch Paradigm

Stretch Paradigm Technique *alpha = 0.05*	**2009 Significance levels. Learning Style (*Cognition*)**					
	In Accord	**Not in Accord**				
		Diverger	***Assimilator***	***Converger***	***Accommodator***	**All**
Diverge	*Diverger*		Cannot reject W < 65	Null	Null	
Assimilate	*Assimilator*	0.0103		Null	Null	
Converge	*Converger*	Null	Null	Null	Null	

Table 4.4 Respondents Assessment of Techniques that Stretch Paradigms

Examining the 2008 appraisals of the techniques from a learning-style cognition perspective, the Divergers were significant in showing greater preference to techniques that are in accord with their learning style. The Convergers showed no significant preference.

The assertion that the Assimilators will show greater preference for techniques that are in accord with their learning style remains accepted. This acceptance or non-rejection is because the smaller of the two Mann-Whitney calculated U-values, were greater than the tabulated critical value, namely the W-value of the Mann-Whitney test, Billiet (2003). This non-rejection was also the case for the diverters' assessment of the assimilation technique.

In the case of the Convergers, there was a consistent failure when comparing Convergers with all the other styles both individually and collectively. This could be due to respondents exerting a greater amount of creativity than usual in order to stretch paradigms.

Examining the 2009 appraisals of the techniques from a learning-style cognition perspective the Divergers were significant (alpha=0.05) in showing greater preference to techniques that are in accord with their learning style. This was only when being compared to Assimilators. The Assimilators were not significant in showing greater preference to techniques that were in accord with their learning style. Due to Convergers not being available in the 2009-sample, further tests were not possible.

4.2.4 Mann-Witney U-Test (alpha=0.05) for significance of activity experiences when using a paradigm keeping technique.

The Mann-Witney U-Test (alpha=0.05) is then used to test significance of results for activity experiences when using a 'keep paradigm' technique. Results are presented in Tables 4.5 and 4.6 derived from details in Appendix 3.

Keep Paradigm Technique alpha = 0.05	**2008 Significance levels. Learning Style (*Action*)**					
	In Accord	**Not in Accord**				
		Diverger	**Assimilator**	**Converger**	**Accommodator**	**All**
Diverge	Diverger		0.0819	0.1077	0.2961	0.0848
Assimilate	*Assimilator*	null		null	0.0157	0.4279
Converge	*Converger*	0.4895	0.0502		0.0638	0.1231

Table 4.5 Respondents Assessment of Techniques that Keep Paradigms

Keep Paradigm Technique alpha = 0.05	2009 Significance levels. Learning Style (*Action*)					
	In Accord	**Not in Accord**				
		Diverger	**Assimilator**	**Converger**	**Accommodator**	**All**
Diverge	Diverger		0.1109	Null	Null	
Assimilate	*Assimilator*	0.2087		Null	Null	
Converge	*Converger*	Null	Null	Null	Null	

Table 4.6 Respondents Assessment of Techniques that Keep Paradigms

Examining the 2008 appraisals of the techniques from a learning-style activity perspective the Divergers, Convergers and Assimilators were all significant in showing greater preference to techniques that are in accord with their learning style.

4.2.5 Mann-Witney U-Test (alpha=0.05) for significance of activity experiences with a paradigm stretching technique

The Mann-Witney U-Test (alpha=0.05) is then used to test significance of results for activity experiences when using a ‘stretch paradigm’ technique. Results are presented in Tables 4.7. and 4.8. derived from Appendix 3.

Stretch Paradigm Technique alpha = 0.05	**The 2008 Significance levels. Learning Style *(action)***					
		Not in Accord				
	In Accord	**Diverger**	**Assimilator**	**Converger**	**Accommodator**	**All**
Diverge	Diverger	0.0143	0.0160	Cannot Reject	0.0347	0.0143
Assimilate	*Assimilator*		Cannot Reject	Cannot Reject	Cannot reject	
Converge	*Converger*	0.3721		0.107	0.2266	0.3721

Table 4.7 Respondents Assessing of Techniques that Stretch Paradigms 2008

Stretch Paradigm Technique alpha = 0.05	**2009 Significance levels. Learning Style *(action)***					
		Not in Accord				
	In Accord	**Diverger**	**Assimilator**	**Converger**	**Accommodator**	**All**
Diverge	Diverger		Cannot reject	No convergers		
Assimilate	*Assimilator*	0.0024		No convergers		
Converge	*Converger*					

Table 4.8 Respondents Assessing of Techniques that Stretch Paradigms 2009

Examining the 2008 appraisals of the techniques from a learning-style activity perspective, the Divergers overall were not significant in showing greater preference to techniques that were in accord with their learning style. However, in the case when the Divergers were compared to the Accommodators, significance remained unrejected. This non-rejection of the test was because the smaller of the two Mann-Whitney calculated U-values, was greater than the tabulated critical value namely, the W-value of the Mann-Whitney test, Billiet (2003).

Convergers and Assimilators were all significant in showing greater preference totechniques that are in accord with their learning style. Examining the 2009 appraisals of the techniques from a learning-style activity perspective, the Divergers were significant in showing greater preference to techniques that are in accord with their learning style but only when the Divergers were compared with the Assimilators. The Assimilators were not significant in showing greater preference for techniques that are in accord with their learning style. Due to Convergers not being available in the 2009-sample, further testing was not possible.

4.2.6 Comparing assessment of paradigm keeping and stretching techniques using an ideation perspective

The Mann-Witney U-Test (alpha=0.05) is used to test significance of comparing preferences for receptive respondents and perceptive respondents in assessment of paradigm keeping and stretching techniques when using an ideation perspective. Results are presented in Table 4.9. derived from Appendix 3.

	Significance levels 2008.		**Significance levels 2009.**	
Receptive show greater preference than Perceptive	**Technique types**			
	Keep Paradigms	**Stretch Paradigms**	**Keep Paradigms**	**Stretch Paradigms**
Ideation assessment	**0.4730**	**0.0012**	**0.0012**	**0.0189**

Table 4.9 Sample Comparison of preference (Ideation)

The following observations can be made:

a) Assessment comparison of techniques within the 2008-sample was significant. The receptive respondents showed greater preference for techniques that keep paradigms than the perceptive respondents did.
b) Assessment comparison of techniques within the 2008-sample was significant. The receptive respondents showed greater preference for techniques that stretch paradigms than did the perceptive respondents.
c) Comparison of technique assessments within the 2009-sample was not significant. The receptive respondents had greater preference for techniques that keep paradigms than the perceptive respondents did.
d) Comparison of technique assessments within the 2009-sample was not significant. The receptive respondents had greater preference for techniques that stretch paradigms than the perceptive respondents did.

4.2.7 Comparing the assessment of paradigm keeping and stretching techniques using an outcomes perspective

The Mann-Witney U-Test (alpha=0.05) is used to test significance of comparing preferences for receptive respondents and perceptive respondents in assessment of paradigm keeping and stretching techniques when using an outcomes perspective. Results are presented in Table 4.10 which are derived from details in Appendix 3.

	Significance levels 2008.		Significance levels 2009.	
Receptive shows greater preference than Perceptive	Technique types			
	Keep Paradigms	Stretch Paradigms	Keep Paradigms	Stretch Paradigms
Outcome assessment	0.2697	0.4197	0.0004	0.2056

Table 4.10 Sample Comparison of preference (Outcome)

The following observations can be made:

a) For assessment based on outcome, the comparison of technique assessments within the 2008-sample was significant showing the receptive respondents to have greater preference for techniques that keep paradigms than did the perceptive respondents.
b) Focusing on outcome the comparison of technique assessments within the 2008-sample was significant showing the receptive respondents had greater preference for techniques that stretch paradigms than the perceptive respondents had.
c) Assessing outcome, the comparison of technique assessments within the 2009-sample was not significant showing the receptive respondents had greater preference for techniques that keep paradigms than the perceptive respondents had.
d) Focusing on outcome the comparison of technique assessments within the 2009-sample was significant as the receptive respondents had greater preference for techniques that stretch paradigms than the perceptive respondents had.

4.2.8 Summary of non-parametric tests

For evidence of repeatability, a series of $\chi 2$ independence tests revealed using Chadfield (1995):

$\chi 2$ (Divergers) = 86.77609
$\chi 2$ (Assimilators) = 60.80834
$\chi 2$ (Accommodators) = 89.48773

$\chi 2$ (0.05, 44df) > $\chi 2$ (0.05, 40df) = 55.8
$\chi 2$ (0.01, 44df) > $\chi 2$ (0.01, 40df) = 63.7

Independence between samples 2008 and 2009 for Divergers, Assimilators and Accommodators must be rejected at alpha = 0.05.

Further examination of summary results presented in table 4.11 indicates that the respondents' outcomes they do appear to agree with learning style expectations. The Convergers not showing cognitive preference for techniques that use their style but showing activity preference was unexpected. This could be specific to the 2008 sample. However, as evidence suggesting repeatability due to rejection of sample independence exists for the non-convergers only, this cannot be confirmed at this stage and will require further investigation.

Technique		Perspective			
		Learning Style		Creative Style	
		Cognition	Action	Ideation	Outcomes
Keep Paradigm	Diverge	greater preference	greater preference	Receptives showed greater preference than Perceptives	Receptives showed greater preference than Perceptives
	Assimilate	greater preference	greater preference		
	Converge	**NOT** greater preference	greater preference		
	Accommodate	Not tested	Not tested		
Stretch Paradigm	Diverge	greater preference	no preference	Receptives did show greater preference than Perceptives *Much less so than for Keep Paradigms*	Receptives showed greater preference than Perceptives *More so than for Keep Paradigms*
	Assimilate	*not rejected*	*not rejected*		
	Converge	**NOT** greater preference.	greater preference		
	Accommodate	Untested	Untested		
Independence between samples 2008 and 2009 for Divergers, Assimilators and Accommodators must be rejected at alpha = 0.05. Due to no Convergers in the 2009 sample comparison could not be made.					

Table 4.11 Summary of findings from non-parametric tests

Considering the responses for creative style, at first sight the paradigm stretching results were unexpected. However, on closer inspection, when comparing the significance levels between techniques that keep paradigms with those that stretch them, there is a noticeable decrease. This decrease suggests to the researcher the possibility that perceptive people might find paradigm keeping techniques non-stimulating while receptive people think the contrary. Moreover, perceptive people might also find paradigm stretching more stimulating than do receptive people do and receptive people might feel more uncomfortable using paradigm stretching techniques than they do using paradigm keeping techniques, but not enough to reject them. This sliding scale is evidence of the creative continuum in action.
Had testing of breaking paradigm techniques been explored then this could have confirmed the expectation in contrast to inferring it. This area will provide a fertile topic for future research.

4.3 Quantitative parametric analysis of individuals' data

The workbook questionnaires, as explained in Chapter 3 on methodology, used a Likert scale (1 to 5) in the interests of simplicity, uniformity of style and ease of use for respondents. However, using discrete measures does carry its own handicap. Using such a measure places a restriction on the freedom of expression of the respondent. Forcing the respondent to use codes can hinder the accuracy of the data by not allowing the respondent the full freedom to answer questions as they perhaps would naturally answer. The researcher can expect, at best, the data to reflect an approximate portrayal of the respondent's true opinion of the matter under question.

4.3.1 Estimating a statistical distribution

When calculating probabilities of behaviour, a statistical probability distribution is computed because of its inherent accuracy. The problem arises, not in the use of such distributions, but when the assumptions are made that the data under investigation will adhere to that distribution – especially when no supporting evidence or argument is available to warrant that conjecture. Argyrous (2005), Snedecor & Cochran (1978) and Chatfield (1995) concur when they explain that, population normality must not be assumed. Even if the level of measurement allows the mean and the descriptive statistics for a set of data to be calculated, to conduct an inference test on this mean requires the additional assumption (especially when working with small samples) that the population is normally distributed.

It is for these reasons that a non-parametric approach was pursued for the initial stages of the investigation. No assumptions about the data under investigation were made. In the event of not finding a suitable distribution to measure against, the hypotheses could still be tested using non-parametric methods.

4.3.2 Examining normality

Snedecor & Cochran (1978) comment on non-parametric tests and explain that there are five main reasons for using the Normal Distribution whenever possible. The reasons suggested were:

- Convenience
- Some variables will naturally approximate to the normal,
- Some non-normal variables can be mathematically transformed to induce approximate normality (square root and logarithms were cited as frequent examples)
- Even if the distribution of the data sample is far from normal, the distribution of the mean tends to normality as the size increases.
- Many statistical results can also hold form as a "rough-and-ready" measure for samples from non-normal populations.

To examine the normality of the data, a series of probability plots and Anderson-Darling Normality Tests were used. The initial assessment returned means and standard deviations with all the p-values of the Anderson-Darling Normality Test being of the order 0.005. This failure of the Normality test was at this stage expected because the sample data were ordinal.

Returning to the issue of lost accuracy discussed earlier, due to using a Likert scale (hence truncation of the mantissa) - this issue can be resolved using a process called re-sampling. Re-sampling generates large random samples of non-ordinal numbers using the means and the standard deviations of the data sets.

Samples were generated randomly; plots made, and Normality tests performed in an attempt to derive a close approximation of the parent distributions, from which the sample data came. The resample data was interval based and using Anderson-Darling normality tests showed with 95% confidence, the data had normal distributions with means and variances very close to those of the original ordinal sample data. The tabulated results are presented in Table 4.12 derived from Appendix 4.

With 95% confidence that the calculated normal distributions represent the data, the subtle question remains as to the degree of confidence that a calculated distribution represents the population from which the sample data came. The reason for this question is randomness. One can take many independent samples from a common population and end up with different sample specific estimations of the position of the population mean. This was resolved using the standard error of the estimated means. Chatfield (1995) explained that to calculate the standard error of an estimated mean with an unknown variance, one should use the Students t-distribution and the sample variance. The standard errors for both the sample and resample data were calculated. Comparisons showed a distinct decrease in the size of the standard error of the estimated means of the calculated distributions from sample, to resample data. The tabulated results and analysis are available in tables 4.13 derived from details in Appendix 4. Table 4.13 shows a clear decrease in the size of the standard error the estimation of the means of the calculated distributions from sample, to resample.

Table 4.12 Comparison of Sample & Resample Means and variances

Phase	Paradigm	Perspective	*User*	Sample			Resample			Normality
				n	M	SD	N	M	SD	A-D value
Diverge	Keep	Cognition	*Diverger*	20	2.8	1.056	500	*2.807*	*1.051*	0.255
			Assimilator	20	2.95	0.826	500	*2.974*	*0.8036*	0.231
			Converger	10	2.5	0.707	500	*2.448*	*0.7223*	0.366
			Accom'r	20	2.95	0.999	500	*3.004*	*0.977*	0.100
Diverge	Stretch	Cognition	*Diverger*	20	3.35	0.671	500	*3.338*	*0.6816*	0.233
			Assimilator	20	3.15	1.089	500	*3.157*	*1.079*	0.323
			Converger	10	2.6	0.803	500	*2.569*	*0.8445*	0.538
			Accom'r	20	3.4	0.94	500	*3.469*	*0.9298*	0.287
Assimilate	Keep	Cognition	*Diverger*	16	2.875	1.025	500	*2.896*	*1.032*	0.235
			Assimilator	16	3.125	1.025	500	*3.109*	*1.05*	0.384
			Converger	8	2.875	0.991	500	*2.947*	*0.9611*	0.209
			Accom'r	16	2.375	0.71	500	*2.347*	*0.7211*	0.653
Assimilate	Stretch	Cognition	*Diverger*	16	3	1.033	500	*2.938*	*1.092*	0.194
			Assimilator	16	3.063	0.929	500	*3.061*	*0.9624*	0.181
			Converger	8	3.5	1.096	500	*3.578*	*1.098*	0.359
			Accom'r	16	2.6	0.817	500	*2.454*	*0.7851*	0.154
Converge	Keep	Cognition	*Diverger*	12	3.083	0.9	500	*3.049*	*0.9245*	0.164
			Assimilator	12	2.917	0.793	500	*2.934*	*0.7991*	0.387
			Converger	6	3.5	0.548	500	*3.495*	*0.5459*	0.368
			Accom'r	12	2.917	0.996	500	*2.87*	*0.9636*	0.368
Converge	Stretch	Cognition	*Diverger*	12	3.083	0.9003	500	3.049	0.9245	0.164
			Assimilator	12	2.917	0.7930	500	2.934	0.7991	0.387
			Converger	6	3.5	0.5477	500	3.495	0.5459	0.368
			Accom'r	12	2.917	0.9962	500	2.870	0.9636	0.276

Phase	Paradigm	Perspective	*User*	Std Errors	
				Sample	Resample
				N= as per sample	*N=500*
Diverge	Keep	Cognition	*Diverger*	0.23613	0.04700
			Assimilator	0.18461	0.03594
			Converger	0.22361	0.03230
			Accom'r	0.22332	0.04369
Diverge	Stretch	Cognition	*Diverger*	0.15	0.03048
			Assimilator	0.24351	0.04825
			Converger	0.25406	0.03777
			Accom'r	0.21026	0.04158
Assimilate	Keep	Cognition	*Diverger*	0.25625	0.04615
			Assimilator	0.25625	0.04696
			Converger	0.35037	0.04298
			Accom'r	0.1775	0.03225
Assimilate	Stretch	Cognition	*Diverger*	0.25825	0.04884
			Assimilator	0.23218	0.04304
			Converger	0.3875	0.04910
			Accom'r	0.20413	0.03511
Converge	Keep	Cognition	*Diverger*	0.25989	0.04134
			Assimilator	0.22892	0.03574
			Converger	0.2236	0.02441
			Accom'r	0.28758	0.04309
Converge	Stretch	Cognition	*Diverger*	0.566	0.081
			Assimilator	0.499	0.07
			Converger	0.5478	0.0478
			Accom'r	0.627	0.09845

Table 4.13 Standard Error of Estimates

Using the resampled data, the technique appraisals were compared using a series of 2-sample t-tests. These comparisons agreed with the non-parametric comparisons. The convergence comparisons had a p-value of 0.0 and all other comparisons a p-value of the order 0.99. The t-test comparisons also gave 95% confidence intervals for difference between compared means. These are presented in tables 4.14 and 4.15 which are derived from details in Appendix 4.

KEEP Paradigm	user	*diverger*	*assimilator*	*converger*	*accommodator*
diverge	***diverger***		0.264	0.2652	-0.3028
assimilate	***assimilator***	0.3192		0.2675	0.8567
converge	***converger***	0.5249	0.6319		0.7064

Table 4.14 95% confidence intervals for differences between means for keep paradigm

STRETCH Paradigm	user	*diverger*	*assimilator*	*converger*	*accommodator*
diverge	***diverger***		0.876	0.6895	-0.2153
assimilate	***assimilator***	0.2307		-0.4096	0.6991
converge	***converger***	0.5249	0.6319		0.7064

Table 4.15 95% confidence intervals for differences between means for stretch paradigm

4.4 Qualitative analysis of individuals' data

The quantitative analysis was effective in determining the perceived usefulness of using cognitive styles as a framework for taxonomising creative problem solving techniques. This qualitative analysis will examine the respondents' views in an attempt to see how user friendly such a framework actually is.

This phase of analysis examined two types of data. The first was the ordinal data, the second being the open comments that respondents were invited to make should they wish to do so.

4.4.1 The qualitative analysis of ordinal data

The ordinal data tabulated by phase and strength of opinion subject to respondent preferred style are now examined. When examining this data in tables 4.16, 4.17 and 4.18 certain modes of behaviour come to the fore. By following the respondent's appraisals of their problem-solving journey, from divergence through assimilation to convergence, it becomes apparent that as people experience a technique that is in accord when their natural learning styles they do show a positive bias but with some degree of variance.

Examining Table 4.16 it is noted that while diverging, the modal behaviour of the opinions suggests the level of preference behaves cyclically between respondent's styles. This suggests that a style falls out of sync with phase, preference for divergence wanes.

Assess Cognition for *Divergent* Technique	Type of Respondent								Totals		
	Divergers		*Assimilators*		*Convergers*		*Accommodators*				
	keep	stretch	keep	stretch	keep	stretch	keep-	stretch	keep-	stretch	all
Strongly Favourable	0	0	0	0	0	0	1	1	1	1	2
Favourable	6	6	3	0	1	2	2	2	12	10	22
Uncertain	4	5	4	1	3	2	3	2	14	10	24
Unfavourable	5	1	3	7	6	4	4	3	18	15	33
Strongly Unfavourable	0	0	0	0	0	0	0	0	0	0	0
Total	15	12	10	8	10	8	10	8	45	36	81

Table 4.16 Respondent Appraisals of Divergent Techniques – by Learning Style

Examining Table 4.17 suggests dissatisfaction while keeping paradigms for assimilating. When stretching paradigms Convergers and Divergers seem to show some favour. This suggests an overall dislike to assimilating particularly amongst the Accommodators

Assess Cognition for *Assimilation* Technique	Type of Respondent								Totals		
	Divergers		*Assimilators*		*Convergers*		*Accommodators*				
	keep	stretch	keep	stretch	keep	stretch	keep-	stretch	keep-	stretch	all
Strongly Favourable	0	1	0	0	0	2	0	0	0	3	3
Favourable	3	4	1	1	3	1	0	1	7	7	14
Uncertain	2	5	3	2	1	4	1	0	7	11	18
Unfavourable	7	2	4	5	4	1	7	7	22	15	37
Strongly Unfavourable	0	0	0	0	0	0	0	0	0	0	0
Total	12	12	8	8	8	8	8	8	36	36	72

Table 4.17 Respondent Appraisals of Assimilation Techniques– by Learning Style

Examining table 4.18 while converging, the preference appears to oscillate, as it did for divergence. The Convergers show expected preference. Surprisingly some of the Divergers also show preference.

Assess Cognition for *Converge* Technique	Type of Respondent								Totals		
	Divergers		*Assimilators*		*Convergers*		*Accommodators*				
	keep	stretch	keep	stretch	keep	stretch	Keep	stretch	keep	stretch	all
Strongly Favourable	1	2	0	0	0	3	0	0	1	5	6
Favourable	2	1	1	0	3	2	0	0	6	3	9
Uncertain	3	3	2	2	3	1	0	2	8	8	16
Unfavourable	3	3	3	4	0	0	6	4	12	11	23
Strongly Unfavourable	0	0	0	0	0	0	0	0	0	0	0
Total	9	9	6	6	6	6	6	6	27	27	54

Table 4.18 Respondent Appraisals of Convergent Techniques – by Learning Style

This perspective of the observed data does strike some degree of contrast with the statistical portrayal of the experiment. The statistical view concerning the favour towards a technique showed distinct comparisons while the view from observed data suggests a degree of flux in opinion as a technique traverses from a person with one style preference to the next. This perspective, which might be described as qualitative analysis variance, shows a degree of similarity (and variance) of response between the different styles. The overlapping of the statistical distributions does suggest a potential for such similarity of favour towards the techniques.

The following observations are pertinent:

- When diverging, technique popularity starts somewhat favourably with the Divergers. It wanes as one follows the styles of the respondents, then returns to favour with the Accommodators.
- When assimilating, the technique seems largely unpopular, except for the Convergers striking a quite unexpected accord with Divergers when paradigms where stretched.
- When converging, opinions for this type of technique seem polarised. The Divergers concurred in favour with the Convergers. The Accommodators and Assimilators also concurred but on an unfavourable note.

Data were reclassified subject to the position of the respondent's style relative to that of the technique. The new classifications for respondents were Match, Neighbour and Oppose.

Tabulated data for these classifications is presented in tables 4.19, 4.20 & 4.21 for Diveging, Assimilation and Convergent techniques respectively. These are derived from detailed data in Appendix 5.

In Table 4.19 it is seen that while diverging, preference clearly diminishes as style similarity decreases.

Assess Cognition for *Divergent* Technique	**Type of Respondent**						**Totals**		
	Match		***Neighbour***		***Oppose***				
	keep	**stretch**	**keep**	**stretch**	**Keep**	**stretch**	**keep-**	**stretch**	**all**
Strongly Favourable	0	0	1	1	0	0	1	1	2
Favourable	6	6	5	2	1	2	12	10	22
Uncertain	4	5	7	3	3	2	14	10	24
Unfavourable	5	1	7	10	6	4	18	15	33
Strongly Unfavourable	0	0	0	0	0	0	0	0	0
Total	**15**	**12**	**20**	**16**	**10**	**8**	45	36	**81**

Table 4.19 Respondent Appraisals of Divergent Techniques – by Style Similarity

Assimilation seems unpopular/slightly acceptable, with about 50% of the Assimilators vote showed favour and approximately 30%-50% of their neighbours and 50% of those opposing showing favour.

Assess Cognition for *Assimilation* Technique	**Type of Respondent**						**Totals**		
	Match		***Neighbour***		***Oppose***				
	keep	**stretch**			**Keep**	**stretch**	**keep-**	**stretch**	**all**
Strongly Favourable	0	0	0	1	0	2	0	3	3
Favourable	1	1	3	5	3	1	7	7	14
Uncertain	3	2	3	5	1	4	7	11	18
Unfavourable	4	5	14	9	4	1	22	15	37
Strongly Unfavourable	0	0	0	0	0	0	0	0	0
Total	**8**	**8**	**20**	**20**	**8**	**8**	36	36	**72**

Table 4.20 Respondent Appraisals of Assimilation Techniques – by Style Similarity

In Table 4.21 Convergers show favour while convergence loses favour when dealt with by its neighbours. Some Divergers show preference while overall Divergers showed no overall bias

Assess Cognition for *Converge* Technique	**Type of Respondent**						**Totals**		
	Match		***Neighbour***		***Oppose***				
	keep	**stretch**	**keep**	**stretch**	**Keep**	**stretch**	**keep-**	**stretch**	**all**
Strongly Favourable	0	3	0	0	1	2	1	5	6
Favourable	3	2	1	0	2	1	6	3	9
Uncertain	3	1	2	4	3	3	8	8	16
Unfavourable	0	0	9	8	3	3	12	11	23
Strongly Unfavourable	0	0	0	0	0	0	0	0	0
Total	**6**	**6**	**12**	**12**	**9**	**9**	**27**	**27**	**54**

Table 4.21 Respondent Appraisals of Convergent Techniques – by Style Similarity

This examination does lend some support to the view that style preference for a technique type will increase/decrease the closer/further the learning style is to the technique phase. This is not the cases when assimilating. By re-classifying the data, the existence of a consistently high proportion of favourable opinions among style neighbours became more noticeable. Even allowing for the fact that the neighbours contain two skill sets in contrast to one – the proportion was approximately 25% for all phases.

The implication here is that learning style preferences overlap at the problem-solving phase boundaries. Skill overlap was also implied by, the graphical representation of normal distributions. This aspect of skills overlapping phase boundaries marks a subtle but powerful paradigm shift.

Earlier, one might too easily have been tempted to align learning style with problem solving phases under the innocent assumption that only people whose style matches that of the phase are appropriate for that task. The observation of favourable opinions of style of neighbour phase, suggests otherwise. Not only does it suggest that while boundaries might be seen as black and white between phases within a process, but it highlights the maxim there, "are a lot of grey areas between black and white," particularly when it comes to people.

This *new* paradigm has a potential advantage, in that it suggests the possibility of assigning a wider human resource to a particular phase than perhaps the paradigm inferred by the quantitative analysis might seem to imply.

4.4.2 The qualitative analysis of the open comments

The aim of this analysis was to understand the experience of the respondents, as the respondents see it. *Atlas-ti* Qualitative Data Analysis software was used to perform a hermeneutic analyse of the themes of opinions.

The views of the respondents carried two main perspectives, the first being a subjective description of the experience encountered, the second, an objective appraisal of the technique. Both perspectives contained opinions that carry positive and negative interpretations. The researcher was primarily interested in knowing more about the respondents experience during the exercise. Hence, attention focused on the subjective description of those experiences. In particular, who had what experience, where and when such experiences occurred and whether or not, experiences were considered favourable?

Looking, through the eyes of the respondent, at the relationship between respondent and technique/phase, gave an opportunity to add validity to the analysis already performed. Moreover, it gave consideration to contradictions or other aspects, not yet considered, to be identified.

The experiences are summarised in Tables 4.22 and 4.23. These suggest there was some degree of unease throughout the system, particularly from the Accommodators. Furthermore, the tables seem to suggest that once the respondent moves away from the activity matching their style, discomfort begins. This is in keeping with expectations of Kolb. It is also in keeping with observations made by McFadzean who explained that observations of unrest came to the fore when respondents were stretching paradigms. (Kolb, 1978; McFadzean, 2002)

	Positive			Negative		
	diverge	*assimilate*	*converge*	*diverge*	*assimilate*	*converge*
Diverger	0	0	0	1	1	2
Assimilator	4	0	0	5	2	0
Converger	1	1	2	2	1	1
Accommodator	0	0	0	4	6	4
Totals	5	1	2	12	10	7

Table 4.22 Person of particular style freely describes experiences per phase

	Positive Experiences			Negative Experiences		
Technique/Style	Match	neighbour	oppose	match	neighbour	Oppose
Diverging	0	4	1	1	9	2
Assimilating	2	1	0	2	2	6
Converging	0	0	0	1	4	2
Totals	2	5	1	4	15	10

Table 4.23 Set style freely describes experiences when phases match/neighbour/oppose style

Paradoxically, one could argue that by making someone think in a way that is to their habitual style one is forcing that person into a paradigm shift, even if the technique used is to keep paradigms.

Similarly, in the context of keeping and stretching paradigms, hermeneutic analyse of the respondents' opinions about their relationship with such technique helped identify where negative and positive opinions arose (Table 4.24) while using techniques occurred.

	Positive		Negative.	
	keep	stretch	keep	stretch
Perceptive	0	3	9	7
Receptive	1	1	7	2

Table 4.24 Opinions when dealing with paradigms

Overall the hermeneutic analyse suggests respondents most willing to comment about their sensitivity to their experience were Perceptive Assimilators or Accommodators, particularly when operating outside their own habitual style. Tabulated results and analysis are available in Appendix 5.

4.4.3 Questions raised by initial qualitative analysis

As in all aspects of reality, while there may be some empirical model of expectations to assist in describing that aspect, inherent variances within all natural systems always exist.

Expectations can be, too hastily interpreted to be rules without justification. When attempting to describe an aspect of reality, such descriptions are no more than systemic models. Such models are *aides-memoir* to assist observers when it comes to interpretation, measurement and understanding. Bearing this in mind and with closer inspection of the data, inconsistencies with expectations soon became apparent. Namely, one would occasionally see an unexpected strong agreement between respondents with different learning styles and assimilators, showing broad agreement with all the other styles that prefer not to assimilate.

These observations raised two further questions:-

- Why is it, people of the same learning style show a wide scope of support for a paradigm keeping technique and a higher level of support with a little variance for paradigm stretching technique?
- Why is it, respondents of different learning styles show a high level of support for techniques that appear contrary to their learning styles?

One could argue that earlier models did not consider the effect that problem-solving techniques might have on the user. Nor did they consider the influence as to what degree the person might be perceptive or receptive. To gain clarity and understanding in this matter further investigation was undertaken.

In an attempt to gain further clarity and understanding about similarities and natural grouping of the respondent's experiences when facing circumstances that do and do not match their own style, it was felt that a different approach was necessary.

Previously and perhaps traditionally, the analytic approach was to categorise the data, thereby assessing them in terms of conformity to set expectations. To understand natural behaviours, a more holistic perspective might allow the data to tell their own story, as opposed to seeing if they tell the stories the observer wants to hear.

4.4.4 Assessing strength of opinion

The approach for assessing the strength of opinion used several methods, including cluster analysis, scatter plots, matrix plots and contour plots. for which details are given in Appendix 6 and discussed here.

First, the cluster analysis showed many sets of distinct clusters. Ironically, instead of the clusters showing strong agreement with the statistical and qualitative view of things, there appeared to be a high level of chaos within the creative problem solving system. At first sight, the clusters appeared to add dissonance to the initial findings and all previous learning style frameworks from Kolb (1978) through to that of Basadur et.al. (1990).

Comparing the three analytic approaches thus far, cluster analysis offers a perspective that is very close to the behaviour of the raw data of each individual response. Statistical analyses offer a composite perspective of what is likely to occur while the qualitative perspective is even broader, offering more of an historic, account of what actually happened. Each approach not only offers a different perspective but also operates at different systemic levels, the observed discourse offers no surprise. The two latter descriptions are seemingly looking at groups or subsystems within a bigger system. The cluster analysis is working at a lower level, attempting to look at the inner-behaviours of each of the individual group within the system, right down to its elements.

Such a view of reality is often invisible to the both the statistical and qualitative eye. Statistics can at best point to the existence of impromptu behaviours. Unfortunately, such impromptu instances can too easily become camouflaged and accepted as variance. Statistical analysis can be weak when it comes to explaining. To gain clarity about the likely reaction of a person with a particular style, subject to the action of using a techniques three methods were used:

- Scatter plots were used to illustrate the cognitive-style identity of each respondent in a pre-treatment state.
- Matrix plots were used to plot votes against fundamental styles in the context of experience encountered. This added clarity to the relationships between the respondents' aggregate vote and variables that describe their cognitive styles.
- Contour plots gave a clearer overview of how respondents behaved experiencing a type of technique.

This approach considered the profile of the respondents overall. Instead of using the composite learning style application definitions of Accommodator (Active Pragmatist), Diverger (Pragmatic –Reflector), Assimilator (Reflective – Theorist), Converger (Theoretic Activist), the fundamental learning style attributes, Pragmatic, Reflective, Theoretic, and Active where used for an axes of reference. For ideation, the perceptive and receptive attributes where used.

This approach offered both two- and three-dimensional ways to plot the aggregate opinions of each technique for each individual respondent. It also gave the opportunity to examine the influences from shared attributes. From this perspective the observations indicate that with composite styles required for a technique:-

- Those with all the fundamental styles that define the composite style required by the technique will be likely to show favour for that technique.
- The degree of favour towards a technique appears to increase in proportion with both the number of, and the level of, the fundamental styles the person has and those required by the technique.

These findings appear to add credibility to what was suggested earlier by the qualitative analysis, namely that the scope of techniques overlap the boundaries of learning styles. This also supports the view that the concept of learning styles as such, would be better described, as a learning continuum as is the case for McFadzean's (2000) 'Creative Continuum'.

4.5 Analysis of Group Data

One might intuitively expect a group of people who share the same cognitive style to show greater preference for techniques that are in accord with their mutual cognitive styles. Also one might intuitively anticipate similarity between the likely preference of people with a shared learning style and work as a group to individuals who share the same learning but work alone. These intuitions were investigated.

To evaluate such intuitions, it was necessary to assess how groups of like-minded people with shared learning styles appraise different problem solving techniques, each technique having been designed to encourage thinking in accord with a particular cognitive style.

For each individual within a group, their cognitive style is defined as an amalgam of Kolb's (Kolb 1978) learning styles and one of Sternberg's (Sternberg 1997) two styles described as receptive or perceptive. The shared cognitive style of a group of people is a further amalgam of these styles. The Learning styles considered were divergence, assimilation and convergence. All the styles mentioned previously have both a preferred activity element and a cognition element. The cognitive style which a technique is designed to encourage, is defined as, one of Kolb's Learning styles and one of McFadzean's (McFadzean 2000) paradigmatic styles - keeping-paradigms and stretching-paradigms. Groups were invited to solve a problem inherent within their own organisation.

Data pertaining to two groups only, divergers and convergers, were available due to participants' withdrawal from the exercise due to ill health. All of the data submitted by these volunteers and their group were removed from the sample.

4.5.1 Group findings and limitations

While the analysis shown in table 4.11, suggest some degree of group adherence to the same expectations for individuals facing a similar task, it must be borne in mind that due to a small sample of groups the validity of these group statistics must remain confined to the sample group. However, the result of t-test comparisons, between the preferences of individual group members with the sample of individuals' preferences suggests that individuals as group members came from the same population that individuals came from. This implies that expectations for the exercise done should remain the same for both groups and individuals. The views offered by respondents does suggest support for this, albeit anecdotally.

While it can be argued that the two groups, selected at random, on all occasions independently met the same expectations as individuals, it cannot be assumed as to what level of preferences shown within the groups have been influenced by group behaviour, cognitive preference, a combination of both, or perhaps some other local factors.

Actual	Match			Non-match		
Vote	group	indiv	total	group	indiv	total
1	6	47	53	13	73	86
2	22	17	39	40	69	109
3	36	52	88	63	85	148
4	50	35	85	105	42	147
5	18	9	27	31	24	55

Table 4.25 Comparison of groups with individuals

Will people, working in a same-style group or working individually, yield a different preference when assigned similar tasks? The $\chi 2$-test for independence with results {$\chi 2$ (match) = 38.58400379 $\chi 2$ (Non-Match) = 75.874 $\chi 2$ (0.05, 4 d. f.) = 9.5} suggests independence be rejected. This rejection of independence implies similarity in the expected behavioural preferences between people, working in a same-style group and working individually.

Rejection of independence between individuals and a group leads to consideration of the strength of influence that working in a group or as an individual might have on the popularity of a technique. Comparing graphically, as presented in Figures 4.2 and 4.3, the preferences of the match and not-match data sets from table 4.25 suggests working in a group could have such an influence. In both cases, this lends broad support to the suggestion that preference increases as styles match their phase. Having shown the existence of such a phenomenon, the question remains as to how steadfast, universal and influential, such a phenomenon actually is. This could provide interesting subject matter for future research.

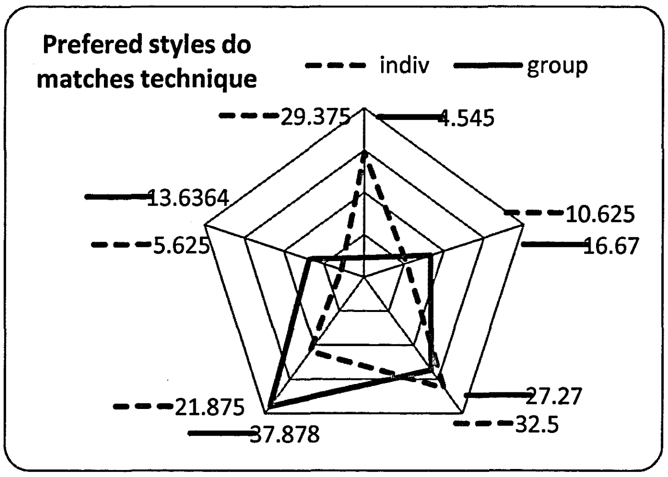

Figure 4.2 Preferred styles matched phases

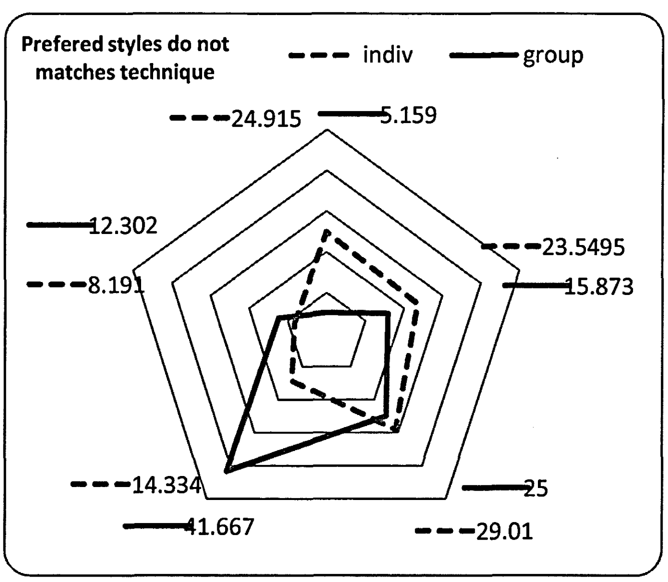

Figure 4.3 Preferences styles do not match phase

In the next section a broader view is taken of the data in relation to the perceptions that creative problem solving helps deliver better solutions.

4.6 Perceptions of creative problem solving and levels of solution

The summary results of comparing opinions and perceptions pre- and post- exercise are presented in Table 4.26 and 4.27. From a personal perspective (Table 4.26) the level of opinion that creative problem solving techniques encourage users to deliver more innovative solutions showed an approximate linear increase relative to the level of solutions. The work related perspectives are presented in Table 4.27 and these show that similar views prevail when considering the potential of creative problem solving techniques within industry.

Reflecting on your personal involvement with creative problem solving, *or brainstorming as it is often called*, how well did such processes encourage you to...	**Solution Level**	**Learning Style Non-Specific**		**Learning Style Specific**					
		Convinced useful	**Overall**	**Diverger**	**Converger**	**Assimilator**	**Accommodator**	**Receptive**	**Perceptive**
Adopt existing solutions currently available within your speciality	1	0.13647	0.191826	1	1	0.550778	0.056337	0.229003	0.443675
Look for solutions beyond your speciality but currently available within your industry	2	0.291633							
Look for solutions to similar situations found outside your speciality and industry	3	0.173854							
Consider the possibility that readymade solutions may not yet exist within industry but could be with the help of scientists and alike	4	0.335561							
Consider the possibility that you could discover a completely new solution not considered yet	5	0.671364							

Table 4.26 Personal Perspectives Pre-Post Student paired t-tests alpha-5%

Reflecting on your work experience overall, how well do you think creative problem solving has encouraged...	**Solution Level**	**Learning Style Non-Specific**		**Learning Style Specific**					
		Convinced useful	**Overall**	**Diverger**	**Converger**	**Assimilator**	**Accommodator**	**Receptive**	**Perceptive**
Adoption of existing solutions currently available within your speciality	1	0.047966	0.262518	0.259464	4.89E-05	0.020992	0.248412	0.73536	0.0189
Looking for solutions beyond a speciality but currently available within the same industry	2	0.036624							
Looking for solutions to similar situations found outside the same speciality and industry	3	0.335561							
Consideration that the possibility of readymade solutions may not yet exist within industry but could be with the help of scientists and alike	4	1							
Awareness that a completely new solution not considered yet is about to unfold	5	0.547028							

Table 4.27 Work-Related Perspectives Pre-Post Student paired t-tests alpha-5%

When taking into account the cognitive styles of the respondents both the Divergers and Convergers felt convinced they had learnt something and creative problem solving techniques would be helpful to them. The Assimilators remained undecided while the Accommodators remained unconvinced. This decision of the Accommodators could be influenced by the fact there were no accommodative exercises in the experiment. The Divergers, Convergers and Perceptives also believed creative problem solving techniques useful. The Assimilators found it a mediocre help while the Accommodators declared no interest.

4.7 Validity of findings

When comparing learning styles from the cognition and activity perspective, eighteen tests were performed. On the assumption that each test has at best a 50 per cent chance of passing or failing, for all tests to agree the probability of that happening, assuming chance or randomness, would carry the odds of the order 2^{18} to 1. Similarly when comparing cognitive style with cognitive style, four tests were performed. On the assumption that each test had a 50 per cent chance of passing or failing then, for four tests to all agree the probability of that happening, assuming randomness, carries the odds of the order 2^4 to 1.

Standing up to such odds, coupled with cross validation (both internally and with findings from previous research) strongly suggests that influences other than serendipity were at play. According to Kumar (2005) to accept the validity of such influences, the questions, "was the researcher measuring what the researcher thought the researcher was measuring?" and "did the data adequately represent the concepts under investigation?" needs addressing.

To capture and identify individual profiles, the questions used were based on previously proven cognitive concepts. The framework for the questions followed a synoptic representation of Kolb (1978), developed in Oslund, & Rubin,(1995) of original full learning style inventory. The questions which were used to appraise the techniques were derived from attributes used by Kolb to describe a learning style and those used by Sternberg (1997) to describe perceptive and receptive styles.

To analyse the data quantitatively, no supporting evidence existed to support the assumptions necessary to use probability distributions. Non-parametric techniques were used in the initial investigation. As evidence of repeatability emerged, the adhesion of data to probability distributions were investigated and verified. Tests performed on random resampled data sets implied repeatability of expectations.

When data showed disagreement with expectations, further investigations where done to find causes. Further investigation resulted in a powerful paradigm change. This suggested that using Honey & Mumford's composite learning styles, thereby typecasting people, is inappropriate as it carries limitations. By reverting to using Kolb's (1978) fundamental learning styles instead of Honey & Mumford's (1995) composite learning styles, people where correctly assessed on the strength, of what they can do and not the synthetic perception of what they cannot do. This perspective removed all dissonance between data and expectations establishing a foundation for resourcing and taxonomising creative problem solving techniques.

Finally, the studies described data collection in less than ideal circumstances, especially in terms of engaging significant numbers of respondents. This chapter concludes with some observations on responders and non- responders.

As in all research projects when human participation is required capturing willing respondents is no easy task. Of those people who were approached, they seem to fall into three distinct categories, those who participated fully and returned the workbooks completed, those who returned the workbooks but incomplete and those who willingly volunteered to participate in full knowledge of what was asked of them but decided to opt out.

Their reasons for opting out are of interest to the researcher. When investigated it revealed plausible honest reasons such as time commitment, poor health, etc. However, there was one reason, which was of interest – fear. Although each person was briefed, in person, that they are requested to give their appraisal of the technique and total anonymity guaranteed, there seemed to be an assumption that the person being asked to make the appraisal was themselves under personal scrutiny. Fear of looking like a fool, fear of doing something wrong, or suggesting something new, soon became apparent. In occasional cases, apologies and the reasons for opting out were volunteered. In most cases however, they were not. In such cases, the reasons where not readily retrieved. However, the researcher became aware of such information albeit unintentionally via informal discussions.

Organisations were approached via networking and those who showed interest had been invited to participate. Unfortunately, with the exception of one, they all chose to block further participation. Although this refusal to participate might not have given the researcher the data required for the experiment it does bring to the fore the general problem of reluctance when it comes to innovation and people's attitude to something new. This also adds weight to the best-fit view that when it comes to innovation, people need support and a method with which they can feel at ease.

5 Taxonomising techniques

This Chapter will explain how the relationship between cognitive styles and problem solving phases form a taxonomic basis for creative problem solving techniques and satisfy Brown's (Brown 1996) vision of a best fit policy for tailoring techniques to the needs of the user.

This Chapter will also explain the methods and data used to create the taxonomy. Details of what was taxonomised, why a taxonomic structure is justified and how such a classification will reinforce Amabile's (Amabile 1985, Amabile & Pillemer 2011) tenets for maintaining an innovator's intrinsic motivation.

5.1 Suitability of cognitive styles for taxonomising techniques

To improve user creative experience Brown (1996) envisaged a strategy for tailoring creative problem solving techniques to the requirements of the user.

5.1.1 Tailoring Techniques

People fulfil problem-solving roles in different ways depending on their personality and cognitive styles. As discussed in Chapter 2, the roles of the Diverger, Assimilator, Converger and Accommodator are all composites of Kolb's fundamental learning styles namely the Pragmatist, Reflector, Theorists and Activist. People who possess high-strength as a Pragmatist and Reflector, for example, appear to show greater ability to stretch paradigms more easily than those people who also have the same styles but at a lesser degree.

Based on research findings, this argument extends further, when dealing with people with neighbouring styles, for example, the accommodator and assimilator, both possess at least one of the fundamental learning styles in common with the Diverger, albeit in some cases at a different level. Possession of such a communal learning style helps them, to a degree, to contribute in the direction of divergence. Such neighbours, in the context of suitability to execute a divergent task can be seen as equivalent to those Divergers, who have the styles that make a full divergent ability but to a lesser degree (Kolb 1978)

Furthermore, from examining the contour plots, derived from the research data, there seems to be a latent appetite within the system. When diverging, for example, assimilators show greater preference than the accommodators. When assimilating, Convergers showed greater preference than the Divergers did. The same pattern existed when converging albeit to a lesser degree. This repetition of patterns and natural boundaries, or limitations on ability, suggests to the researcher, the possibility of some generality. It could be that such limitations can be used to tailor both the techniques used and the role of the individual, to a degree, of participation that an individual can feel both comfortable in doing while perceiving some sense of value as a result.

Having awareness of such a phenomenon and its appropriateness should assist when devising a tailoring strategy to best-fit techniques to the requirements of individual or group, intending to use them.

5.1.2 Taxonomising creative problem-solving techniques

According to Barsalou (1983, 2000), when left to their own devices people will describe a situation using many subjective perspectives and concepts and will construct ad-hoc categories to achieve their goal. Barsalou also explained that, using ad-hoc categories only offered a gradient of structure whereas common categories gave a more formal structure. However, using formal in contrast to ad-hoc categories gave the added advantage of encouraging greater consistency of instance -to-concept association in the human memory. Explaining that, the human conceptual system probably did not evolve to represent concepts in isolation, nor to detach taxonomies, it probably evolved to support human action in the environment but used taxonomic structures for that purpose.

According to Bijnen (1973), when confronted with a situation described by a plethora of variables it is often necessary to identify strong similarities between such variables. Identification of similarities and strength thereof can help reduce the number of variables and hence the overall complexity of the situation.

To taxonomise such techniques, it was necessary to examine all techniques for similarities when it comes to their purpose and how well it is seen to serve its purpose. Descriptions and appraisals of the techniques were obtained from many previously cited sources. These included, first appraisals describing how ably techniques aided the divergence, assimilation, convergence and accommodation phases of problem solving. Second there are appraisals describing and levels of confidence of how well the techniques encouraged the user to keep, stretch or break paradigms formed the primary points of interest. These attributes were used as taxonomic parameters. Third, and as a matter of completeness, appraisals of other attributes of a technique's usability were recorded but not used for analysis.

To evaluate similarity assessments of the differences between objects was necessary. Such differences are defined as linkage or measuring how similar two items are when examined in the context of a shared characteristic (eg Gordon, 1999). When calculating similarity between many objects, subject to many shared characteristics or variables, the resulting value of similarity of objects resembles the calculation of a statistical standard deviation by taking the square root of the sum of squares of each object calculated linkages. Similarity is inversely proportional to linkage.

Using such similarity calculations identifies natural clusters of objects based on the strength of similarity. This approach is known as nearest neighbour analysis and the measures of similarity it helps calculate are used to determine levels of clustering or similarity. This information can be displayed graphically using a tree-like diagram known as a dendrogram. The nodes of the tree represent the level of similarity identified, and the branches represent the compared objects that share the characteristics used to calculate the similarity of the objects.

The result of such analysis was a dendrogram of all the techniques recorded. Classification of observations into groups, the boundaries of which are initially not known, was done using cluster analysis. The Minitab describes this dendogram construction process as an "... agglomerative hierarchical method that begins with all observations being separate, each forming its own cluster. In the first step, the two observations closest together are joined. In the next step, either a third observation joins the first two, or two other observations forming unity with a different cluster. This process will continue until all clusters are joined..."

To accomplish these recursive comparisons of the observation data, the distance between each item needs to be compared. This distance, described as linkage, is the noticeable difference between each item. Such distances can be calculated in several ways, the choice being subject to circumstance. At this stage of the investigation, as the point of interest is the degree of similarity between creative problem-solving techniques, the choice of linkage was the nearest neighbour. It is assumed the type of technique is clearly defined.

A dendrogram shows the data in the form of a tree diagram, displaying the level of similarity on the vertical axis with observations on horizontal axis. Further analysis of creative problem-solving techniques may rely on more parameters with the description of techniques being more subjective, hence more complex. For this, other more appropriate, linkage methods may be used. Table 5.1 presents a summary of reults. Details are further tabulated alongside graphical presentation are available in Appendix 8.

Cognitive Style				Receptive Thinking		Perceptive Thinking
					Paradigm	
Learning Preference	Creative Style	CPS Phases		Keep	Stretch	Break
Intuition Thinking	Pragmatist Concrete experience	Active Pragmatist	Analyse			
		Pragmatic Reflector	Recognise			
Reflection Thinking	Reflector Reflective Observation		Identify			
		Reflective Theorist	Assumptions			
Systematic Thinking	Theorist Abstracts & concepts		Alternatives			
		Theoretic Activist	Evaluate			
Active Thinking	Activist Active experience		Implement			
		Active Pragmatist	Control			
Furnham (1995)	(Kolb,1978; Honey & Mumford,1995;Basadur *et al*	(Kolb,1978), Honey & Mumford (1995) Basadur *et al*	(Higgins, 1994)	Furnham (1995) Kuhn (McFadzean,2000)		

Table 5.1 Taxonomy of cognitive skills and CPS techniques

Phase One	Thinking Required Activist - **Pragmatist** - Reflector Accommodators Divergers	Receptives	Keep	Either	Benchmarking
					Browsing
					Brutethink
					Bug Listing
					CATWOE
					Causal-cognitive Mapping
					cognitive mapping
					Collective Notebook
					Compare to others
					Contradiction Analysis
					EitherFuturist
					Monitor weak signals
					Opportunity Searches
					Scenario analysis
		Rec-Perct	Stretc	Either	5W+H
		Perc	Break	Either	Cartoon Story Board

Table 5.2 Taxonomy of cognitive skills techniques appropriate to phase-one

Table 5.2 shows a collection of techniques aligned to their appropriate individual or group usage, perceptive and cognitive skill levels requirements and paradigmatic purpose for phase-one of the problem solving cycle.

hase Two	Thinking Required Activist – **Pragmatist** – Reflector Accommodators Divergers	Receptives	Keep	Either	Bkwards Fwards Planning
					Bounce it off someone else
					Boundary exam'n (DeBono 82)
					Boundary Relaxation
					Brutethink
					Bug Listing
					Camelot
					CATWOE
					Causal-cognitive Mapping
					Checklist
					cognitive mapping
					Collective Notebook
					concensus building
					Consensus Mapping
					Contradiction Analysis
					Criteria for idea-finding potential
					Dimensional Analysis
					Draw a picture/Visual Thinking
					Experience kit
					Fishbone diagram
					Inverse Brainstorming
					King of the moubtain
					Limericks and parodies
					Listing Complaints
					Redefining a problem/opportunity
					Respond to someone else
					Rewrite objective many ways
					Role playing
					Scenario analysis
					Squeeze & Stretch
					Suggestion techniqwues
					What do you know
					What patterns eist?
					Why-why diagram
					Workout/retreats

Table 5.3a Taxonomy of cognitive skills techniques appropriate to phase-two

Phase Two	Thinking Required Pragmatist – **Reflector** – Analyst Divergers Assimilators	Receptive **Perceptive**	Stretch	Either	5W+H
					Affinity Diagram
					Concept Fan
					Force Field Analysis
					Hexagons
					Progressive Abstraction
				Group	Brainstorming
					Brainwriting
					Brainwriting 6-3-5
					Card Story Boards
		Perceptive	Break	Either	Component Detailing
					False faces
					Heuristic Ideation Technique
					Metaphors
					Pugh Matrix
					Reversal
					Cartoon Story Board
					Collage
					Rolestorming
					Rich Pictures
				Individual	Mind Maps

Table 5.3b Taxonomy of cognitive skills techniques appropriate to phase-two

Tables 5.3a & 5.3b collectively show a collection of techniques aligned to their appropriate individual or group usage, perceptive and cognitive skill levels requirements and paradigmatic purpose for phase two of the problem solving cycle.

Table 5.4a Taxonomy of cognitive skills techniques appropriate to phase-three

Phase Three	Thinking Required Reflector – **Analyst** – Activists Divergers Assimilators Convergers	Receptive	Keep	Either	Assumption Surfacing
					Attribute Listing
					Boundary exam'n (DeBono 82)
					Boundary Relaxation
					BrainWriting Constrained
					BrainWriting constraint Varied
					BrainWriting Game
					BrainWriting Idea Card
					BrainWriting Pool
					CATWOE
					Consensus Mapping
					In the realm of the sences
					Kepner-Trego
					LARC
					Listing Complaints
					Circle of Opportunity
				Individual	7x7 matrix
					Analogies & Metaphors
					Analysis of past solutions
					Associations
					Attribute Association Chains
					Back to the customer
					Back to the Sun
					Deadlines
					Direct Analogies
					Establish Idea Sources
					Examine it with the sences
					FCB Grid
					Focussed Object
					Fresh eye
					Idea bits and racking
					Idea notebook
					Listening to music
					Lotus Blossom
					Name possible uses
					Organised Random Search
					Personal Analogies
					Product improvement checklist
					Related Words
					Relatedness
					Reversal — dereversal
					Rolling in the grass for ideas
					Sleeping/dreaming on it
					The Napoleon technique
					The two-words technique
					Visualization
					What if?

Table 5.4b Taxonomy of cognitive skills techniques appropriate to phase-three

Phase Three	Thinking Required Reflector – **Analyst** – Activists Divergers Assimmilators Convergers	Receptive	Keep	Group	Crawford Slip Writing
					Creative circles
					Creative Imaging
					Creative leap
					Delphi
					Excursion technique
					Gallery Method
					Gordon Little
					Group decision support systems
					Idea board
					Idea triggers
					Innovation committee
					Inter -companyInnovation groups
					Lion's den
					Mitsubishi Method
					NHK method
					Nominal group technique
					Phillips 66
					Photo ecursion
					Pin Card Technique
					Scenario writing
					SIL method (combining)
					Storyboarding
					Synectics
					Take five
					TKJ
		Receptive Perceptive	Stretch	Either	5W+H
					Affinity Diagram
					Cherry Split
					Concept Fan
					Force-Fit Game
					Hexagons
					Progressive Abstraction
					Word Diamond
				Individual	Input-output
				Group	Brainstorming
					Brainwriting
					Brainwriting 6-3-5
					Morphological Analysis

Phase Three	Thinking Required Reflector – **Analyst** – Activists Divergers Assimmilators Convergers	Perceptive	Break	Either	Assumption Reversals
					Component Detailing
					False faces
					Free Association
					Heuristic Ideation Technique
					Metaphors
					Object Stimulation
					Pugh Matrix
					Reversal
					Rolestorming
				Individual	Mind Maps
					Picture Stimulation
				Group	Brainsketching
					Collage
					Imagining
					Rich Pictures
					Star Cruising
					Wildest Ideas
					Wishful Thinking

Table 5.4c Taxonomy of cognitive skills techniques appropriate to phase-three

Tables 5.4a 5.4b and 5.4c collectively show a collection of techniques aligned to their appropriate individual or group usage, perceptive and cognitive skill levels requirements and paradigmatic purpose for phase –three of the problem solving cycle

Table 5.5 Taxonomy of cognitive skills techniques appropriate to phase-four

Phase Four	Thinking Required Analyst – Activists - Pragmatist Assimmilators Convergers Accommodators	Receptive	Keep	Individual & Group	AIDA
					Be a Warrior
					Browsing
					BulletProofing
					Checklist
					Comparison tables
					Contradiction Analysis
					Control charts
					Critical Path Diagrams
					Design of experiments
					Dimensional Analysis
					Dot voting
					Estimate-Discuss-Estimate
					Flow diagram
					Histogram
					How-How Diagram
					Matrix data analysis
					Measles chart
					Pareto diagram
					Run chart
					Screening Matrix of ideas
				Group	Anonymous Voting
					Dialectical Approaches
		Perceptive - Receptive	Stretch	Individual & Group	5W+H
					Affinity Diagram
					Force Field Analysis
					Hexagons
					Progressive Abstraction
					Sticky Dots
		Perceptive	Break	Individual & Group	False faces
					Nominal Group Evaluation
					Pugh Matrix
					Reversal
				Individual	Mind Maps

Tables 5.5 shows a collection of techniques aligned to their appropriate individual or group usage, perceptive and cognitive skill levels requirements and paradigmatic purpose for phase –four of the problem solving cycle

Following the investigation into the instinctive behaviour and motivation of people when confronting problems, their cognitive preferences towards different types of problem solving tools, the application of such tools and the sensitivities that people have to such tools; a natural alignment of cognitive abilities, problem-solving phases and paradigm-changing strengths has emerged. This new structure allows a creative problem-solving technique to be classified by:

- Appropriateness to meet the requirements of a problem-solving phase
- Ability to encourage people to make paradigm changes
- Ability to satisfy the cognitive and motivational needs of its user.

This new structure also allows cognitive abilities to be classified by:

- Ability to satisfy the needs of a particular problem solving phase
- Ability to work within or create new paradigms.

5.1.3 Using the creative problem solving taxonomy

Goleman (1999) explained that being creative in an organisation can be both a cognitive and emotional experience, particularly when one is subject to Amabile's (Amabile 1998) creativity killers: over-surveillance, over- evaluation, micro-management and unrealistic tight deadlines all of which induce panic and remove the freedom to think creatively (Goleman 1999, Amabile 1998)

According to Van Grundy (2004), facilitators and problem-solvers may find themselves facing creative challenges for new products or devising a strategy to tackle people problems. Many ideas may be required quickly, or maybe with focus aimed at novelty, time can take a lower priority. Facilitators may also want to appraise the skills and abilities of the people they are facilitating. (Van Grundy 2004)

Tidd, Bessant & Pavitt (2001) explained that an identifying element of any organisation is the presence of key enabling people who have the ability to champion innovation and surmount cultural innovation killers described by Amibile (1998). Such organisations are easily identified by their attitude to training associated with innovation, which according to Tidd, Bessant & Pavitt (2001), is often ranked higher than financial rewards by its employees. This cultural indicator identifies the fact that such employees are intrinsically motivated.

This new formal structure gives an improved opportunity to create and manage a strategy of skills and resources when solving complex problems. Using such a structure should encourage greater involvement in creativity, easier recall of the process overall, how each part of the process works, helps to identify where the user is likely to feel most comfortable, promote user satisfaction and induce the self-confidence to surmount Amabile's (1998) creativity killers.

While each individual may only be able to make an incremental contribution to an innovation project overall, having such a framework should encourage a positive open climate which can do much to bring out creative ideas. The combined effort overall can be far reaching.

5.2 User acceptance

At this stage, the research into techniques driven by cognitive styles is on its last phase of the full problem solving cycle. A survey was necessary to assess how the proposed new approach, tailored to the thinking styles of individuals is seen by potential users. The foci of interest were the levels of belief in the effectiveness of the approach and where the respondents envisaged it would have most impact.

In an attempt to gain insight into different users' perspectives, the opinions of the respondents were collated overall and then according to industrial sectors, the day to day role and main focus of the respondent. Full tabulation of assessments can be found in Appendix 8 across a wide range of respondents who worked in the education, petrol-chemical, information-technology, research & development, finance, retail and health services.

It is interesting that according to the overall data, the respondent's level of confidence in a cognitive style approach is quite positive, particularly when considering the possibility that solutions may be outside their usual scope of interest. It is also worth noting that when the respondents considered intangible features of a business improving skills were at the top of their agenda with a cluster of personal communication aspects a close second.
When examining the tangible aspects of a business, people were top of the agenda followed by planning and improved products and services. The opinions from product and service perspectives appear similar.

Comments submitted by respondents suggest some recognition and awareness of the importance of people's skills, natural abilities and roles in innovation. Aware that people automatically resort to their preferred way of thinking, comments made by respondents suggest the view it is a resourcing issue with the occasional belief that training is the solution. What is a surprise is that improved innovation and change scored less than improved products and services. This could be because the respondents previously had little or no involvement with innovation but are in constant involvement with products and services brought about by innovating. This could be an example of Rickards (1985) view that, managers had long misunderstood creativity and innovation.

Comparing the opinions of the usefulness of the tailoring approach, with details presented in Appendix 9 indicates that the decision- making sample and respondents who had volunteered earlier both showed agreement that a tailored approach would help individual and groups when solving complex problems.

6 Summary and conclusions

This research has examined the creative problem-solving process from many perspectives. Considering the cognitive aspects of individuals and groups and the application of the creative problem-solving techniques, a more meaningful and holistic view of the creative problem process has emerged.

The propositions set out as the hypotheses enumerated at the end of Chapter 2 were, many cases, supported by the research. The next section 6.1 goes through these and then section 6.2 summarises.

6.1 Support for hypotheses

H1. 1. FOR THE INDIVIDUAL, FROM A USABILITY PERSPECTIVE: participants will show noticeable preference for techniques that will be in accord, and the individuals preferred learning styles.

While working on paradigm keeping techniques the initial investigations using non-parametric techniques showed that when people used a paradigm keeping technique, the Divergers and Assimilators were all significant in showing greater preference (with evidence of repeatability) to techniques that are in accord with their learning style. The Convergers were also significant) in showing greater preference (with no evidence of repeatability) to techniques that are in accord with their learning style. Lack of repeatability was due to no Convergers being available in the repeated experiment sample.

Examining the paradigm stretching techniques, the initial investigations using non-parametric techniques showed that when people used a paradigm stretching technique, Convergers and Assimilators were all significant in showing greater preference to techniques that are in accord with their learning style. The Divergers overall were not significant in showing greater preference to techniques that were in accord with their learning style but were significant when compared with the Accommodators.

However, when comparing the Divergers with the Accommodators the significance remained unrejected. This automatic non-rejection of the test was because the smaller of the two Mann-Whitney calculated U-values was greater than the tabulated critical value namely, the W-value of the Mann-Whitney test, Billiet (2003). This automatic non-rejection was supported by the a different sample showing the Divergers to be significant when compared with the Assimilators. The Assimilators were not significant in showing greater preference for techniques that are in accord with their learning style (2009 – sample). Due to Convergers not being available in the 2009-sample, further testing was not possible.

H1. 2. FOR THE INDIVIDUAL, FROM A PERFORMANCE PERSPECTIVE: participants will show a noticeable preference for techniques that will be in accord, and the individuals preferred learning styles.

While working on paradigm keeping techniques the initial investigations using non-parametric techniques showed that when people used a paradigm keeping technique, both the Divergers and Assimilators (with evidence of repeatability) were significant in showing preference to techniques that were in accord with their learning style.

Convergers did not show significant preference. However, on closer inspection, when comparing the Convergers appraisal of a convergent technique to the Divergers, Assimilators and Accommodators appraisal, the collective data offered by all the Accommodators was equal in this instance. This stalemate of opinions could have influenced the appraisal comparisons of the convergent technique. Convergers were not present in the second sample so further tests on Convergers were not possible.

While working on paradigm stretching techniques the initial investigations using non-parametric techniques showed that when people used a paradigm stretching technique, the Divergers were significant in showing greater preference to techniques that are in accord with their learning style. Repeatability was only evident when comparing Divergers with Assimilators.

The assertion that Assimilators will show greater preference for techniques that are in accord with their learning style remained accepted. This automatic acceptance or non-rejection was because the smaller of the two Mann-Whitney calculated U-values was greater than the tabulated critical value namely, the W-value of the Mann-Whitney test, Billiet (2003). Repeatability was evident.

Convergers showed no significant preference. This could be due to respondents exerting a greater amount of creativity than usual in order to stretch paradigms. Due to Convergers not being available in the second sample, further tests were not possible.

Due to anomalies of expectations in the initial investigation, further analysis was undertaken. Instead of investigating, using composite styles to describe preferred tendencies, Kolb's (1984) set of fundamental learning styles were used to describe abilities.

This investigation led to the understanding that the concept of Learning Styles would be better named The Learning Continuum and two general conclusions:

- Those with all the fundamental styles that define the composite style required by the technique will be likely to show favour for that technique.
- The degree of favour towards a technique appears to increase in proportion with both the number of, and the level of, the fundamental styles the person has and those required by the technique.

H1. 3. FOR THE INDIVIDUAL, FROM A USABILITY PERSPECTIVE: participants will show a noticeable preference for techniques that will be in accord and the individuals preferred creative styles.

For opinions related to the outcome of working with a paradigm keeping technique, the receptive respondents were significant in showing greater preference for techniques that were in accord with their preferred creative style. On the other hand for opinions related to the outcome of working with a paradigm stretching technique, in all cases, the perceptive respondents were not significant in showing greater preference for techniques that were in accord with their preferred creative style.

H1. 4. FOR THE INDIVIDUAL, FROM A PERFORMANCE PERSPECTIVE: *participants will show a noticeable preference for techniques that will be in accord and the individuals preferred creative styles.*

When working with paradigm keeping techniques the initial investigations using non-parametric techniques showed (without evidence of repeatability) that receptive respondents showed significantly greater preference for techniques that keep paradigms than the perceptive respondents did. While this outcome did meet the experimental expectation, it did not repeat in the second trial albeit with a smaller sample.

When working on paradigm stretching techniques the initial investigations using non-parametric techniques showed that receptive respondents showed significantly greater preference for techniques that stretch paradigms than the perceptive respondents did. This outcome did not meet the experimental expectation, it did not repeat in the second trial albeit with a smaller sample.

These results were somewhat unexpected until closer inspection showed a noticeable decrease in significance levels between techniques that keep paradigms with those that stretch them. This noticeable decrease in significance levels suggests to the researcher the possibility that perceptive people might find paradigm keeping techniques non-stimulating while receptive people think the contrary. Moreover, receptive people might also find paradigm stretching more stimulating than perceptive people do, while receptive people might feel more uncomfortable using paradigm stretching techniques than they do using paradigm keeping techniques, but not enough to reject them. This decrease of significance illustrates a relative increase in opinion for perceptive people and a decrease of opinion for receptive people, when it comes to paradigm stretching techniques.

Next the hypotheses H1.5 and H1.6 are taken together

H1. 5. GROUP MEMBERS HAVE THE SAME LEARNING STYLE, FROM A USABILITY PERSPECTIVE: *preferences for specific technique will lie in accord with the individual group member's preferred learning style.*

H1. 6. GROUP MEMBERS HAVE THE SAME LEARNING STYLE, FROM A PERFORMANCE PERSPECTIVE: *preferences for specific technique will strike accord with the individual group member's preferred learning style.*

For H1.5 and H1.6, investigation was not possible to the same extent as it was for the individuals. However, comparisons were made between like-style groups and individuals with the same learning style who worked alone.

Tests for independence between people working in a same-style group and those having the same style but working individually were not significant. Rejection of the $\chi 2$-test for independence infers that a similarity in behavioural preferences between people, working in a same-style group and working individually, for Divergers and Convergers is to be expected.

With independence between individuals and a group rejected, the remaining factor for consideration is the strength of influence that working in a group or as an individual might have on the popularity of a technique. Comparing the preferences of the two samples graphically suggests working in a group could have such an influence but establishing this would require further research.

H1. 7. For the Group, all members have the same Learning Style preference: a bias of preferences will exist in favour of working with peers who have the same learning style.

Due to mitigating circumstances and therefore no control group, no test for H1.7 was possible.

6.2 Summary of principal findings

The proven hypotheses H1.1, H1.2, H1.3, and H1.4, give validity to the general statement that an individual will show noticeable preference for creative problem-solving techniques that will be in accord with that individuals preferred cognitive styles.

When examining responses from individuals, the investigations found that using Honey & Mumford's composite learning styles model, although indicative in some cases, was inappropriate as it carries limitations. By contrast, using the Kolb's fundamental learning styles people were correctly assessed on the strength of what they can do and not the synthetic perception of what they cannot do. (Kolb, 1978; Honey & Mumford, 1995)

These findings led to the conclusion that the concept of Learning Styles would be better represented as a Learning Continuum with the general conclusion that:

- People who possess all the fundamental cognitive styles that define the composite style required by the technique will be highly likely to show favour for that technique.
- The degree of favour towards a technique appears to increase in proportion with both the number of, and the level of the fundamental styles the person has and those required by the technique.

The preference, in general, of individuals for creative problem-solving techniques that are in accord with that individuals preferred cognitive styles and the association between cognitive styles with phases in the problem solving cycle suggest:

- Cognitive styles as suitable parameters for tailoring techniques to the cognitive preferences of individuals.
- The problem solving phases associated with cognitive styles provide a suitable basis for a taxonomic structure for creative problem-solving techniques.

People who worked as a group all of whom have the equivalent learning style showed a greater level of preference than those who have the same learning styles but worked alone. Tests for independence between these data sets were not significant inferring similarity in behavioural preferences between people, working in a same-style group and working individually, for Divergers and Convergers is to be expected.

For a tailored approach, it was necessary to consider the level of acceptance of the people who are likely to use such an approach. Two overall observations are relevant:

- The decision-making sample of respondents' confidence in a cognitive style approach was quite positive, particularly when considering the possibility CPS could assist in finding proven solutions that exist outside the respondent's usual scope of interest.

- It was reassuring to see respondents when considering intangible features of a business improving skills was at the top of their agenda with people at top of their agenda when examining the tangible aspects of a business. With comments submitted by respondents recognising the importance of people's skills, natural abilities and roles they also showed agreement with the respondents who experienced the tailored approach in that it would help people when solving complex problems within innovation.

The result of this research has allowed creative problem-solving to, be seen in a new way. The perception that Creative problem-solving is a set of disconnected competing choices is now redundant. Creative problem solving can now be seen as one unified strategy with all attributes thereof contributing to solving a common problem.

With a more profound appreciation of what happens during the process and more sensitivity towards the people aspects of the process, better use and greater acceptance of the creative problem solving should unfold. Pidd described his phrase, 'crafting a strategy,' as detecting small changes that lead to big things thereby helping emergent patterns to take a desirable shape. The researcher believes that this thesis is the kernel of such a change. (Pidd 2003)

7 Discussion and recommendations

NESTA (2008) explained that the process of innovation is multi-dimensional, containing many actors for which Brown (1996) had a vision of a best-fit policy for innovation tools and techniques. This study has for the first time, examined in depth the feasibility and potential of making a strategy for creative problem solving by tailoring the techniques to the natural abilities of the user. Moreover, this study has highlighted the importance of having a better awareness of the abilities offered by the people who use the process.

This research has also highlighted a generally conservative perspective that creative problem-solving techniques, have for too long, been seen through the eyes of the problem owner and not the problem solver. This view, emphasising, 'the what' at the expense of, 'the how', has hindered creative problem solving for some time.

Having examined the difficulties met while problem solving, such as the human capabilities required together with the purpose and usefulness of the techniques; a tailored strategy for the creative problem-solving process, (once believed to be beyond the horizon), now looks realistic. Human activity systems, by their nature, carry a high burden of complexity. It is because of the complexity of such systems, coupled with the human tendency to adhere too strongly to a chosen paradigm that new perspectives have taken so long to evolve.

Brown (1996) explained that attention should focus on tailoring techniques to meet the needs of sectors or type of firm. The design and selection of techniques be subject to success factors appropriate to that firm. With this new meta-strategy, organisations should have the ability to satisfy the requirements of their problem solvers as well as the organisation's problems. Brown's 'best fit' recommendations for innovation were that techniques should be characterised to help assess that technique. Features considered by Brown included, the provision for action-planning, simplicity for data collection and presentation, flexibility to satisfy current needs, able to handle company background information, provide linkages between the diagnostic tools, methodologies and other implementation aids, have the provision for systematic follow-up, implementation and facilitate learning ensuring that it is retained.

It is the researcher's view that having the best-fit framework as part of the procedural furniture within any organisation should provide such a platform to employ people and techniques more appropriately with greater potential. It is also the researcher's view that replacing the understanding of the concept of Learning Styles as discrete entities with that of a Continuum of Learning Abilities with the general understanding that, people with all the fundamental styles that define the composite style required by the technique will be likely to show favour for that technique. Moreover, the degree of favour towards a technique appears to increase in proportion with both the number of, and the level of, the fundamental styles the person has and those required by the technique should provide an appropriate host for such a framework.

7.1 Implications

This study has shown for the first time that, cognitive styles overlap and in some cases share natural synergies, not only with the phases met during the creative problem-solving process, but also, at the conceptual level of exploring and creating different paradigms.

Furthermore, this researcher's evidence suggests that individual users of creative problem-solving techniques are likely to prefer techniques akin to their natural thinking styles. This researcher's evidence further suggests the likelihood that behaviours similar to those of individuals, should be expected from a group of like-styled individuals. The research evidence also appears to suggest the possibility that working in a group inflates this preference, as there was a noticeable difference between groups and individuals, in that, a working group of like-styled individuals showed a stronger preference than a set of individuals, who independently; all have the same learning style. This phenomenon also suggests that working as a group of like-styled individuals, improves task conflict and group cohesion.

The traditional model of creativity, being seen as a cyclic-phase-model on a two-dimensional plane, now has the new dimension of perception. This new three-dimensional model displays creativity as an holistic entity, as it brings together the earlier models based on learning style and phase with people's perceptive ability and paradigms. Seeing creativity from this perspective has opened up a better understanding of human creative capabilities and a greater awareness of the cognitive and social difficulties met by different people when working in the different phases of the problem-solving process. This also brings to the fore a possible reason why some people, particularly those employed in a decision-making role, show little faith in creativity.

Contrary to negative perceptions of creativity, this study has also shown that there exists a natural appetite for tackling problems. Evidence showed that, while a problem progresses through the problem-solving cycle, individuals whose styles were akin to the phase and one-step ahead of where the problem was in the cycle, showed greater preference than those whose styles were one-step behind the position of the problem in the cycle.

This phenomenon re-enforces the evidence of the synergy between learning style and phase. Better awareness and understanding of these phenomena do give rise to the opportunity of taxonomising the skills and techniques required to solve 'real world' problems.

Inference from this study indicates that a hard systems phase model, while useful for describing a process, is inappropriate when used to assess people's cognitive styles. Cognitive styles are a *continuum* containing peaks and troughs of competences, not discrete type casts. This project has aligned these peaks of cognitive competence with their appropriate problem-solving phase. It is the researcher's view that, cognitive styles do form a realistic and viable basis for taxonomising creative problem-solving techniques. A sample of techniques, assessed by reputable academics and authors, was taxonomised subject to, how ably they fulfilled phase requirements and encouraged paradigm shifts.

While sampling, the researcher encountered some very negative reactions to participation in research and more so towards creativity. Quite often, people appeared to show little awareness of creativity and its contribution to innovation coupled with a fear of something new and an over-reliance on memory with an inherent ignorance of their own creative ability and its potential. However, after explaining the concept of cognitive styles as being complementary to skills and their alignment to problem-solving phases, opinions and interest towards creativity became more positive. This opportunity also showed the potential value of this research. The respondents did this by declaring their level of faith in this new strategy, where they could see its application with the impact, they believed it will have on their business and industry.

7.2 Limitations

A question raised by this research is: will the dominant common style of a group of like-styled people extend and become the group's dominant style? In an attempt to answer this question on group-behaviour each style was assessed independently. Due to a general reluctance to participate, hence a small number of willing volunteers, the result was not statistically significant. However, comparing both group and individual behaviours gave evidence inferring that the common style of a group of like-styled people will extend to become the group's dominant style. For achieving statistical significance on independent styles, further work will be necessary.

The overall aim of this study has been to make creative problem solving more comfortable and easier, by tailoring the techniques to the user's abilities. Furthermore, the research has shown indications that people in industry believe that industry will benefit by adopting this strategy. The general population should understand and accept the importance of creativity and innovation. More importantly, people need to habitually, think creatively to discourage barriers that discourage innovation and the inherent cultural reluctance to be creative.

One might argue that, as a strategy, there is the potential drawback of only participating through part of the creative process. Initially, this issue might be perceived to be discriminatory by some people. However, with some guidance towards the policy that, every person does what they are good at to assist the next person to do what they are good at, then left in the hands of a competent facilitator, this problem should be minimal. Tactfully, this also has the potential of reducing the reluctance to innovate, as the experiences encountered when doing something that one is intrinsically good at, should be more acceptable and rewarding than those experienced when doing something which one is intrinsically uncomfortable.

7.3 Application and Use

Creative problem solving can be described as a phase-based process used to help people to be creative within a paradigm or stretch, and sometimes break, such a paradigm. Cognitive styles can be seen as a resource of learning styles that can, fully support distinct phase requirements, partially support phase requirements or contradict phase requirements of the problem-solving process. Cognitive styles can also be described as a resource of perceptive styles, the strengths of which help people to stretch or break paradigms.

Assigning cognitive strengths to the phase and paradigmatic task they serve best should optimise creative performance. By assigning people to tasks they do naturally, will also reinforce the conditions to maintain their intrinsic motivation. To achieve optimal assignment between cognitive styles and creative tasks the facilitator should provide the means to identify the cognitive styles of ideators. Where possible the facilitator should primarily assign those persons possessing all the cognitive strengths appropriate to the task. Then assign people from neighbouring styles who possess one of the required cognitive strengths. The assignment of cognitive strengths and perceptive bias to phases and techniques is summarised in tables 7.1 to 7.4.

.Table 7.1 Cognitive Resources for Phase One

	Personality Trait	Cognitive Strengths	Perceptive Bias	
			Receptive	Perceptive
Phase One	*Convergers*	*Active*	Keep & *Stretch* Paradigm Techniques	Stretch & Break Paradigm Techniques
	Accommodators	Active Pragmatic		
	Divergers	*Pragmatic*		

Table 7.1 illustrates that people posessing both active and pragmatic cognitive strengths (Accommodators) will be better suited to and feel more comfortable when working on phase one of the problem solving cycle.

Table 7.2 Cognitive Resources for Phase Two

	Personality Trait	Cognitive Strengths	Perceptive Bias	
			Receptive	Perceptive
Phase Two	*Accommodators*	*Pragmatic*	Keep & *Stretch* Paradigm Techniques	Stretch & Break Paradigm Techniques
	Divergers	Pragmatic Reflectors		
	Assimilators	*Reflective*		

Table 7.2 illustrates that people posessing both pragmatic and reflective cognitive strengths (Divergers) will be better suited to and feel more comfortable when working on phase one of the problem solving cycle.

Table 7.3 Cognitive Resources for Phase Three

	Personality Trait	Cognitive Strengths	Perceptive Bias	
			Receptive	Perceptive
Phase Three	*Divergers*	*Reflective*	Keep & *Stretch* Paradigm Techniques	Stretch & Break Paradigm Techniques
	Assimilators	Reflectors Theorists		
	Convergers	*Theorists*		

Table 7.3 illustrates that people posessing both reflective and theoretic cognitive strengths (Assimilators) will be better suited to and feel more comfortable when working on phase one of the problem solving cycle.

Table 7.4 Cognitive Resources for Phase Four

	Personality Trait	Cognitive Strengths	Perceptive Bias	
			Receptive	Perceptive
Phase Four	*Assimilators*			
		Theorists	Keep & *Stretch* Paradigm Techniques	Stretch & Break Paradigm Techniques
	Convergers	Theoretic		
		Active		
	Accommodators	*Active*		

Table 7.4 illustrates that people posessing both theoretic and active cognitive strengths (Convergers) will be more better suited to and feel more comfortable when working on phase one of the problem solving cycle.

In all cases, Tables 7.1 to 7.4, people posessing a receptive bias will be better suited to and feel more comfortable when using paradigm keeping techniques but may experience some unrest when using paradigm stretching techniques. People posessing a strong perceptive bias will be better suited to and feel more comfortable with paradigm stretching techniques and paradigm breaking techniques.

Also in all phases, people whose primary cognitive strengths partially overlap those required for each phase can also be involved with and use the techniques for that phase but may experience some unrest. However, such involvement does have the advantage of preparing such people for their role as primary contributors to their appropriate phase in the problem solving cycle.

This assignment strategy is applicable to both individual and group scenarios.

Using techniques designed for the individual does offer greater flexibility as ideators do not have to be physically present at the same venue at the same time. The facilitator has more freedom and stronger resources to explore and solve the problem and with full knowledge of the ideator's cognitive preferences, there is less risk of de-motivating them.
Using techniques designed for groups gives the facilitator the ability to assign a group of group of people possessing equivalent cognitive styles to the same creative task, an ability previously left to chance.

People whose cognitive styles may not align with the creative task of a particular phase could be assigned the non-creative role of being the scribe for that phase. Perhaps become involved in the decision-making at the end of the phase. This situation maintains involvement for all and is in constant flux as the facilitator and ideators traverse the problem solving phases. Forcing to facilitator to re-group the ideators for each phase has the bonus of preventing unwanted group-think.

7.4 Further Research

Having taxonomised creative problem-solving techniques and the skills needed, the imperative emerges for better management of creative projects. Many companies now have the opportunity to address their reluctance to be creative, by management training and adopting this strategy as a standard company procedure.

Given that this approach is adopted and embedded into company procedures, it should go some way to removing the fear that creativity often meets by making it appear more culturally acceptable. It would be interesting to follow up the influences and effectiveness that such a strategy might have within industry as well as the obstacles it encounters.

This study also opens the opportunity for more profound investigations into creative problem-solving tools and practices. These include further examination of techniques and their factors in order to optimise how they can be tailored. In particular several areas of further research can be identified.

First, while this research has focused on learning styles in a cognitive context, educationalists also use this term in a communicative context. These styles refer to the user's preferred input and output. Some people prefer words, some pictures; some prefer sound and some action. If data are not in a form comfortable to the user, then this could be a further barrier to creativity as it presents the possible weakness that, while a problem solving technique could be apt to their cognitive ability, it might not be in complete synergy with their communicative needs. Focusing on a communication methodology is a fruitful field for research.

Second, research to improve the tailoring of the techniques should be done and also to explore any underlying relationships between these communicative styles and cognitive styles. This could lead to the possibility of fragmenting and reconstructing techniques thereby making them more bespoke to the needs of any user in any situation.

Third, an innovation strategy called TRIZ examines the possible alternatives one has in a particular situation. Giving a scope of freedom and suitable manoeuvers to resolve the problem to hand, it is the researcher's view that combining TRIZ's ability to appraise situations and select fitting opportunities with this new strategy's ability to select and use appropriate skills, and techniques would yield positive results.

Fourth, operational research methods could be developed to make use of the better information available from this research. Better understanding of the capabilities of people and techniques would allow optimisation of this type of people-task-problem assignment.

Finally, the ability of companies to employ their staff as a creative resource comes to the fore. By removing the necessity to participate in all stages, this has the valuable potential of using computer networks thereby making this new strategy virtual. People need only contribute to particular phases without the need to be physically present in a fixed location.

Taken together such further research might go some way to overcome barriers to innovation, improve creative performance and encourage a creative workplace ethic.

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Appendices

Appendices

Appendix 1

The Workbook

Personal Profile

Please describe your in order of preference

1 = First or most prefered, 2 = second, 3 = third and 4 = forth or least prefered

Example

When I relax I prefer to…	Watch films	Go fishing	Do gardening	Listen to music
	4	**1**	**2**	**3**

When I learn	I'm open to new experiences	I look at all sides of issues	I like to analyse things and break them into their parts	I like to try things out
I like to Change routines to improve how things are done	Usually	Never	Occasionally	Always
I like to… be where the role I play is a traditional one	Usually	Occasionally	Always	Never
I learn best when I …	Listen and watch carefully	Rely on logical thinking	Trust my hunches and feelings	Work hard to get things done
When I learn	I like to see results from my work	I like ideas and theories	I take my time before acting	I feel personally involvedin things
When I learn	I get involved	I like to observe	I evaluate things	I like to be active
When I'm learning	I am an observing person	I am an active person	I am an intuitive person	I am a logical person

When I'm involved with projects I prefer to try new strategies or methods	Never	Occasionally	Always	Usually
I like to Do things in new ways not done by other people	Occasionally	Never	Usually	Always
I like to Follow methods used in the past	Usually	Occasionally	Always	Never
I like to do things In ways that have been done in the past	Always	Usually	Occasionally	Never
When I am learning...	I tend to reason things out	I am responsible about things	I am quiet and reserved	I have strong feelings and reactions
When I'm involved with projects I prefer to solve things in a traditional way	Always	Never	Usually	Occasionally
I learn best from	Observation	Personal relationships	Rational theories	A chance to try out and practice
I like to... stick to standard rules or ways of doing things	Always	Usually	Occasionally	Never

When I'm involved with projects I prefer to methods and ideas used in the past	Always	Occasionally	Usually	Never
When I learn I like to …	deal with my feelings	think about ideas	be doing things	watch and listen
When I'm learning	I am a reserved person	I am an accepting person	I am a responsible person	I am a rational person
When I'm involved with projects I prefer novel waysof doing things	Occasionally	Always	Usually	Never
I learn best when	I analyse ideas	I am receptive and open minded	I am careful	I am practical
I learn best when	I rely on my observations	I rely on my feelings	I can try things out for myself	I rely on my ideas
I like to…find old problems then find ways of solving them	Always	Occasionally	Usually	Never
I like to… callenge old ideas or ways of doing things and seek new and better ways	Always	Never	Occasionally	Usually

Your views on Creating New Ideas and Solving Problems

Reflecting on your personal involvement with problem solving in the work place, how well do you belive the processes available encourage you to...	***1= little*** ***5=Always***
Adopt existing solutions currently available within your speciality	1 : 2 : 3 : 4 : 5
Look for solutions beyond your speciality but currently available within your industry	1 : 2 : 3 : 4 : 5
Look for solutions to similar situations found outside your speciality and industry	1 : 2 : 3 : 4 : 5
Consider the possibility that ready made solutions may not yet exist within industry but could be with the help of scientists and alike	1 : 2 : 3 : 4 : 5
Consider the possibility that you could discover a completely new solution not considered yet	1 : 2 : 3 : 4 : 5

Reflecting on those in your industry/profession overall, how well do you belive the processes available encouraged ...	***1= never*** ***5=Always***
Adoption of existing solutions currently available within your speciality	1 : 2 : 3 : 4 : 5
Looking for solutions beyond a speciality but currently available within the same industry	1 : 2 : 3 : 4 : 5
Looking for solutions to similar situations found outside the same speciality and industry	1 : 2 : 3 : 4 : 5
Consideration that the possibility of ready made solutions may not yet exist within industry but could be with the help of scientists and alike	1 : 2 : 3 : 4 : 5
Awareness that a completely new solution not considered yet is about to unfold	1 : 2 : 3 : 4 : 5

From the fist below ...

Please Select a Role and an associated Problem

- **Your role is a manufacturer OR retailer of household devices.**
    - There is change and competition in the marketplace

- **Your role is a councillor serving your community.**
    - It is eighteen months to election time and your party needs to show the electorate it is worthy of re-lection by resolving some high profile community issues.

- **Your role is a Head Teacher OR Chair of a School Governing Body serving your community.**
    - It is eighteen months to inspection time and your school needs to impress The Inspectors by resolving some high profile educational issues.

- **Your role is a bicycle manufacturer OR retailer**
    - With greater social awareness of climate , environmental , energy issues and alike, there is a sence of confusion and unrest in the public at large. This *unrest* and the searching for alternatives, is seen as a business opportunity for you to make "Cycling seen to be cool".

- **Your role is a charity organiser.**
    - The community seems to be showing little or no interest in the purpose of your charity. In order maintain the charity greater awareness and community willingness is necessary

Each techniques provided should take approx. 30 – 40 min.
The techniques privided will assist in:-

- Identifying an item to work on
- Identifying what changes and improvements you believe need to be addressed
- Identifying possible ways and means to achieve such improvements
- Present changes in terms of maximum payoff and feasibility

After your design you will be asked to assess the techniques used.

Phase 1 A

Force Field Analysis

1. In the box below, briefly describe the initial problem you selected.

Phase 1 **Problem**	

2. What, in your mind, would you describe as the ***best case*** and ***worst case*** outcomes

   ⇒ **Best outcome**

   ⇒ **Worst outcome**

3. As a consequence ...what would the situation be like if a worst case catastrophe were to occur.

4. Also as a consequence ...what would the situation be like if the best situation were to occur.

Problem *(copy problem here)*	
Best Case *(copy best case here)*	*(copy worst case here)* **Worst Case**
What could help force the best outcome?	***What could help force the worst outcome?***

Continued…	
What could help force the best outcome?	What could help force the worst outcome?

Select from Your list of suggestions… Copy below the one which you feel has most impact	
Solution 1A	

Assess Phase 1 A

To what degree did this techniques help you... *1= little*									*5=lots*
Exert your imagination	1	:	2	:	3	:	4	:	5
Draw on your feelings and intuition	1	:	2	:	3	:	4	:	5
Encourage the free flow of ideas	1	:	2	:	3	:	4	:	5
Get to the *heart of the problem*	1	:	2	:	3	:	4	:	5
See the situation from many angles	1	:	2	:	3	:	4	:	5

To what degree do you believe this technique helped you... *1= little*									*5=lots*
Change intuition into fact	1	:	2	:	3	:	4	:	5
Changed ideas from vague to lucid	1	:	2	:	3	:	4	:	5
Confirm suspicions	1	:	2	:	3	:	4	:	5
Make beliefs more plausible	1	:	2	:	3	:	4	:	5

Did the technique help you... *1= little*									*5=lots*
Show the fact a problem actually exists rather than merely a belief	1	:	2	:	3	:	4	:	5
Help lend support to confirm beliefs	1	:	2	:	3	:	4	:	5
Idenfy root causes	1	:	2	:	3	:	4	:	5
Clarify extent of causes	1	:	2	:	3	:	4	:	5
Make obvious the role of the causes	1	:	2	:	3	:	4	:	5

To what degree did the techniques help you... *1= little*									*5=lots*
Focus on reasons that formed problems	1	:	2	:	3	:	4	:	5
Add weight to the importance of the underlying issues	1	:	2	:	3	:	4	:	5
Identify the underlying issues that helped form the problems	1	:	2	:	3	:	4	:	5
Identify any other issues that had any bearing on the problems to hand	1	:	2	:	3	:	4	:	5

How would you best describe your experience with this techniques *1= little* *5=lots*									
Didnt really work for me	1	:	2	:	3	:	4	:	5
Found it a bit taxing	1	:	2	:	3	:	4	:	5
Helped encourage similar alternatives	1	:	2	:	3	:	4	:	5
Stretch my imagination	1	:	2	:	3	:	4	:	5
Encouraged some really obscure ideas	1	:	2	:	3	:	4	:	5

Looking at your ideas would you say they were *1= little* *5=lots*									
Very minor changes	1	:	2	:	3	:	4	:	5
Slight changes	1	:	2	:	3	:	4	:	5
Adapt ideas seen elsewhere	1	:	2	:	3	:	4	:	5
Adopt new ways not seen before	1	:	2	:	3	:	4	:	5
Discover totally new radical ideas never seen	1	:	2	:	3	:	4	:	5

If there is any particular aspects about this technique you liked or disliked please explain...

Thankyou

Please take a short break before the next phase

Phase 1 B

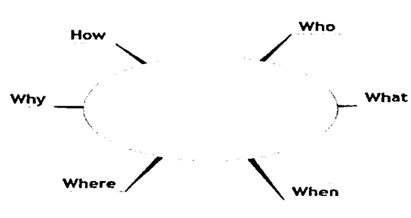
A Spiders Map

Copy the ***initial*** role & problem you selected into the box below.

Phase 1 **Problem**	

The Solution Spider Map

Turn the page lengthways and follow the instructions provided. You should end up with a map resembling the following with your ideas added to it.



It is advisable to tick each instruction as you complete it.

The Problem Spider Map
<u>Start Here</u>

⇒ *Explain very <u>briefly…</u>* in the oval shape on the next page … *the problem as you see it*

⇒ Now, on each of the legs, using *2 to 3 words* put a very brief description of what ***you think*** are the key <u>**factors**</u> that helped cause the main problem.

⇒ Now look at each **factor** in turn and ask yourself, "What is it that helped make or cause **this factor**?"

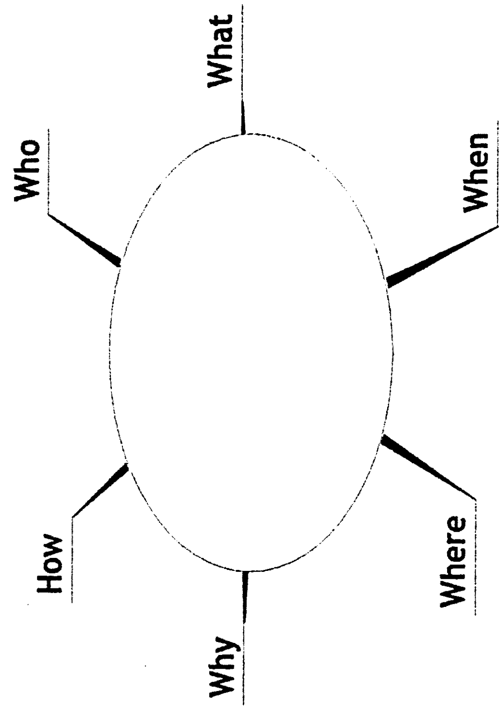
⇒ Write any ideas on correspinding sub-legs

⇒ When you have dealt with all **factors** and **sub-factors** *Pause for a moment…*

⇒ Now, observing the <u>**whole diagram in its entirety**</u> look for items that you feel could in some way have some bearing or relationship with each other.

⇒ Draw lines to connect such items.

Complete


What
Who
When
How
Where
Why

The Solution Spider Map
Start Here

⇒ *Explain very briefly…* in the oval shape on the next page … *the solution as **you** see it*

⇒ Now, on each of the legs, using *2 to 3 words* put a very brief description of what ***you think*** are the key **fixing factors** that will resolve the main problem and deliver **your** solution.

⇒ Now look at each **fixing factor** in turn and ask yourself, "What is it that needs to be done or put in place to enable **this fixing factor**?"

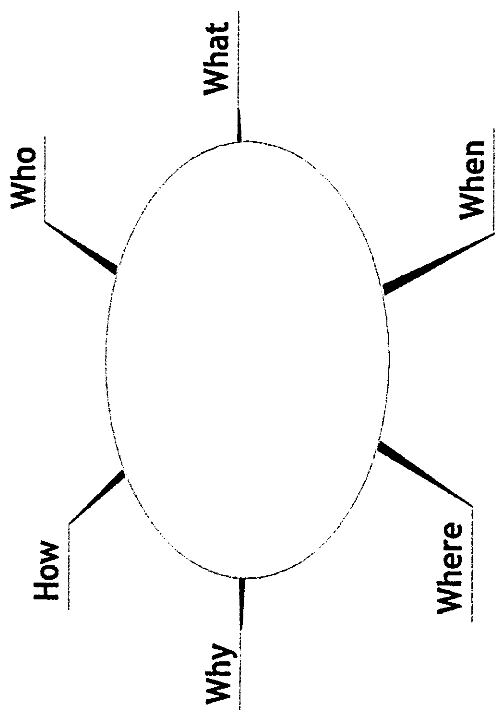
⇒ Write any ideas on correspinding sub-legs

⇒ When you have dealt with all the **fixing factors** and their sub-factors … *Pause for a moment…*

⇒ Now, observing the **whole diagram in its entirety** look for items that you feel could in some way have some bearing or relationship with each other.

⇒ Draw lines to connect such items.

Complete



Looking at your Maps …

In *your own words* how would *you* describe the **problem** illustrated on your map.

In *your own words* how would *you* describe *your* **solution** illustrated on your solution map.

Describe any views and feelings of any people you have included on your maps

1. ***Problem Map***

2. ***Solution Map***

Can you see any ***relationships*** between any of the items on your maps? Is so, briefly describe them:-.

3. ***Problem Map***

4. ***Solution Map***

From both the maps and descriptions...

Describe any new ideas that come to mind?

From Your list of suggestions and ideas… Copy below the one which you feel has most impact	
Solution *1 B*	

Assess Phase 1 B

To what degree did techniques help you ... *1= little*									*5=lots*
Exert your imagination	1	:	2	:	3	:	4	:	5
Draw on your feelings and intuition	1	:	2	:	3	:	4	:	5
Encourage the free flow of ideas	1	:	2	:	3	:	4	:	5
Get to the *heart of the problem*	1	:	2	:	3	:	4	:	5
See the situation from many angles	1	:	2	:	3	:	4	:	5

To what degree do you believe the technique helped you *1= little*									*5=lots*
Change intuition into fact	1	:	2	:	3	:	4	:	5
Changed ideas from vague to lucid	1	:	2	:	3	:	4	:	5
Confirm suspicions	1	:	2	:	3	:	4	:	5
Make beliefs more plausible	1	:	2	:	3	:	4	:	5

Did the technique help you... *1= little*									*5=lots*
Show the fact a problem actually exists rather than merely a belief	1	:	2	:	3	:	4	:	5
Help lend support to confirm beliefs	1	:	2	:	3	:	4	:	5
Idenfy root causes	1	:	2	:	3	:	4	:	5
Clarify extent of causes	1	:	2	:	3	:	4	:	5
Make obvious the role of the causes	1	:	2	:	3	:	4	:	5

To what degree did the technique help you... *1= little*									*5=lots*
Focus on reasons that formed problems	1	:	2	:	3	:	4	:	5
Add weight to the importance of the underlying issues	1	:	2	:	3	:	4	:	5
Identify the underlying issues that helped form the problems	1	:	2	:	3	:	4	:	5
Identify any other issues that had any bearing on the problems to hand	1	:	2	:	3	:	4	:	5

How would you best describe your experience with the technique									
	1= little								*5=lots*
Didnt really work for me	1	:	2	:	3	:	4	:	5
Found it a bit taxing	1	:	2	:	3	:	4	:	5
Helped encourage similar alternatives	1	:	2	:	3	:	4	:	5
Stretch my imagination	1	:	2	:	3	:	4	:	5
Encouraged some really obscure ideas	1	:	2	:	3	:	4	:	5

Looking at your ideas would you say they were									
	1= little								*5=lots*
Very minor changes	1	:	2	:	3	:	4	:	5
Slight changes	1	:	2	:	3	:	4	:	5
Adapt ideas seen elsewhere	1	:	2	:	3	:	4	:	5
Adopt new ways not seen before	1	:	2	:	3	:	4	:	5
Discover totally new radical ideas never seen	1	:	2	:	3	:	4	:	5

If there is any particular aspects about this technique you liked or disliked please explain...

Thankyou

Please take a short break before the next phase

Phase 2 A

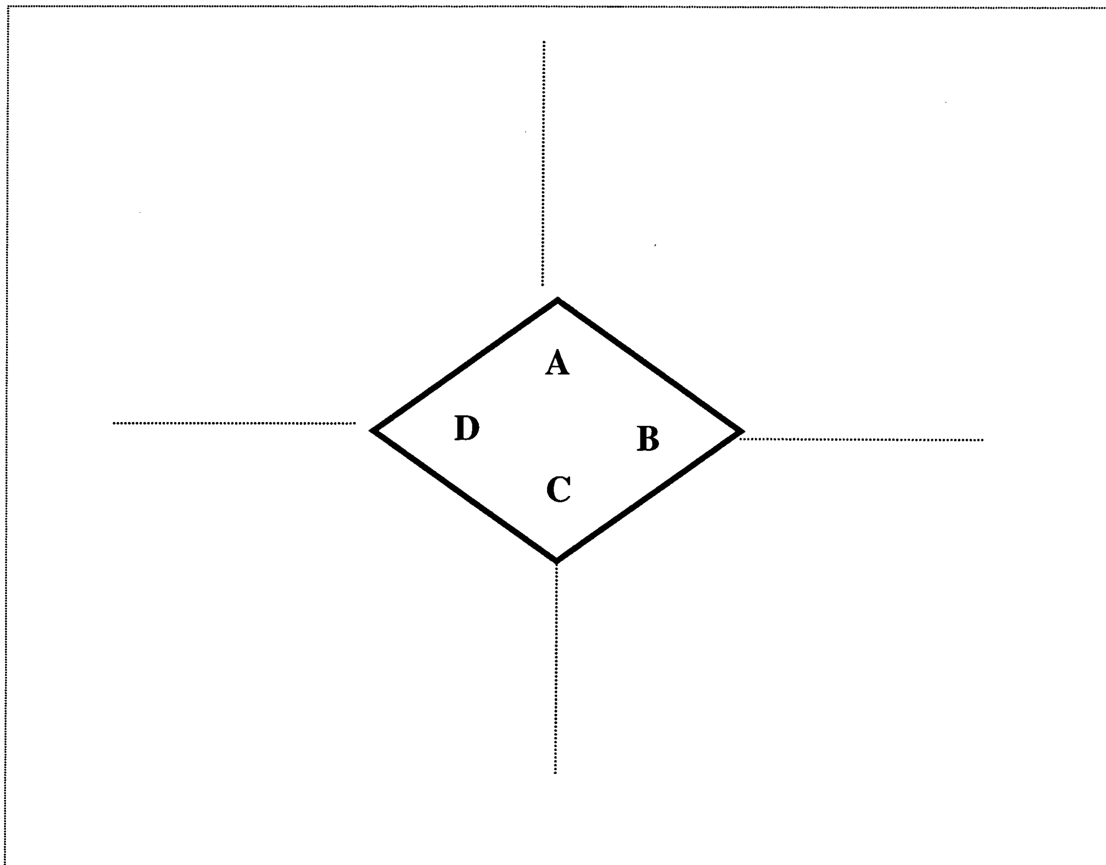
Word Diamond

Copy Solution 1A and Solution 1B… into the boxes below

Solution 1a here
Solution 1b here

Choose four Key words or phrases from the **above boxes.**

Place these words on the diamond shape so that each word or phrase lies at one of the lines at the corner points.



Refering to example… choose two words at a time then by combining them together use them to generate new views & ideas.
Write all your ideas.

AB=

BC=

AC=

BD=

AD=

CD=

Now using two words, which were initially selected, combine with a third word and write them on the dotted line.
Now use all three to develop more ideas.

ABC= ....

ACD= ....

BCD= ....

Select from Your list of suggestions… Copy below the one which you feel has most impact	
Solution 2 A	

Assess Phase 2 A

How did the technique help you … *1= little* *5=lots*									
Handle mass information	1	:	2	:	3	:	4	:	5
Get things into clear more logical form	1	:	2	:	3	:	4	:	5
Think more in concepts and less in facts	1	:	2	:	3	:	4	:	5
Think more logically	1	:	2	:	3	:	4	:	5
Handle mass information	1	:	2	:	3	:	4	:	5

How much did the technique help encourage you to ... *1= little* *5=lots*									
Keep open minced and less presumptuous	1	:	2	:	3	:	4	:	5
Focus on the future rather than the here and now	1	:	2	:	3	:	4	:	5
Keep a dynamic view of things	1	:	2	:	3	:	4	:	5
Make room for possible clanges	1	:	2	:	3	:	4	:	5

How much did the technique help encourage you to ... *1= little* *5=lots*									
Spot useful alternatives	1	:	2	:	3	:	4	:	5
List many options	1	:	2	:	3	:	4	:	5

How much did the technique help encourage you to use... *1= little* *5=lots*									
intuition	1	:	2	:	3	:	4	:	5
logic	1	:	2	:	3	:	4	:	5
more free thinking	1	:	2	:	3	:	4	:	5

On reflection, having used the technique, which of the following best describes your assessment of your ideas?.... *please select only one*	
Few Focused ideas	
Many Focussed ideas	
Few Broad ranging ideas	
Many Broad ranging ideas	

How would you best describe your experience with the technique									
	1= little								***5=lots***
Didnt really work for me	1	:	2	:	3	:	4	:	5
Found it a bit taxing	1	:	2	:	3	:	4	:	5
Helped encourage similar alternatives	1	:	2	:	3	:	4	:	5
Stretch my imagination	1	:	2	:	3	:	4	:	5
Encouraged some really obscure ideas	1	:	2	:	3	:	4	:	5

Looking at your ideas would you say they were									
	1= little								***5=lots***
Very minor changes	1	:	2	:	3	:	4	:	5
Slight changes	1	:	2	:	3	:	4	:	5
Adapt ideas seen elsewhere	1	:	2	:	3	:	4	:	5
Adopt new ways not seen before	1	:	2	:	3	:	4	:	5
Discover totally new radical ideas never seen	1	:	2	:	3	:	4	:	5

If there is any particular aspects about this technique you liked or disliked please explain...

Thankyou

Please take a short break before the next phase

Phase 2 B

Wishful Thinking
EVERYTHING is possible!

From ***Phase 2a*** , copy the statement of the problem.

Phase 2 **Problem**	

Now assume that ***everything is possible*** ...

Using terms such as:

- In the future, it would be nice if the organisation did....
- What really needs to happen to be a great company is....
- If I were in charge of this situation I would do....

Develop some fantasy statements about the future

Remember, *everything is possible*

Examine each fantasy statement
Develop ideas on *how each one can be achieved.*

Now looking at your fantasy ideas…
Using phrases such as:

- *Although this is difficult to achieve, we can....*
- *It might be possible to do that if we....*

try to link the achievements just described with the present problem situation.

From Your list of suggestions in phase 2B… Copy below the one which <u>you feel</u> has most impact	
Solution *2 B*	

Assess Phase 2 B

How did the technique help you ... *1= little*									*5=lots*
Handle mass information	1	:	2	:	3	:	4	:	5
Get things into clear more logical form	1	:	2	:	3	:	4	:	5
Think more in concepts and less in facts	1	:	2	:	3	:	4	:	5
Think more logically	1	:	2	:	3	:	4	:	5
Handle mass information	1	:	2	:	3	:	4	:	5

How much did the technique help encourage you to ... *1= little*									*5=lots*
Keep open minced and less presumptuous	1	:	2	:	3	:	4	:	5
Focus on the future rather than the here and now	1	:	2	:	3	:	4	:	5
Keep a dynamic view of things	1	:	2	:	3	:	4	:	5
Make room for possible clanges	1	:	2	:	3	:	4	:	5

How much did the technique help encourage you to ... *1= little*									*5=lots*
Spot useful alternatives	1	:	2	:	3	:	4	:	5
List many options	1	:	2	:	3	:	4	:	5

How much did the technique help encourage you to use... *1= little*									*5=lots*
intuition	1	:	2	:	3	:	4	:	5
logic	1	:	2	:	3	:	4	:	5
more free thinking	1	:	2	:	3	:	4	:	5

On reflection, having used the technique, which of the following best describes your assessment of your ideas?.... *please select only one*	
Few Focused ideas	
Many Focussed ideas	
Few Broad ranging ideas	
Many Broad ranging ideas	

How would you best describe your experience with the technique *1= little* *5=lots*									
Didnt really work for me	1	:	2	:	3	:	4	:	5
Found it a bit taxing	1	:	2	:	3	:	4	:	5
Helped encourage similar alternatives	1	:	2	:	3	:	4	:	5
Stretch my imagination	1	:	2	:	3	:	4	:	5
Encouraged some really obscure ideas	1	:	2	:	3	:	4	:	5

Looking at your ideas would you say they were *1= little* *5=lots*									
Very minor changes	1	:	2	:	3	:	4	:	5
Slight changes	1	:	2	:	3	:	4	:	5
Adapt ideas seen elsewhere	1	:	2	:	3	:	4	:	5
Adopt new ways not seen before	1	:	2	:	3	:	4	:	5
Discover totally new radical ideas never seen	1	:	2	:	3	:	4	:	5

If there is any particular aspects about this technique you liked or disliked please explain...

Thankyou

Please take a short break before the next phase

Phase 3 A

Copy Solution 2A and Solution 2B… into the boxes below

Solution 2a here
Solution2b here

By comparing or combining **the above boxes …**what do you feel should now be persued.

What I feel should be persued is…

⇒ Express *Your thoughts* regarding the problem you have just defined

⇒What do you feel should be accomplished (Needs)?

⇒What could stop you from meeting these goals (Obstacles)?

⇒What restrictions must you consent to in order to solve the problem (Constraints)?

Now using the information you have just created…
Redefine what you ***felt should be persued …***

Select from Your suggestions … Copy below what <u>you feel</u> should now be aimed for	
Solution 3 A	

Assess Phase 3 A

To what level do you believe the technique help you to make solutions that will... *1= little* *5=lots*									
Gain interest from other parties who the solution may affect	1	:	2	:	3	:	4	:	5
Raise enthusiasm on reaching goals	1	:	2	:	3	:	4	:	5
Focus determination on reaching goals	1	:	2	:	3	:	4	:	5

While using the technique ...
did you prefer the level of focussing on one solution at a time or would you have prefered to take a broader view of things such as many solutions at a time

Focus								*Broad*
1	:	2	:	3	:	4	:	5

Assuming this exercise was for real and part of your job...
What level of interest and support do you believe you would receive from your employer to implement the solutions

Little								*Lots*
1	:	2	:	3	:	4	:	5

How well did the technique help you to ... *1= little* *5=lots*									
Evaluate alternatives	1	:	2	:	3	:	4	:	5
Work systematically	1	:	2	:	3	:	4	:	5
Use criterea determined earlier	1	:	2	:	3	:	4	:	5
Adopt new criterea	1	:	2	:	3	:	4	:	5

To what level do you believe the technique helped you to ... *1= little* *5=lots*									
Explore the potential outcomes of each solutions	1	:	2	:	3	:	4	:	5
Generate alternative solutions	1	:	2	:	3	:	4	:	5
- overall how **feasible** do you believe the solutions were	1	:	2	:	3	:	4	:	5

How realistic and specific were your goals and deadlines *1= little* *5=lots*									
Realistic	1	:	2	:	3	:	4	:	5
Specific	1	:	2	:	3	:	4	:	5

How would you best describe your experience with the technique *1= little*									*5=lots*
Didnt really work for me	1	:	2	:	3	:	4	:	5
Found it a bit taxing	1	:	2	:	3	:	4	:	5
Helped encourage similar alternatives	1	:	2	:	3	:	4	:	5
Stretch my imagination	1	:	2	:	3	:	4	:	5
Encouraged some really obscure ideas	1	:	2	:	3	:	4	:	5

Looking at your ideas would you say they were *1=few*									*5=many*
Very minor changes	1	:	2	:	3	:	4	:	5
Slight changes	1	:	2	:	3	:	4	:	5
Adapt ideas seen elsewhere	1	:	2	:	3	:	4	:	5
Adopt new ways not seen before	1	:	2	:	3	:	4	:	5
Discover totally new radical ideas never seen	1	:	2	:	3	:	4	:	5

If there is any particular aspects about this technique you liked or disliked please explain...

Thankyou

Please take a short break before the next phase

Phase 3 B

Copy Solution 2A and Solution 2B… into the boxes below

Solution 2a here
Solution2b here

By comparing or combining **the above boxes …**<u>what</u> do you feel should now be persued.

What I feel should be persued is…

Now make a list of likely alternative solutions to the problem ...

Now make quick list of criteria you would use to judge these solutions *(these may include resources, training issues, funding, time etc.).*

Now look at each criteria in turn make a short list of what you see as good and bad aspects of each one

Criterion ……………………………..

Good Aspect……………………Bad aspect…………………
Good Aspect……………………Bad aspect…………………

Criterion ……………………………..

Good Aspect……………………Bad aspect…………………
Good Aspect……………………Bad aspect…………………

Criterion ……………………………..

Good Aspect……………………Bad aspect…………………
Good Aspect……………………Bad aspect…………………

Criterion ……………………………..

Good Aspect……………………Bad aspect…………………
Good Aspect……………………Bad aspect…………………

Criterion ……………………………..

Good Aspect……………………Bad aspect…………………
Good Aspect……………………Bad aspect…………………

Copy to the spaces provided

- the ***problem statement*** in the box provided
- the list of ***criteria*** *(A – H)* across the top row of the table.
- the list of ***potential solutions*** *(1 – 7)* to the column

1. Now, examining each alternative ***potential solutions*** in turn…

   Column by column, examine each potential solution against each criterion and its aspects just listed … Place a **+** sign for each positive aspect and **–** sign for each negative aspects you feel each alternative may have

2. Finally, from your analysis of the ***aspects*** of the ***potential solutions*** and ***criteria…***

3. List **the most positive aspects, or best of the best aspects,** from the alternatives in the bottom row.

4. From these …try to describe/develop an ***ideal solution*** that will incorporate as many of the **best of the best aspects** as possible to describe your **Ideal Solution**?

Problem Statement

Criteria / Potential Solutions	A	B	C	D	E
1					
2					
3					
4					
5					
6					
7					
ideal Solution?					

Assess Phase 3 B

To what level do you believe the technique help you to make solutions that will... *1= little* *5=lots*									
Gain interest from other parties who the solution may affect	1	:	2	:	3	:	4	:	5
Raise enthusiasm on reaching goals	1	:	2	:	3	:	4	:	5
Focus determination on reaching goals	1	:	2	:	3	:	4	:	5

While using the technique ... did you prefer the level of focussing on one solution at a time or would you have prefered to take a broader view of things such as many solutions at a time								
Focus								***Broad***
1	:	2	:	3	:	4	:	5

Assuming this exercise was for real and part of your job... What level of interest and support do you believe you would receive from your employer to implement the solutions								
Little								***Lots***
1	:	2	:	3	:	4	:	5

How well did the technique help you to ... *1= little* *5=lots*									
Evaluate alternatives	1	:	2	:	3	:	4	:	5
Work systematically	1	:	2	:	3	:	4	:	5
Use criterea determined earlier	1	:	2	:	3	:	4	:	5
Adopt new criterea	1	:	2	:	3	:	4	:	5

To what level do you believe the technique helped you to ... *1= little* *5=lots*									
Explore the potential outcomes of each solutions	1	:	2	:	3	:	4	:	5
Generate alternative solutions	1	:	2	:	3	:	4	:	5
- overall how **feasible** do you believe the solutions were	1	:	2	:	3	:	4	:	5

How realistic and specific were your goals and deadlines *1= little* *5=lots*									
Realistic	1	:	2	:	3	:	4	:	5
Specific	1	:	2	:	3	:	4	:	5

How would you best describe your experience with the technique *1= little*									*5=lots*
Didnt really work for me	1	:	2	:	3	:	4	:	5
Found it a bit taxing	1	:	2	:	3	:	4	:	5
Helped encourage similar alternatives	1	:	2	:	3	:	4	:	5
Stretch my imagination	1	:	2	:	3	:	4	:	5
Encouraged some really obscure ideas	1	:	2	:	3	:	4	:	5

Looking at your ideas would you say they were *1=few*									*5=many*
Very minor changes	1	:	2	:	3	:	4	:	5
Slight changes	1	:	2	:	3	:	4	:	5
Adapt ideas seen elsewhere	1	:	2	:	3	:	4	:	5
Adopt new ways not seen before	1	:	2	:	3	:	4	:	5
Discover totally new radical ideas never seen	1	:	2	:	3	:	4	:	5

If there is any particular aspects about this technique you liked or disliked please explain...

Assess Perception

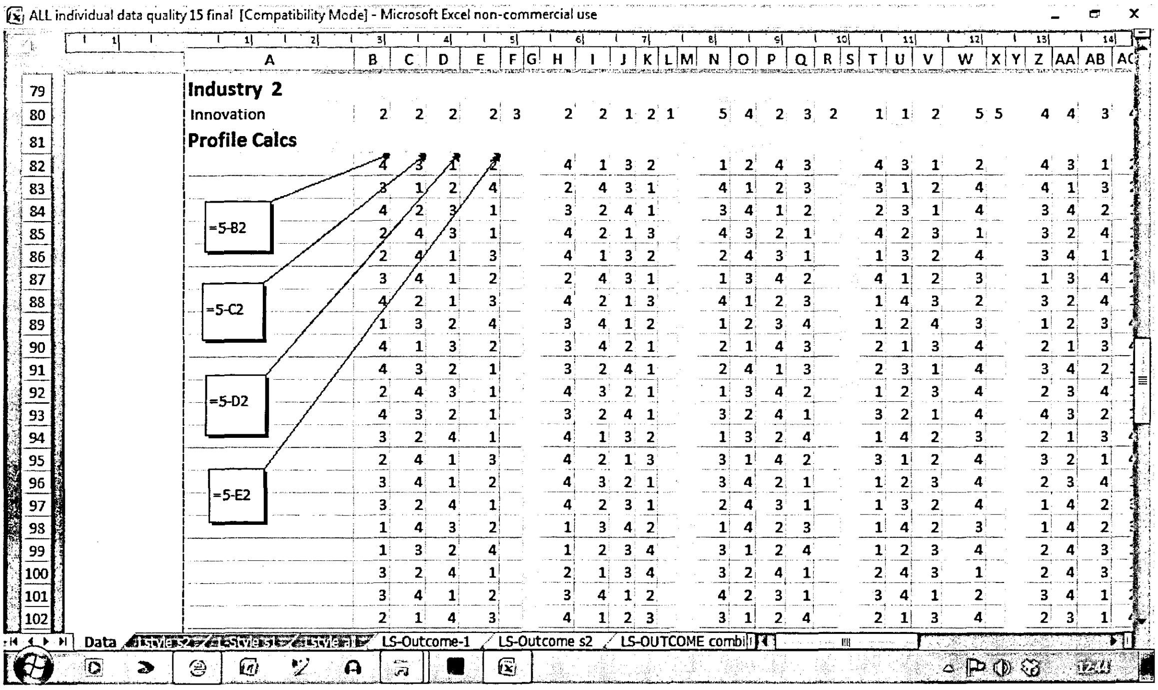
Reflecting on your experience with these exercises, how well do you think the process encourage you to...									
	1= little								***5=lots***
Identify existing solutions currently available within your speciality	1	:	2	:	3	:	4	:	5
Look for solutions beyond your speciality but currently available within your industry	1	:	2	:	3	:	4	:	5
Look for solutions to similar situations found outside your speciality and industry	1	:	2	:	3	:	4	:	5
Consider the possibility that ready made solutions may not yet exist within industry but could be with the help of scientists and alike	1	:	2	:	3	:	4	:	5
Consider the possibility that you could discover a completely new solution not considered yet	1	:	2	:	3	:	4	:	5

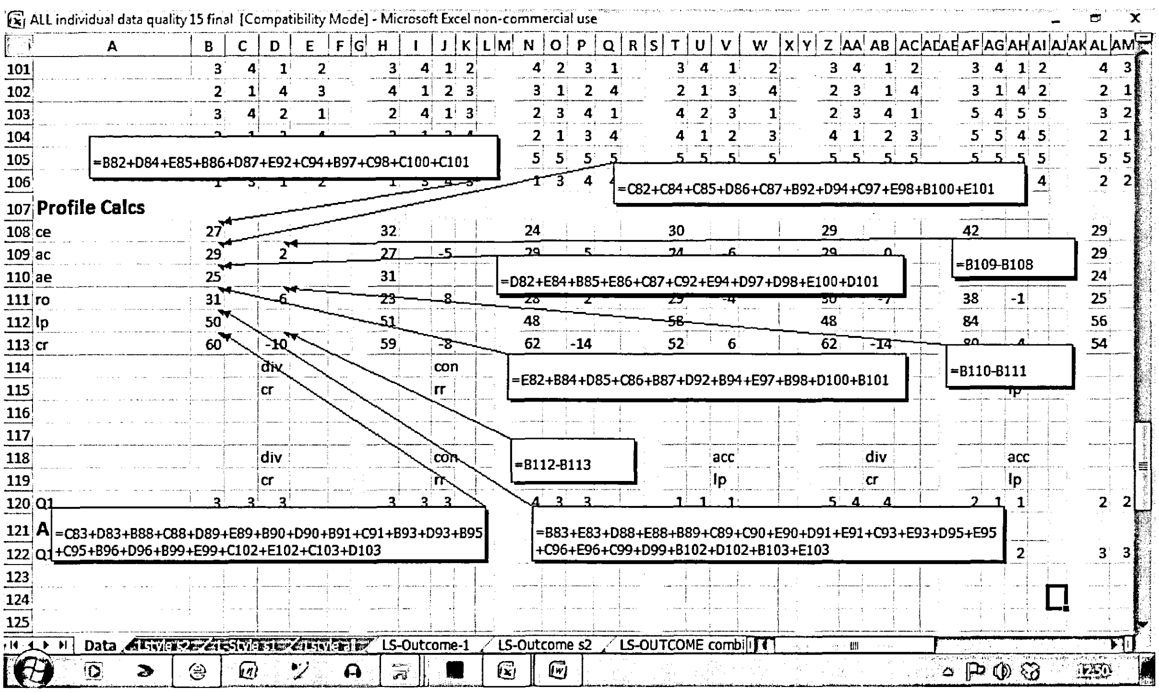
Reflecting on your work experience overall, **If the process explored in this book, or something very similar, were to be adopted within your industry or profession...** **how well do you think such processes would could encourage...**									
	1= little								***5=lots***
Identification of existing solutions currently available within your speciality	1	:	2	:	3	:	4	:	5
Looking for solutions beyond a speciality but currently available within the same industry	1	:	2	:	3	:	4	:	5
Looking for solutions to similar situations found outside the same speciality and industry	1	:	2	:	3	:	4	:	5
Consideration that the possibility of ready made solutions may not yet exist within industry but could be with the help of scientists and alike	1	:	2	:	3	:	4	:	5
Awareness that a completely new solution not considered yet is about to unfold	1	:	2	:	3	:	4	:	5

Thankyou for your valued contribution

Appendix 2 Sample Data

Calculation of cognitive preferences





Individuals data 2008

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	3 4 2 1	3 4 2 1	3 4 2 1	1 4 3 2	1 4 3 2	1	3 4 1 2	1 4 3 2	3 4 2 1
Personal 1									
Innovation	4 2 4 3 2	4 2 1 2 1	4 2 1 1 1	1 1 3 4 5	1 2 3 4 5	4 2 1 1 1	3 3 2 1 2	3 4 4 4 4	4 4 4 4 3
Industry 1									
Innovation	4 4 3 2 2	4 3 2 4 2	3 4 3 4 2	4 3 2 1 1	3 3 4 4 4	4 3 1 2 1	3 3 3 3 2	2 4 3 3 2	5 4 4 3 3
Assess 1A	A div div	B con con	C ass ass	D acc acc	E div div	F acc acc	G div div	H con con	I ass ass
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Q2	4 3 1 2	2 2 2 2	2 4 1 2	2 4 1 2	4 4 3 3	1 1 1 2	1 1 1 1	1 2 2 3	1 2 1 1
Q3	2 3 4 4 7	2 2 2 3 1	2 2 3 3 3	3 2 4 4 3	3 4 3 3 4	1 2 1 1 1	1 1 1 1 1	1 2 3 3 3	1 2 1 1 1
Q4	4 2 3 3	2 2 3 1	4 3 4 2	5 4 4 4	4 3 3 4	1 1 1 3	1 1 1 1	2 2 2 2	1 1 1 3
Q5	3 1 2 3 3	2 1 1 1 1	1 2 4 3 3	1 1 2 3 4	4 4 4 5 3	5 5 1 4 2	5 3 1 1 1	5 57 7 2	3 1 2 2 1
Q6	2 3 3 2 1	1 1 1 1 1	4 4 4 1 1	3 3 1 4 4	3 4 4 3 3	4 4 5 1 1	5 1 1 1 1	3 3 4 3 2	2 2 2 3 3
Assess 1B									
Q1	4 3 4 3 4	1 1 1 2 1	3 2 2 2 4	4 3 4 5 5	4 3 4 4 3	2 2 3 1 2	3 3 4 2 4	4 3 4 3 1	1 1 2 1 1
Q2	4 4 2 3	1 1 2 2	3 2 2 2	2 4 2 3	5 4 3 3	1 1 1 1	1 1 1 1	1 4 1 4	1 2 1 1
Q3	2 3 3 2 2	1 2 2 2 1	2 2 4 3 4	5 4 4 4 4	4 3 4 3 3	3 3 4 3 4	1 1 3 1 3	5 3 3 4 3	1 1 2 2 2
Q4	3 3 2 3	1 1 2 1	3 3 4 4	3 3 4 3	5 4 4 4	2 1 3 1	3 3 3 3	1 1 2 2	1 1 2 2
Q5	3 2 3 3 2	2 4 1 1 1	4 3 4 2 1	4 1 1 4 4	2 2 3 4 3	5 5 2 2 1	2 4 4 3 2	5 57 4 4	4 3 1 1 1
Q6	3 3 3 2 2	4 1 1 2 1	4 2 4 1 1	3 3 1 4 4	3 3 4 3 3	4 3 1 1 1	2 4 4 1 1	5 5 1 5 5	2 2 2 1 1
Assess 2A									
Q1	2 1 1 2 1	1 1 1 1 1	4 3 2 3 4	1 1 3 1 1	3 4 4 3 3	1 1 2 1 1	1 3 4 2 1	4 4 4 3 4	1 3 2 2 1
Q2	2 2 1 1	1 1 1 2	2 3 3 2	3 3 2 2	4 3 4 4	3 1 1 2	2 1 3 1	5 5 5 5	1 1 1 1
Q3	1 1	2 2	4 4	1 1	4 3	1 1	2 4	3 3	2 3
Q4	1 3 1	1 2 2	3 4 4	1 1 1	4 3 4	1 1 2	5 2 3	5 5 5	1 2 2
Q5	FEW FOCUSSO	FEW BROAD	few focus	few broad	few focus	few focus	few broad	few focus	mi focus
Q6	1 1 2 1 1	1 1 1 1 1	2 2 4 3 1	5 1 1 1 2	3 2 3 4 3	4 3 2 1 1	1 1 3 3 3	3 3 4 4 5	1 2 4 2 1
Q7	5 5 1 1 1	1 2 1 1 1	3 3 4 2 1	5 3 1 3 2	3 4 4 2 2	5 5 1 1 1	1 4 3 1 1	3 3 3 3 3	2 2 4 2 1
Assess 2B									

Q1	2 3 4 3 3	2 3 3 3 2	2 2 1 3 3	1 2 4 1 1	4 4 3 3 2	1 1 2 2 1	1 5 4 3 1	3 4 5 5 3	1 2 4 3 1
Q2	3 4 3 2	3 2 3 4	4 4 3 2	1 4 3 4	5 4 4 4	2 3 3 4	2 5 3 3	5 5 5 5	2 3 1 3
Q3	4 4	2 1	4 3	4 3	4 4	4 4	2 2	4 4	3 3
Q4	4 3 3	4 4 2	4 2 4	3 2 4	4 3 4	2 3 3	2 4 4	5 5 5	2 3 4
Q5	few broad	MANY FOCUS	few bro	Many focus	fewfocus	few broad	fewbroad	fewfocus	maifocus
Q6	3 2 3 2 2	3 1 3 2 1	3 4 4 4 3	2 1 1 3 3	3 3 4 4 3	4 5 3 2 1	1 1 4 3 1	3 4 5 5 5	2 3 3 4 3
Q7	4 4 3 3 3	2 3 1 1 1	3 2 5 2 1	1 1 1 3 3	2 2 3 4 2	4 4 4 1 1	1 4 2 1 1	3 3 3 3 3	2 3 3 3 2
Assess 3A									
Q1	3 3 3	3 3 3	4 3 3	1 1 1	5 4 4	2 1 1	2 2 2	4 4 4	2 1 1
Q2	4	3	3	5	2	3	3	2	4
Q3	3	4	1	3	5	3	3	2	3
Q4	2 2 3 3	2 2 4 1	2 3 4 2	2 4 4 5	5 4 4 4	1 1 7 7	2 1 3 3	5 5 5 5 5	2 2 1 2
Q5	2 3 3	2 4 3	3 3 2	2 3 3	4 7 5	1 1 3	2 3 4	3 3 1	3 2 2
Q6	3 3	4 4	4 2	2 2	5 4	1 1	4 1	1 3	3 2
Q7	3 2 3 3 3	2 4 3 3 1	3 4 3 2 2	2 1 2 3 4	2 2 4 5 3	5 5 4 1 1	3 1 2 3 2	3 3 3 3 3	3 3 1 2 1
Q8	2 2 3 3 3	4 4 1 1 1	3 3 3 2 1	7 7 7 4 4	2 2 4 4 3	4 4 2 1 1	5 1 2 1 1	3 3 3 3 3	2 2 4 1 1
Assess 3B									
Q1	2 2 2	3 4 4	2 3 2	1 3 3	5 5 4	1 1 2	3 3 3	5 5 5	3 1 1
Q2	3	5	4	5	1	3	2	1	2
Q3	1	4	1	1	5	3	4	2	3
Q4	2 2 2 2	2 2 1 1	4 4 2 3	3 4 2 4	4 4 3 4	1 1 1 2	5 4 4 2	5 5 5 5	3 4 5 4
Q5	2 2 1	1 1 3	2 3 3	3 4 2	3 4 5	1 1 2	5 5 4	5 5 1	2 3 3
Q6	1 1	3 3	4 2	2 3	5 4	1 1	4 4	4 4	3 3
Q7	5 5 3 3 3	1 1 1 1 1	4 4 3 1 1	3 4 4 4 4	3 3 4 5 3	5 5 2 1 1	1 2 4 4 4	3 3 3 3 3	2 1 1 2 1
Q8	2 2 2 2 2	2 2 1 1 1	4 3 4 2 1	2 2 2 4 4	3 3 4 4 4	1 1 1 1 1	2 3 3 2 1	3 3 3 3 3	2 2 4 2 1
Personal 2									
Innovation	2 2 2 2 2	2 1 1 3 1	3 4 2 4 2	1 1 2 5 5	4 4 4 5 5	1 1 1 1 2	7 7 7 7 7	3 3 5 5 5	2 3 3 3 2
Industry 2									
Innovation	2 2 2 2 3	2 2 1 2 1	5 4 2 3 2	1 1 2 5 5	4 4 3 4 5	1 1 1 1 1	7 7 7 7 7	5 5 5 5 4	2 3 3 3 2
Profile Calcs									
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	3 2 4 1	4 1 3 2	1 3 2 4	1 4 2 3	2 1 3 4	5 5 4 5	2 1 4 3	2 1 3 4	1 2 3 4
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	3 4 1 2	4 3 2 1	3 4 2 1	1 2 3 4	2 3 4 1	5 4 5 5	3 4 2 1	2 4 3 1	2 3 4 1
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	3 4 2 1	2 4 1 3	2 3 4 1	4 2 3 1	2 3 4 1	5 4 5 5	3 2 4 1	2 4 3 1	2 3 4 1

	2 1 3 4	2 1 3 4	2 1 3 4	4 1 2 3	4 1 2 3	5 5 4 5	2 1 4 3	4 1 2 3	2 1 3 4
	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5
	1 3 1 2	1 3 4 3	1 3 4 4	4 4 2 1	4 3 2 1	1 3 4 4	2 2 3 4	2 1 1 1	1 1 1 1
Profile Calcs									
ca	27	32	24	30	29	42	29	31	27
ac	29 2	27 -5	29 5	24 -6	29 0	39 -3	29 0	27 -4	30 3
ae	25	31	30	25	23	37	24	26	27
ro	31 -6	23 8	28 2	29 -4	30 -7	38 -1	25 -1	24 2	24 3
lp	50	51	48	53	48	84	56	52	54
cr	60 -10	59 -8	62 -14	52 6	62 -14	80 4	54 2	60 -8	56 -2
	div	con	ass	acc	div	acc	div	con	ass
	cr	rr	cr	lp	cr	lp	lp	cr	cr
	div	con	ass	acc	div	acc	div	con	ass
	cr	rr	cr	lp	cr	lp	lp	cr	cr
Q1	3 3 3	3 3 3	4 3 3	1 1 1	5 4 4	2 1 1	2 2 2	4 4 4	2 1 1
Assess 3B									
Q1	2 2 2	3 4 4	2 3 2	1 3 3	5 5 4	1 1 2	3 3 3	5 5 5	3 1 1

	1	2	3	4	5	6	7	8	9
	div	con	ass	acc	div	acc	div	con	ass
Q7	5 5 3 3 3	1 1 1 1 1	4 4 3 1 1	3 4 4 4 4	3 3 4 5 3	5 5 2 1 1	1 2 4 4 4	3 3 3 3 3	2 1 1 2 1
Q8	2 2 2 2 2	2 2 1 1 1	4 3 4 2 1	2 2 2 4 4	3 3 4 4 4	1 1 1 1 1	2 3 3 2 1	3 3 3 3 3	2 2 4 2 1

	1	5	7	10	2	8	3	9	11	15	4	6	12	14
ca	27	29	29	22	32	31	24	27	20	23	30	42	33	29
ac	29	29	29	23	27	27	29	30	31	34	24	39	26	23
ae	25	23	24	24	31	28	30	27	31	29	25	37	23	24
ro	31	30	25 3-		23	24	28	24	27	26	29	38	30	27
lp	50	48	56	30	51	52	48	54	40	55	53	84	46	57
cr	60	62	54	31	59	60	62	56	62	55	52	80	64	53
reality	2	0	0	1	-5	-4	5	3	11	11	-6	-3	-7	-1
concept	-6	-7	-1	-6	8	2	2	3	4	3	-4	-1	-7	-3
perceptive/receptive	-10	-14	2	-1	-8	-8	-14	-2	-13	0	6	4	-18	4

Individual Data 2009

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few focus					few focus					few broad					fewbroad					few focus				
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2					3					3					3					4				
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1	2	3			2	1	4			3	2	4			4	3	4			2	4	4		
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3	4	1	1	1	2	2	1	1	2	3	3	4	3	2	3	3	4	2	1	3	3	3	4	4
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5					4					3										2				
1					4					2										2				
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4	3				3	3				3	2									2	2			
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23	1		
24			
30	-6		
30			
31	-1		
	dlv		
	cr		

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5	5	5	5
2	1	3	1
20			
31	11		
31			
27	4		
49			
62	-13		
	dis		
	cr		

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5	5	5	5
1	1	2	3
33			
26	-7		
23			
30	-7		
46			
64	-18		
	acc		
	cr		

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5	5	5	5
1	1	0	1
23			
34	11		
29			
26	3		
55			
55	0		
	as		
	lp		

2	1	4	3
5	5	5	5
1	2	2	3
29			
28	-1		
24			
27	-3		
57			
53	4		
	acc		
	lp		

Group Data

Assess 1A	lrk	grp 1 conv				sh	grp 1 conv				bh	grp 1 conv				ce	grp 2 div				st	grp 2 div				ja	grp 3 acc			
Q1	3	2	4	3	2	3	4	3	5	5	4	4	4	5	5	4	4	4	4	4	4	4	4	4	4	5	5	4	3	4
Q2	2	2	4	3		5	4	3	4		5	5	4	4		5	5	4	1		4	4	3	4		3	3	2	4	
Q3	4	3	4	2	3	5	5	4	4	4	5	4	5	4	4	5	4	4	4	4	4	4	4	4	3	4	5	3	3	4
Q4	4	4	3	4		5	5	4	4		5	4	4	4		5	4	4	4		4	4	4	4		5	4	3	3	
Q5	3	3	4	3	2	1	1	2	2	2	1	1	3	2	2	4	4	3	3	3	2	3	4	4	1	1	2	3	2	
Q6	3	2	3	4	1	2	3	4	4	4	2	3	4	4	4	2	2	1	5	4	2	4	4	3	3	0	0	0	0	0
Assess 2A	lrk	grp 1 conv				sh	grp 1 conv				bh	grp 1 conv																		
Q1	2	3	4	3	2	5	5	5	4	5	5	5	4	4	5	4	4	3	4	3	3	4	4	4	1	1	4	5	2	1
Q2	3	3	5	5		5	5	4	4		4	4	5	4		4	4	4	4		2	3	4	4		3	3	4	4	
Q3	3	3				4	4				4	4				4	4				4	4				3	3			
Q4	3	4	3			4	5	4			3	4	4			3	4	4			4	4	4			3	3	3		
Q5	broad					focus					focus					focus few					few broad					broad few				
Q6	3	4	4	2	1	1	3	4	4	1	1	2	4	4	3	4	3	4	4	2	4	3	4	4	1	3	2	3	3	1
Q7	3	3	4	2	2	3	2	2	2	2	2	2	3	2	3	4	3	2	4	1	2	3	3	4	2	2	3	1	1	1
Assess 3A																														
Q1	3	2	3			5	5	5			5	5	5			4	5	5			3	4	4			4	4	4		
Q2	1					5					4					3					2					3				
Q3	3					5					5					5					3					3				
Q4	2	3	2	2		3	4	4	4		4	4	4	4		4	5	3	4		3	4	2	2		4	4	3	3	
Q5	2	2	3			4	4	4			4	4	4			4	4	3			4	4	2			3	3	3		
Q6	3	2				4	4				4	4				3	3				3	3				3	4			
Q7	2	3	2	3	1	1	3	4	5	1	1	1	4	3	4	4	2	3	3	2	3	4	4	4	1	2	2	4	3	1
Q8	3	3	3	1	1	4	1	1	5	4	1	2	3	3	3	3	3	3	4	4	2	3	3	3	2	2	3	1	2	1

responders comments

GROUP1

2a	sh... there is similarity and repetition in tl
1a	
1a...bh	The technique requires thorough knowle
1a...bh	The technique necessitates understandin
1a...bh	bh...For any enterprise to take off three tl

1a	
1a...rk	what we are trying to maintain could be r system of helping and supporting people
GROUP 2	
2a...ce	encouraged clwarer focus of thought can be difficult to apply brief statements t awareness of resourcescan influence resp putting ideas into practice ie differences between wish list and actio
2a ...st	found assessment of experience difficult I liked exercise of generating ideas then fo found those activities interestinf and reall
3a...st	as previously... found assessment of experience difficult I liked exercise of generating ideas then fo found those activities interestinf and reall but as time went on we became more rrealisti and possibly tired and worried about our li
GROUP 3	
1a...ja	clearly time dependent depends lots on conversation would hope to achieve more in a couple o
1a...marj	it made me state the obvious
2a...marj	initially I was dubious about the usefulnes and expected it to be a bore

	but in fact it did usefully help to sort out id
3a...mh	an interesting range of questions
3a ...mh	not much scope for further ideas in what i
3a...ja	I'm more interested than I expected to be may actually use some of these ideas

facilitators observations

convergers gp1

very focussed on definitions - they appeared to be locked due to p
after encouragement the ideas seemed to flow.

divergers grp 2

a slight objection to the use of the one point of notation used by a
started to argue between themselves...became too focussed too q

accs grp 3

nothing to draw attention - just got on with the task

Overall

all a bit hesitant about exercise at begining
mixed expectations
needed re-assurance at the beginning
all very grateful at the end and
all left in high spirit exchanging ideas on what they intend to do

Appendix 3 Sample Independence and Non-Parametric testing

Sample Independence Analysis Individual Samples (2008, 2009)

data for independence tests

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24
	dv08	<3	=3	>3	dv09	<3_1	=3_1	>3_1	A>>	<3_2	=>>	>>>	As09	<3_3	=3_3	>3_3	Ac08	<3_4	=3_4	>3_4	Ac09	<3_5	=3_5	>3_5
1	5	5	4	6	4	4	0	1	3	3	4	3	4	4	3	3	4	4	2	4	5	5	2	3
2	1	1	6	8	1	1	3	1	8	8	1	1	0	0	2	8	4	4	2	4	0	0	4	6
3	1	1	6	8	1	1	3	1	8	8	1	1	0	0	2	8	4	4	2	4	0	0	4	6
4	2	2	5	5	3	3	1	0	5	5	2	1	1	1	1	6	7	7	0	1	4	4	2	2
5	3	3	3	3	0	0	3	0	3	3	2	1	1	1	3	2	6	6	0	0	0	0	1	5
6	3	3	3	3	3	3	0	0	4	4	2	0	0	0	5	1	4	4	2	0	6	6	0	0
7	4				0				4				3				4				2			
8	6				3				1				2				4				4			
9	6				3				1				2				4				4			
10	5				1				2				1				7				2			
11	3				3				2				3				6				1			
12	3				0				2				5				4				0			
13	6				1				3				3				2				3			
14	8				1				1				8				2				6			
15	8				1				1				8				2				6			
16	5				0				1				6				0				2			
17	3				0				1				2				0				5			
18	3				0				0				1				2				0			

Results for: Worksheet 3

Kruskal-Wallis Test: dv08 versus dv09

Kruskal-Wallis Test on dv08

dv09	N	Median	Ave Rank	Z
0	6	3.000	8.0	-0.84
1	6	5.500	10.8	0.75
3	5	3.000	9.2	-0.15
4	1	5.000	12.0	0.48
Overall	18		9.5	

H = 1.08 DF = 3 P = 0.781
H = 1.14 DF = 3 P = 0.768 (adjusted for ties)

* NOTE * One or more small samples

Kruskal-Wallis Test: As08 versus As09

Kruskal-Wallis Test on As08

As09	N	Median	Ave Rank	Z
0	3	8.000	16.5	2.49
1	4	2.500	9.5	0.00
2	3	1.000	4.5	-1.78
3	3	3.000	11.8	0.83
4	1	3.000	12.0	0.48
5	1	2.000	9.0	-0.10
6	1	1.000	4.5	-0.96
8	2	1.000	4.5	-1.40
Overall	18		9.5	

H = 11.22 DF = 7 P = 0.129
H = 11.77 DF = 7 P = 0.108 (adjusted for ties)

* NOTE * One or more small samples

Kruskal-Wallis Test: Ac08 versus Ac09

Kruskal-Wallis Test on Ac08

Ac09	N	Median	Ave Rank	Z
0	5	4.000	10.3	0.39
1	1	6.000	15.5	1.16
2	3	4.000	9.8	0.12
3	1	2.000	4.5	-0.96
4	3	4.000	12.8	1.18
5	2	2.000	6.0	-0.98
6	3	2.000	6.5	-1.07
Overall	18		9.5	

H = 5.24 DF = 6 P = 0.513
H = 5.82 DF = 6 P = 0.443 (adjusted for ties)

* NOTE * One or more small samples

Non-Parametric Testing

Comparing Respondent Assessments

Mann-Whitney Non- Parametric Comparison of the experience assessment reported by respondents with different learning styles when they used techniques that keep paradigms.

Table 11

Keep Paradigm Technique alpha = 0.05	2008 Significance levels. Learning Style (*Cognition*)					
	In Accord	**Not in Accord**				
		Diverger	**Assimilator**	**Converger**	**Accommodator**	**All**
Diverge	**Diverger**		0.4339	0.0708	0.5	**0.2351**
Assimilate	***Assimilator***	0.5		????	0.1038	**0.3732**
Converge	***Converger***	0.2047	0.0547		Can't test equal data	**0.0135**

Table 12

Keep Paradigm Technique alpha = 0.05	2009 Significance levels. Learning Style (*Cognition*)					
	In Accord	**Not in Accord**				
		Diverger	**Assimilator**	**Converger**	**Accommodator**	**All**
Diverge	Diverger		Can't reject W < 65	Null		
Assimilate	*Assimilator*	0.0885		Null		
Converge	*Converger*	Null	Null	Null		

Table 13 Respondents Assessment of Techniques that Keep Paradigms

Stretch Paradigm Technique *alpha = 0.05*	2008 Significance levels. Learning Style (*Cognition*)					
	In Accord	**Not in Accord**				
		Diverger	***Assimilator***	***Converger***	***Accommodator***	***All***
Diverge	*Diverger*		Cannot Reject	0.0532	0.1974	0.1709
Assimilate	*Assimilator*	Cannot Reject		Cannot Reject	0.2474	Cannot Reject
Converge	*Converger*	0.0495	0.0041		0.0041	0.0016

Table 14 Respondents Assessment of Techniques that Keep Paradigms

Stretch Paradigm Technique *alpha = 0.05*	2009 Significance levels. Learning Style (*Cognition*)					
	In Accord	**Not in Accord**				
		Diverger	***Assimilator***	***Converger***	***Accommodator***	**All**
Diverge	*Diverger*		Cannot reject W < 65	Null	Null	
Assimilate	*Assimilator*	0.0103		Null	Null	
Converge	*Converger*	Null	Null	Null	Null	

able 15 Respondents Assessment of Techniques that Keep Paradigms

Keep Paradigm Technique alpha = 0.05	**2008 Significance levels. Learning Style (*Action*)**					
	In Accord	**Not in Accord**				
		Diverger	**Assimilator**	**Converger**	**Accommodator**	**All**
Diverge	Diverger		0.0819	0.1077	0.2961	0.0848
Assimilate	*Assimilator*	null		null	0.0157	0.4279
Converge	*Converger*	0.4895	0.0502		0.0638	0.1231

Table 16 Respondents Assessment of Techniques that Keep Paradigms

Keep Paradigm Technique alpha = 0.05	2009 Significance levels. Learning Style (*Action)*					
	In Accord	**Not in Accord**				
		Diverger	**Assimilator**	**Converger**	**Accommodator**	**All**
Diverge	Diverger		0.1109	Null	Null	
Assimilate	*Assimilator*	0.2087		Null	Null	
Converge	*Converger*	Null	Null	Null	Null	

Table 17 Respondents Assessing of Techniques that Stretch Paradigms 2008

Stretch Paradigm Technique Alpha = 0.05	**The 2008 Significance levels. Learning Style (*action*)**					
	In Accord	**Not in Accord**				
		Diverger	**Assimilator**	**Converger**	**Accommodator**	**All**
Diverge	Diverger		0.0143	0.0160	Cannot Reject	0.0347
Assimilate	*Assimilator*	Cannot Reject		Cannot Reject	Cannot Reject	Cannot reject
Converge	*Converger*	Cannot Reject	0.3721		0.107	0.2266

Table 18 Respondents Assessing of Techniques that Stretch Paradigms 2009

Stretch Paradigm Technique alpha = 0.05	**2009 Significance levels. Learning Style (*action*)**					
	In Accord	**Not in Accord**				
		Diverger	**Assimilator**	**Converger**	**Accommodator**	**All**
Diverge	Diverger		Cannot reject	No convergers		
Assimilate	*Assimilator*	0.0024		No convergers		
Converge	*Converger*					

Mann-Whitney Non Parametric Comparison of Respondents Assessment of Techniques that Keep and Stretch Paradigms using Sternberg's (1997) Receptive – Perceptive perspective.

Table 19

2008 Significance levels.		
H0: Receptive shows greater preference than Perceptive	**Technique type**	
	Keep Paradigms	**Stretch Paradigms**
Ideation assessment	**0.4730**	**0.0773**

2009 Significance levels.		
H0: Receptive shows greater preference than Perceptive	**Technique type**	
	Keep Paradigms	**Stretch Paradigms**
Ideation assessment	**0.0012**	**0.0189**

Table 20

2008 Significance levels.		
H0: Receptive shows greater preference than Perceptive	Technique type	
	Keep Paradigms	Stretch Paradigms
Outcome assessment	0.2697	0.4197

2009 Significance levels.		
H0: Receptive shows greater preference than Perceptive	Technique type	
	Keep Paradigms	Stretch Paradigms
Outcome assessment	0.0004	0.2056

For evidence of repeatability, a series of $\chi 2$ independence tests revealed:-

$\chi 2$ (Divergers) = 86.77609 $\chi 2$ (0.05, 44df) > $\chi 2$ (0.05, 40df) = 55.8
$\chi 2$ (Assimilators) = 60.80834 $\chi 2$ (0.01, 44df) > $\chi 2$ (0.01, 40df) = 63.7
$\chi 2$ (Accommodators) = 89.48773 *Tables from Chadfield (1995).*

Independence between samples 2008 and 2009 for Divergers, assimilators and accommodators must be rejected at alpha = 0.05.

Unfortunately, due to convergers not being in the 2009 sample set comparison could not be made.

Synopsis of Non-Parametric Statistical Analysis

Table 21

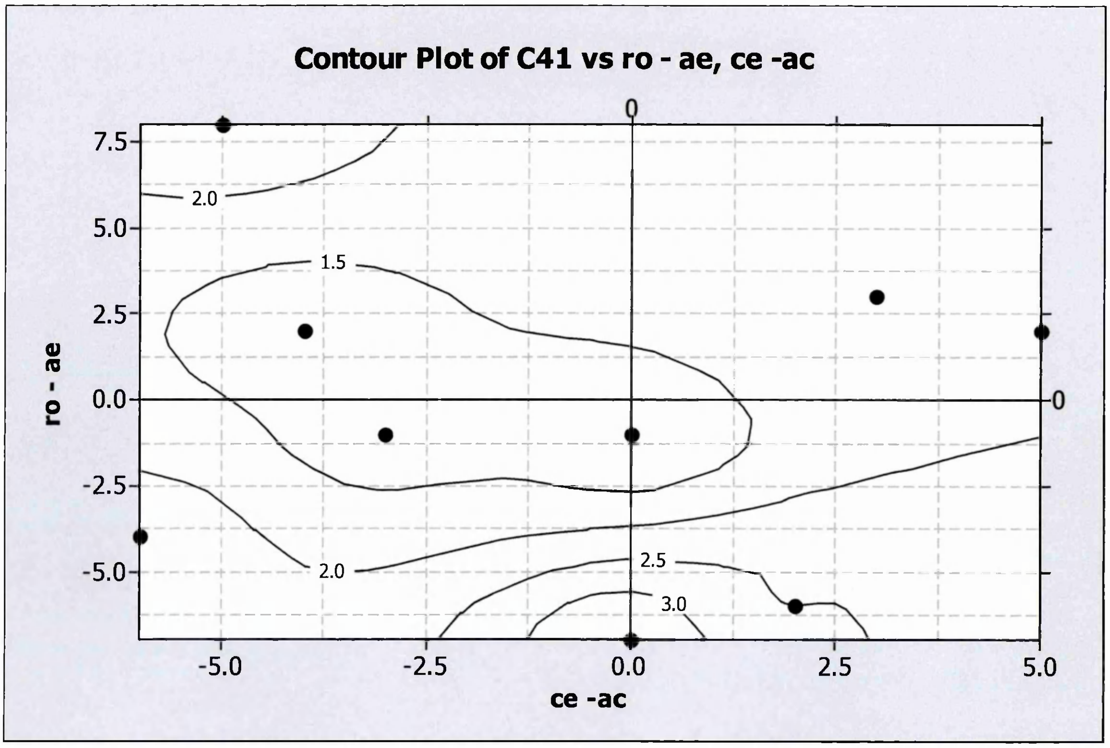
<table>
<tr><th colspan="6">H0: Show preference to techniques in accord with personal style alpha = 5%</th></tr>
<tr><th colspan="2" rowspan="3">Technique</th><th colspan="4">Perspective</th></tr>
<tr><th colspan="2">Learning Style</th><th colspan="2">Creative Style</th></tr>
<tr><th>Cognition</th><th>Action</th><th>Ideation</th><th>Outcomes</th></tr>
<tr><td rowspan="4">Keep Paradigm</td><td>Diverge</td><td>Divergers showed greater preference</td><td>Divergers showed greater preference</td><td rowspan="4">Receptives showed greater preference than Perceptives</td><td rowspan="4">Receptives showed greater preference than Perceptives</td></tr>
<tr><td>Assimilate</td><td>Assimilators showed greater preference</td><td>Assimilators showed greater preference</td></tr>
<tr><td>Converge</td><td>Convergers did not show greater preference</td><td>Convergers showed greater preference</td></tr>
<tr><td>Accommodate</td><td>Not tested</td><td>Not tested</td></tr>
<tr><td rowspan="4">Stretch Paradigm</td><td>Diverge</td><td>Divergers, showed greater preference</td><td>Divergers showed no preference</td><td rowspan="4">Receptives did show greater preference than Perceptives

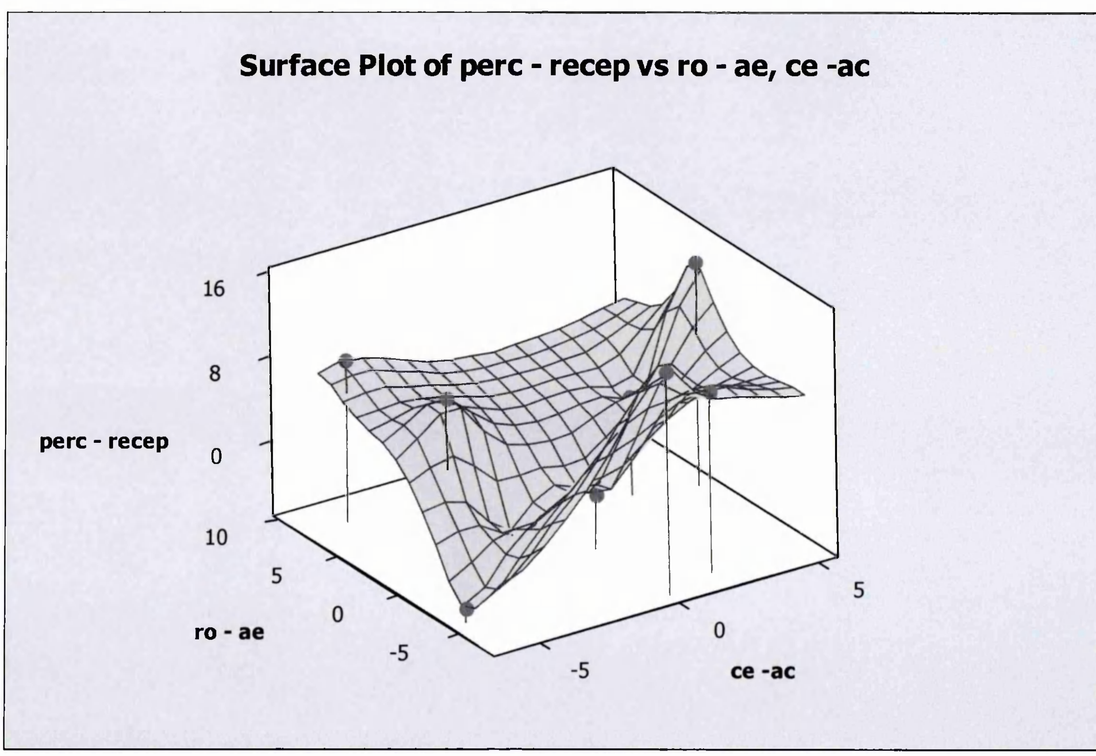
Much less so than for Keep Paradigms</td><td rowspan="4">Receptives showed greater preference than Perceptives

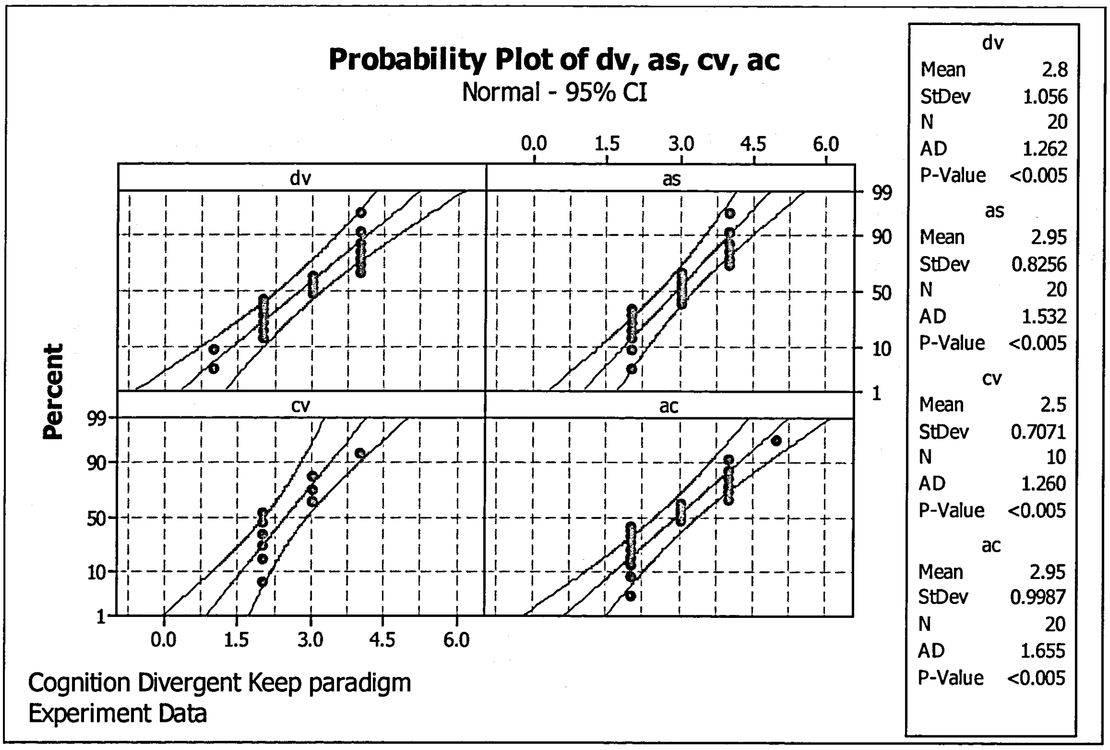
More so than for Keep Paradigms</td></tr>
<tr><td>Assimilate</td><td>The Assimilators "could not be rejected"</td><td>The Assimilators "could not be rejected"</td></tr>
<tr><td>Converge</td><td>Convergers did not show greater preference.</td><td>Convergers showed greater preference</td></tr>
<tr><td>Accommodate</td><td>Not tested</td><td>Not tested</td></tr>
<tr><td colspan="6">Independence between samples 2008 and 2009
for Divergers, assimilators and accommodators must be rejected at alpha = 0.05.
Due to no convergers in the 2009 sample a $\chi 2$ comparison could not be made.</td></tr>
</table>

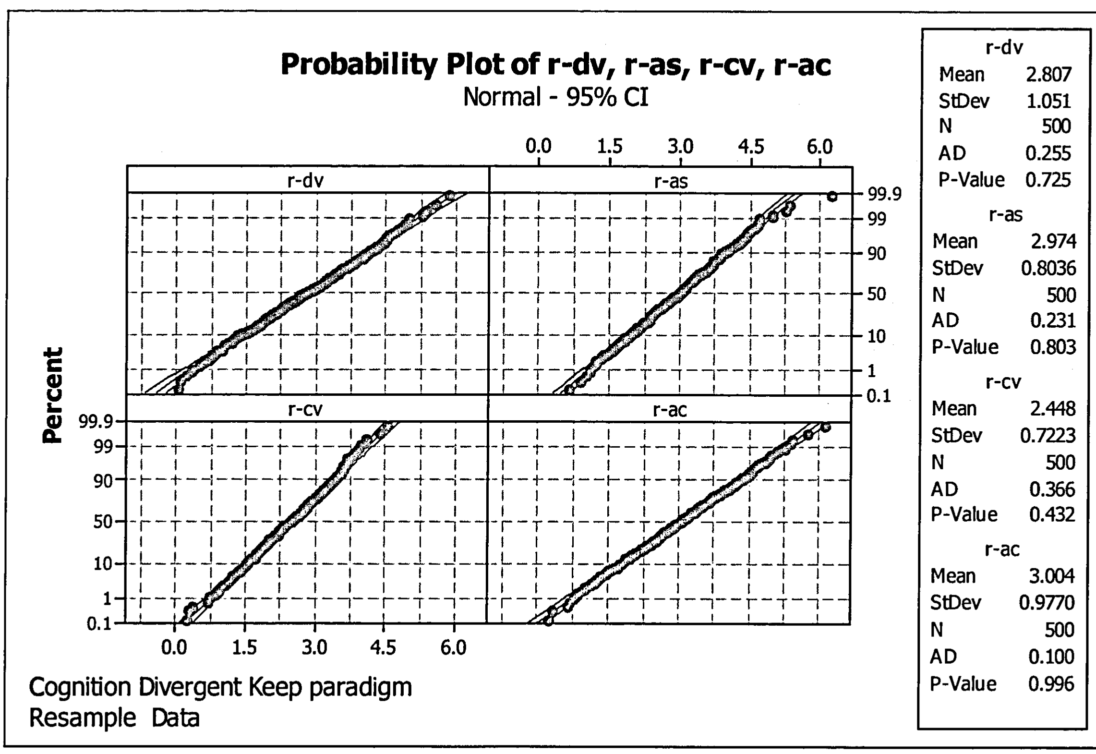
Sample Profile   Contour & Surface Plots

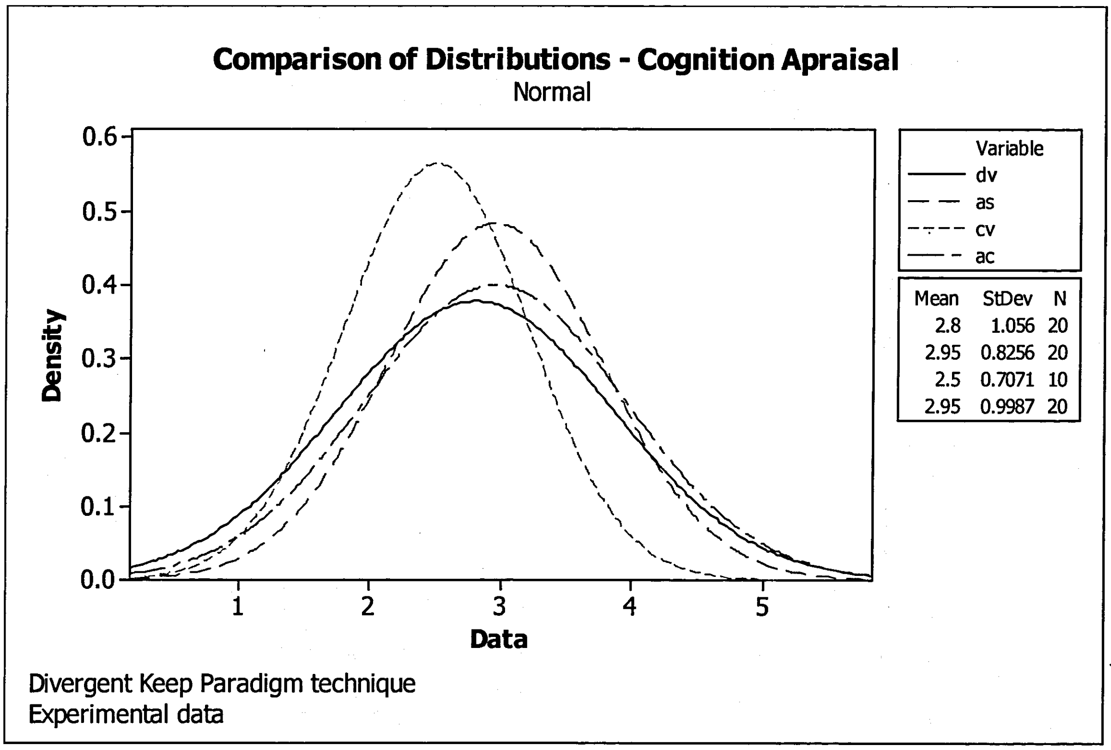
Minitab Project Report

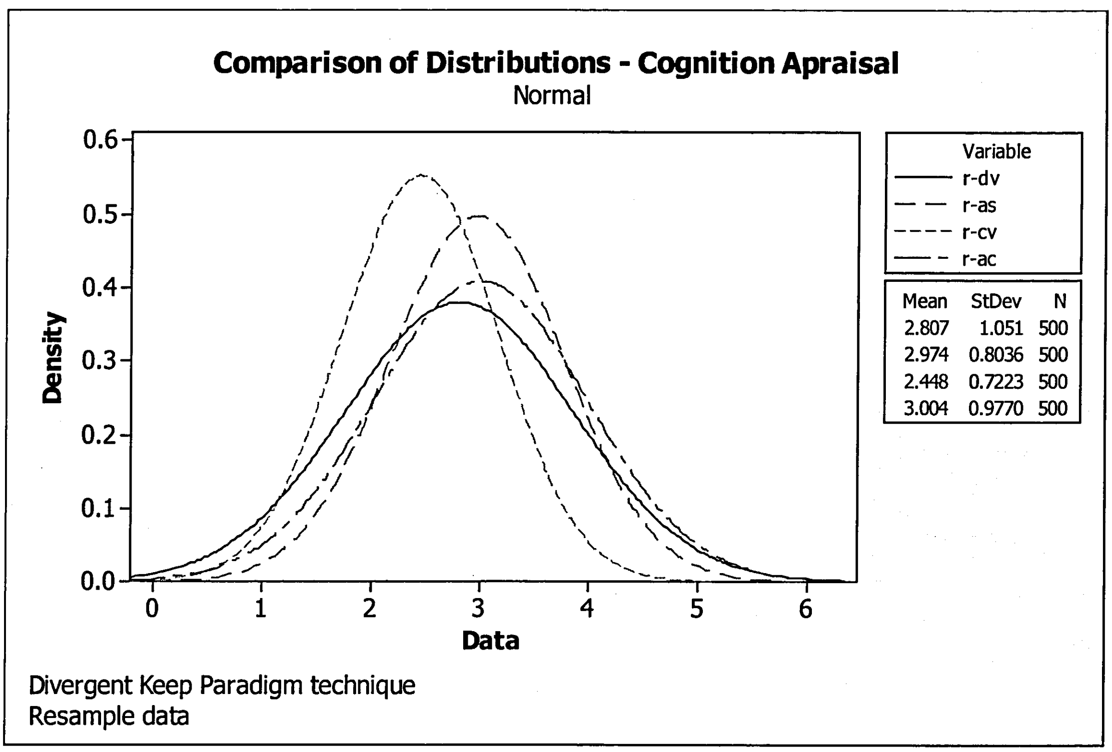





Probability Plot of dv, as, cv, ac
Normal - 95% CI
dv
as
cv
ac
Percent
99
90
50
10
1
0.0
1.5
3.0
4.5
6.0
dv
Mean 2.8
StDev 1.056
N 20
AD 1.262
P-Value <0.005
as
Mean 2.95
StDev 0.8256
N 20
AD 1.532
P-Value <0.005
cv
Mean 2.5
StDev 0.7071
N 10
AD 1.260
P-Value <0.005
ac
Mean 2.95
StDev 0.9987
N 20
AD 1.655
P-Value <0.005
Cognition Divergent Keep paradigm
Experiment Data


Probability Plot of r-dv, r-as, r-cv, r-ac
Normal - 95% CI
r-dv
r-as
r-cv
r-ac
Percent
99.9
99
90
50
10
1
0.1
0.0
1.5
3.0
4.5
6.0
r-dv
Mean 2.807
StDev 1.051
N 500
AD 0.255
P-Value 0.725
r-as
Mean 2.974
StDev 0.8036
N 500
AD 0.231
P-Value 0.803
r-cv
Mean 2.448
StDev 0.7223
N 500
AD 0.366
P-Value 0.432
r-ac
Mean 3.004
StDev 0.9770
N 500
AD 0.100
P-Value 0.996
Cognition Divergent Keep paradigm
Resample Data


Comparison of Distributions - Cognition Apraisal
Normal
Density
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
Data
Variable
dv
as
cv
ac
Mean StDev N
2.8 1.056 20
2.95 0.8256 20
2.5 0.7071 10
2.95 0.9987 20
Divergent Keep Paradigm technique
Experimental data


Comparison of Distributions - Cognition Apraisal
Normal
Density
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
1
2
3
4
5
6
Data
Variable
r-dv
r-as
r-cv
r-ac
Mean StDev N
2.807 1.051 500
2.974 0.8036 500
2.448 0.7223 500
3.004 0.9770 500
Divergent Keep Paradigm technique
Resample data

Two-Sample T-Test and CI: r-dv, r-as

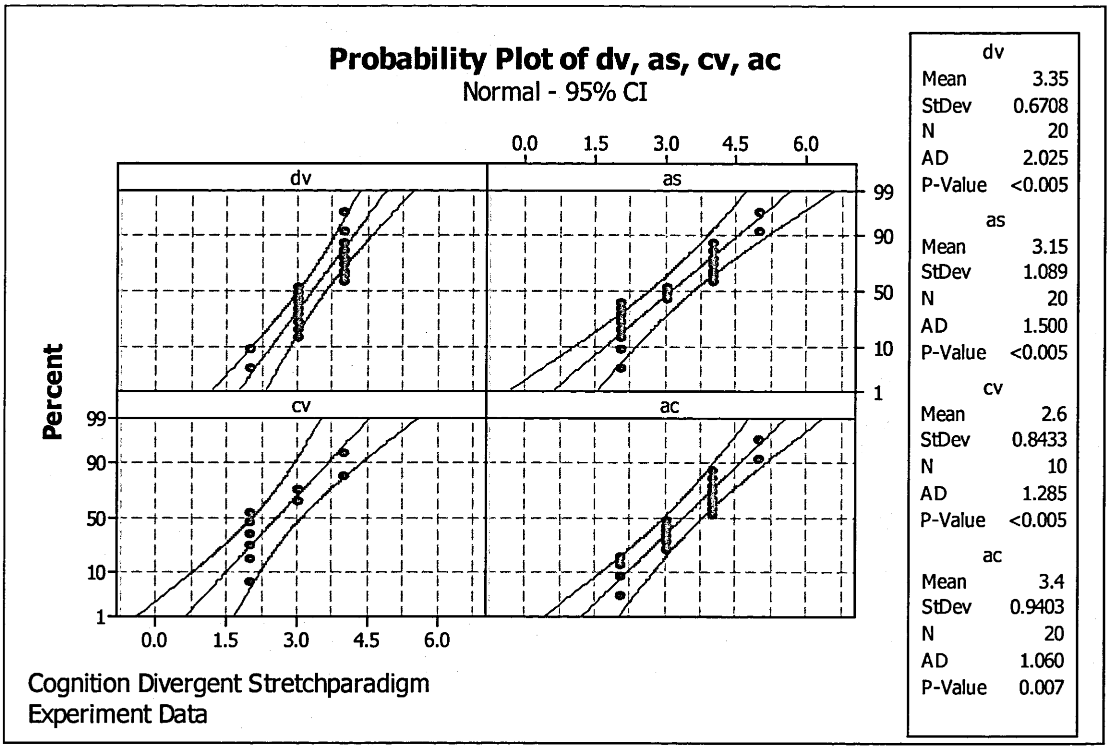
```
Two-sample T for r-dv vs r-as

        N   Mean  StDev  SE Mean
r-dv  500   2.81   1.05    0.047
r-as  500  2.974  0.804    0.036


Difference = mu (r-dv) - mu (r-as)
Estimate for difference:  -0.1666
95% lower bound for difference:  -0.2640
T-Test of difference = 0 (vs >): T-Value = -2.81  P-Value = 0.998  DF = 933

MTB > TwoSample 'r-dv' 'r-cv';
SUBC>   Alternative 1.
```

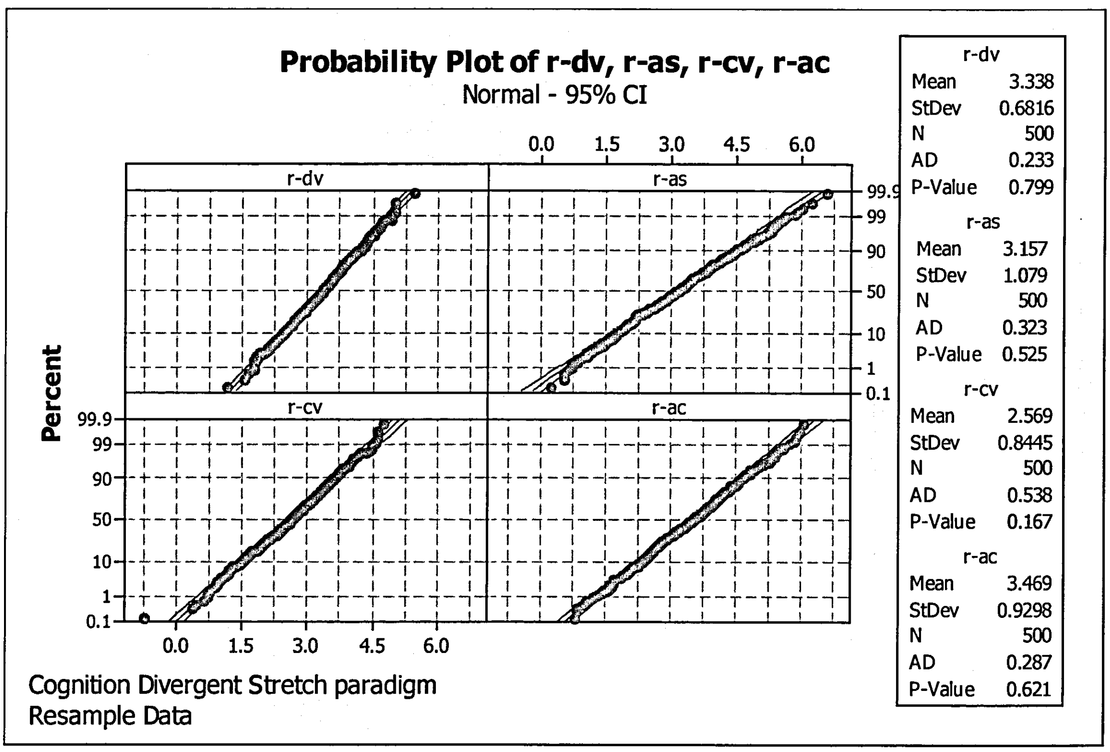
Two-Sample T-Test and CI: r-dv, r-cv

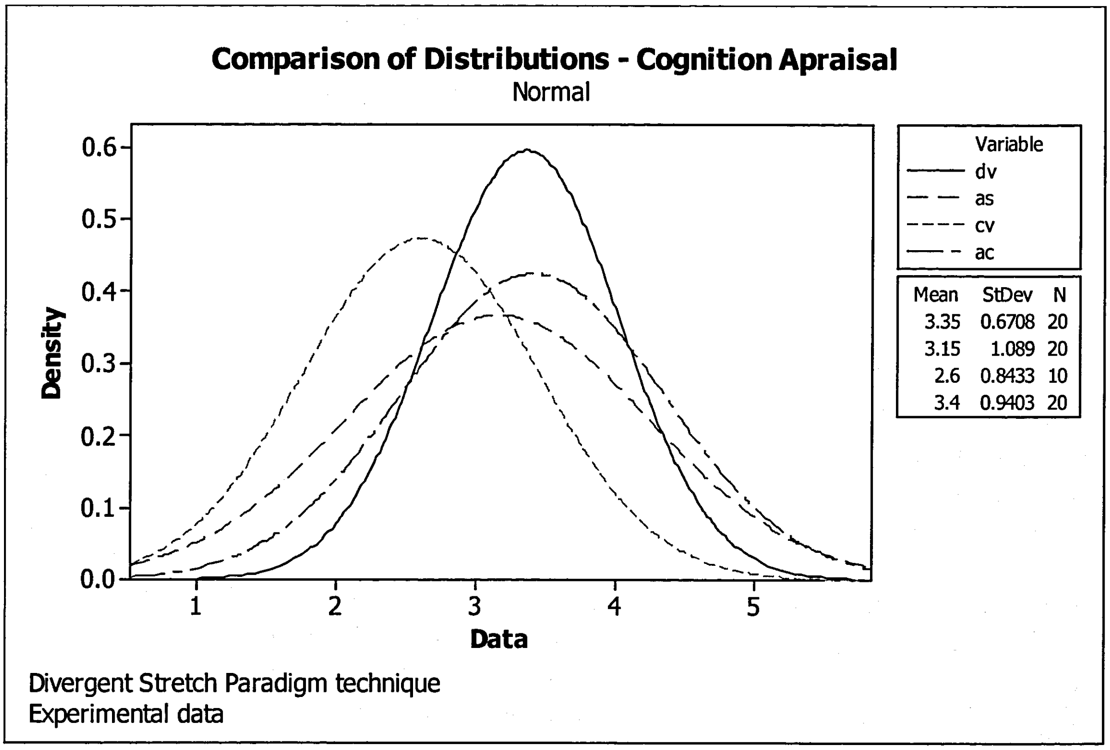
```
Two-sample T for r-dv vs r-cv

        N   Mean  StDev  SE Mean
r-dv  500   2.81   1.05    0.047
r-cv  500  2.448  0.722    0.032


Difference = mu (r-dv) - mu (r-cv)
Estimate for difference:  0.3596
95% lower bound for difference:  0.2657
T-Test of difference = 0 (vs >): T-Value = 6.30  P-Value = 0.000  DF = 884

MTB > TwoSample 'r-dv' 'r-ac';
SUBC>   Alternative 1.
```

Two-Sample T-Test and CI: r-dv, r-ac

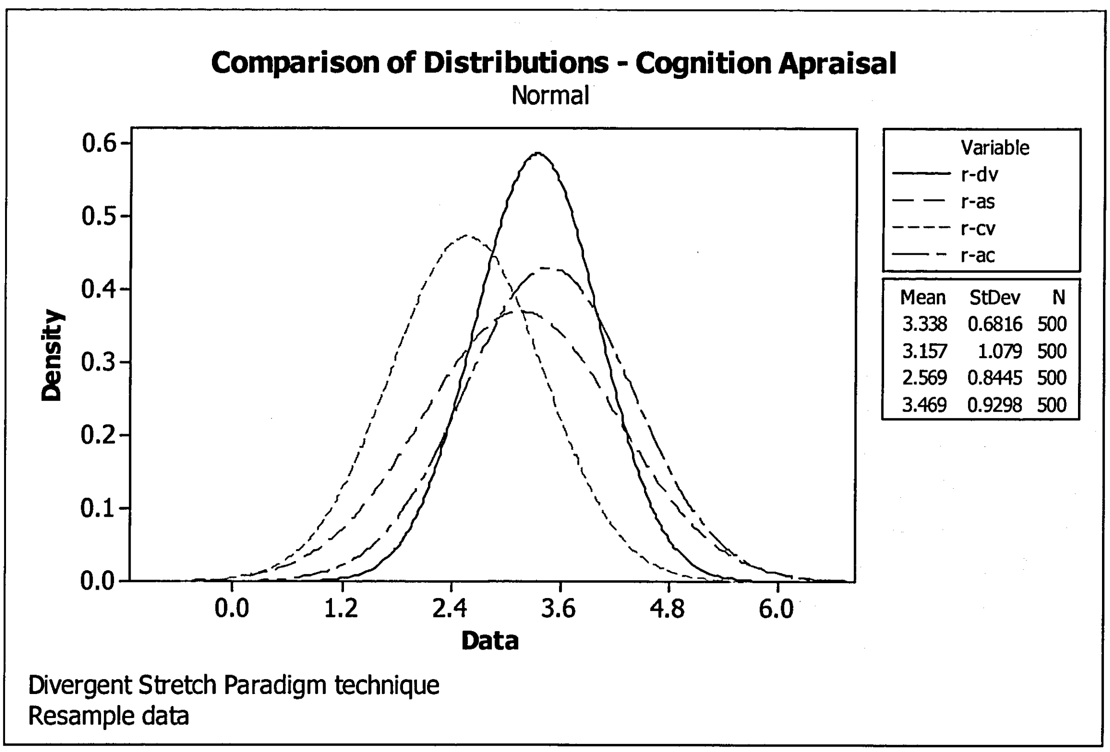
```
Two-sample T for r-dv vs r-ac

        N   Mean  StDev  SE Mean
r-dv  500   2.81   1.05    0.047
r-ac  500  3.004  0.977    0.044


Difference = mu (r-dv) - mu (r-ac)
Estimate for difference:  -0.1972
95% lower bound for difference:  -0.3028
T-Test of difference = 0 (vs >): T-Value = -3.07  P-Value = 0.999  DF = 992
```


Probability Plot of dv, as, cv, ac
Normal - 95% CI
dv
as
cv
ac
Percent
99
90
50
10
1
0.0
1.5
3.0
4.5
6.0
Cognition Divergent Stretchparadigm
Experiment Data
dv
Mean 3.35
StDev 0.6708
N 20
AD 2.025
P-Value <0.005
as
Mean 3.15
StDev 1.089
N 20
AD 1.500
P-Value <0.005
cv
Mean 2.6
StDev 0.8433
N 10
AD 1.285
P-Value <0.005
ac
Mean 3.4
StDev 0.9403
N 20
AD 1.060
P-Value 0.007


Probability Plot of r-dv, r-as, r-cv, r-ac
Normal - 95% CI
r-dv
r-as
r-cv
r-ac
Percent
99.9
99
90
50
10
1
0.1
0.0
1.5
3.0
4.5
6.0
Cognition Divergent Stretch paradigm
Resample Data
r-dv
Mean 3.338
StDev 0.6816
N 500
AD 0.233
P-Value 0.799
r-as
Mean 3.157
StDev 1.079
N 500
AD 0.323
P-Value 0.525
r-cv
Mean 2.569
StDev 0.8445
N 500
AD 0.538
P-Value 0.167
r-ac
Mean 3.469
StDev 0.9298
N 500
AD 0.287
P-Value 0.621



Comparison of Distributions - Cognition Apraisal
Normal
Density
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
Data
Variable
dv
as
cv
ac
Mean StDev N
3.35 0.6708 20
3.15 1.089 20
2.6 0.8433 10
3.4 0.9403 20
Divergent Stretch Paradigm technique
Experimental data



Comparison of Distributions - Cognition Apraisal
Normal
Density
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
1.2
2.4
3.6
4.8
6.0
Data
Variable
r-dv
r-as
r-cv
r-ac
Mean StDev N
3.338 0.6816 500
3.157 1.079 500
2.569 0.8445 500
3.469 0.9298 500
Divergent Stretch Paradigm technique
Resample data

Two-Sample T-Test and CI: r-dv, r-as

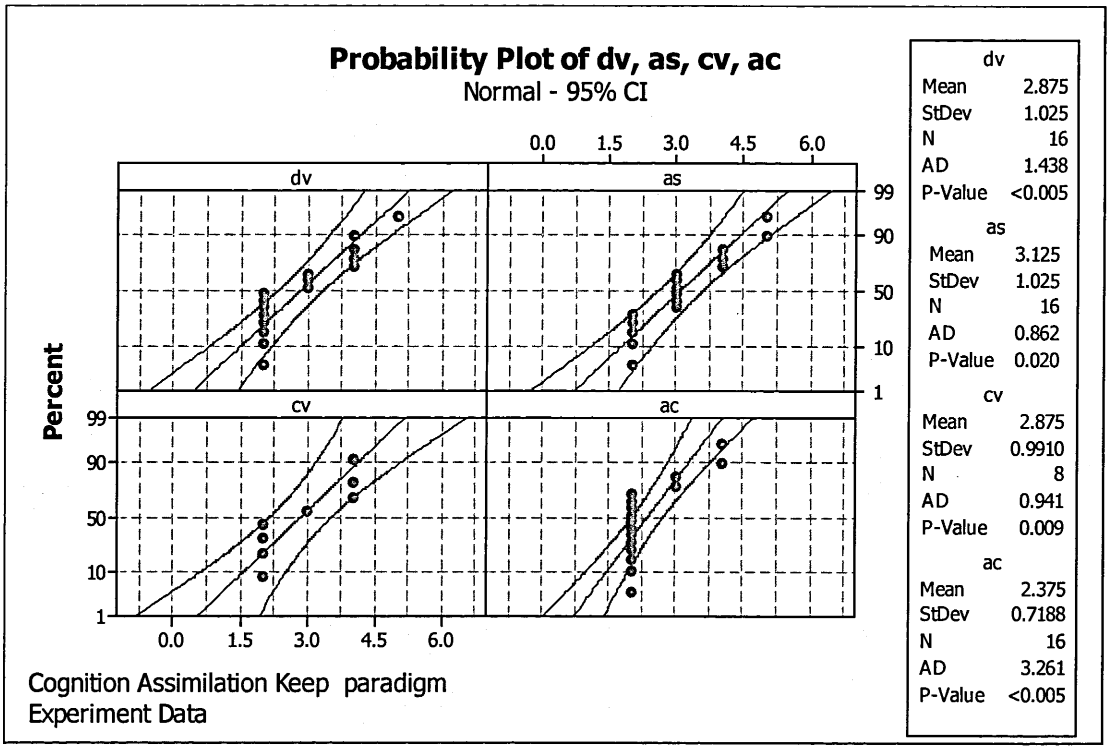
```
Two-sample T for r-dv vs r-as

        N   Mean  StDev  SE Mean
r-dv  500  3.338  0.682    0.030
r-as  500   3.16   1.08    0.048


Difference = mu (r-dv) - mu (r-as)
Estimate for difference:  0.1816
95% lower bound for difference:  0.0876
T-Test of difference = 0 (vs >): T-Value = 3.18  P-Value = 0.001  DF = 842

MTB > TwoSample 'r-dv' 'r-cv';
SUBC>   Alternative 1.
```

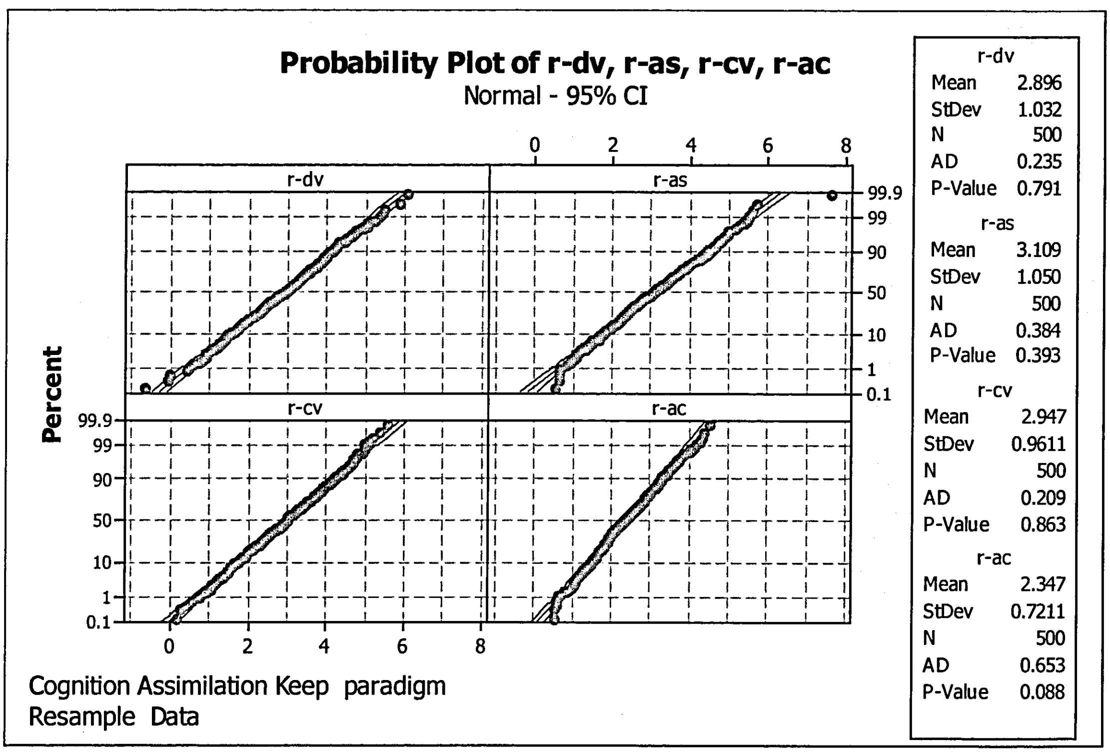
Two-Sample T-Test and CI: r-dv, r-cv

```
Two-sample T for r-dv vs r-cv

        N   Mean  StDev  SE Mean
r-dv  500  3.338  0.682    0.030
r-cv  500  2.569  0.844    0.038


Difference = mu (r-dv) - mu (r-cv)
Estimate for difference:  0.7694
95% lower bound for difference:  0.6895
T-Test of difference = 0 (vs >): T-Value = 15.85  P-Value = 0.000  DF = 955

MTB > TwoSample 'r-dv' 'r-ac';
SUBC>   Alternative 1.
```

Two-Sample T-Test and CI: r-dv, r-ac

```
Two-sample T for r-dv vs r-ac

        N   Mean  StDev  SE Mean
r-dv  500  3.338  0.682    0.030
r-ac  500  3.469  0.930    0.042


Difference = mu (r-dv) - mu (r-ac)
Estimate for difference:  -0.1304
95% lower bound for difference:  -0.2153
T-Test of difference = 0 (vs >): T-Value = -2.53  P-Value = 0.994  DF = 915
```


Probability Plot of dv, as, cv, ac
Normal - 95% CI
dv
as
cv
ac
Percent
99
90
50
10
1
0.0
1.5
3.0
4.5
6.0
Cognition Assimilation Keep paradigm
Experiment Data
dv
Mean 2.875
StDev 1.025
N 16
AD 1.438
P-Value <0.005
as
Mean 3.125
StDev 1.025
N 16
AD 0.862
P-Value 0.020
cv
Mean 2.875
StDev 0.9910
N 8
AD 0.941
P-Value 0.009
ac
Mean 2.375
StDev 0.7188
N 16
AD 3.261
P-Value <0.005


Probability Plot of r-dv, r-as, r-cv, r-ac
Normal - 95% CI
r-dv
r-as
r-cv
r-ac
Percent
99.9
99
90
50
10
1
0.1
0
2
4
6
8
Cognition Assimilation Keep paradigm
Resample Data
r-dv
Mean 2.896
StDev 1.032
N 500
AD 0.235
P-Value 0.791
r-as
Mean 3.109
StDev 1.050
N 500
AD 0.384
P-Value 0.393
r-cv
Mean 2.947
StDev 0.9611
N 500
AD 0.209
P-Value 0.863
r-ac
Mean 2.347
StDev 0.7211
N 500
AD 0.653
P-Value 0.088

Two-Sample T-Test and CI: r-as, r-dv

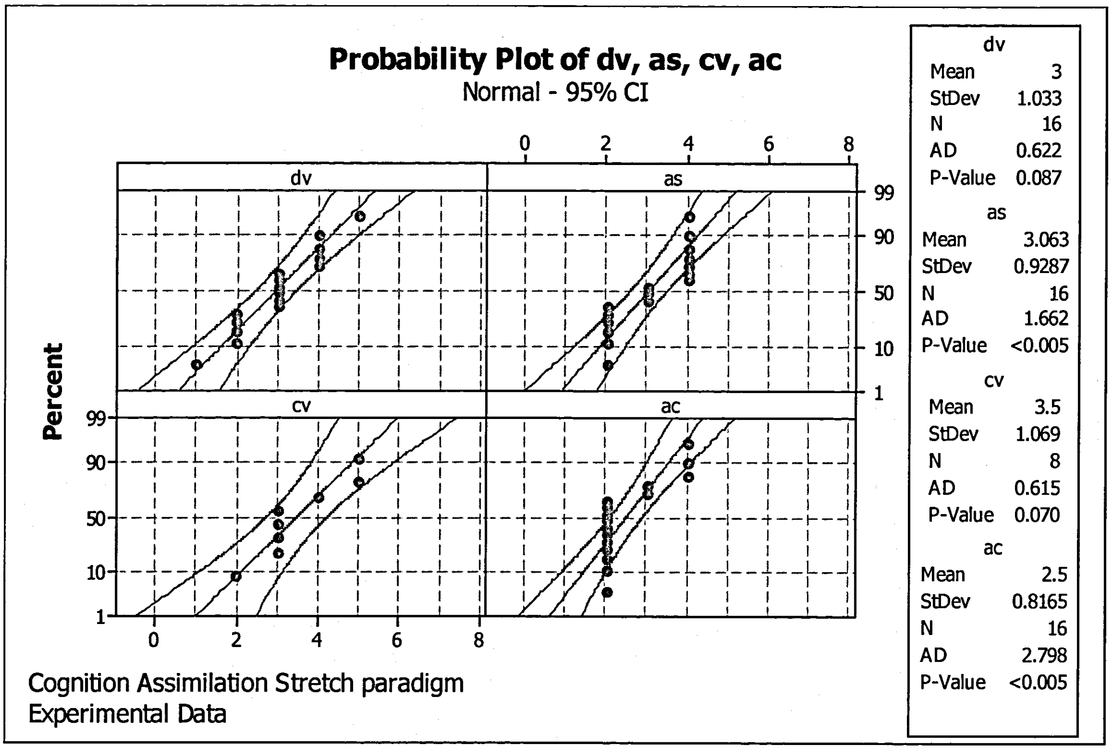
```
Two-sample T for r-as vs r-dv

        N  Mean  StDev  SE Mean
r-as  500  3.11   1.05    0.047
r-dv  500  2.90   1.03    0.046


Difference = mu (r-as) - mu (r-dv)
Estimate for difference:  0.2135
95% upper bound for difference:  0.3219
T-Test of difference = 0 (vs <): T-Value = 3.24  P-Value = 0.999  DF = 997

MTB > TwoSample 'r-as' 'r-cv';
SUBC>   Alternative -1.
```

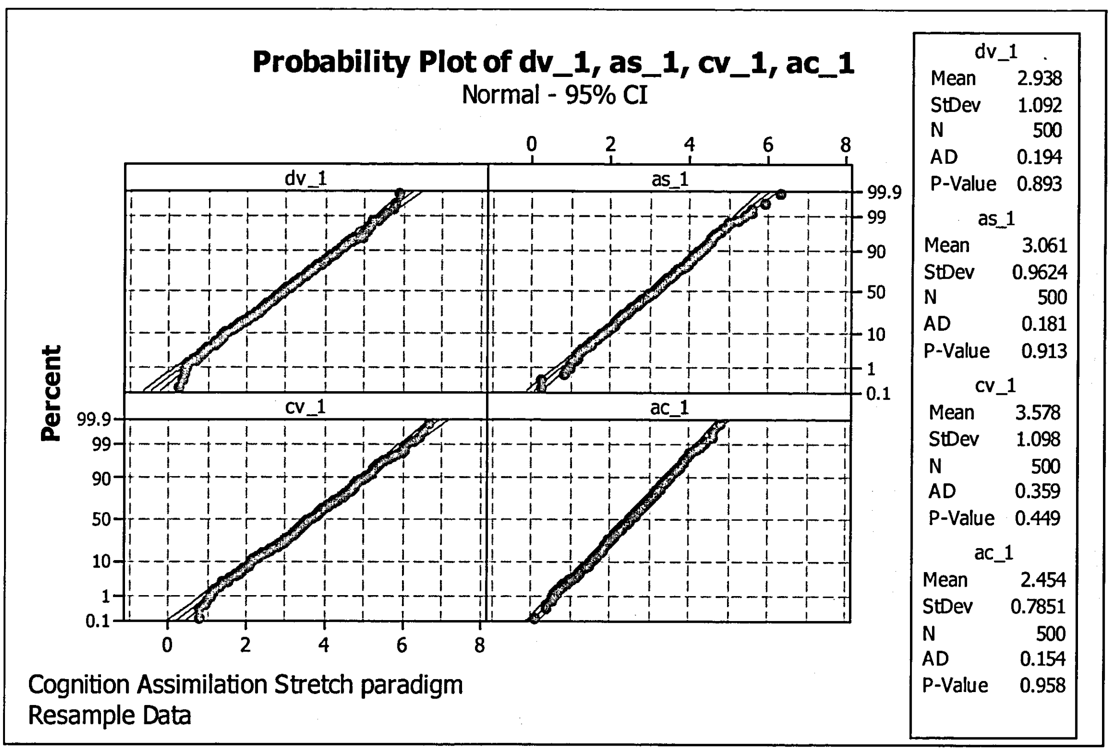
Two-Sample T-Test and CI: r-as, r-cv

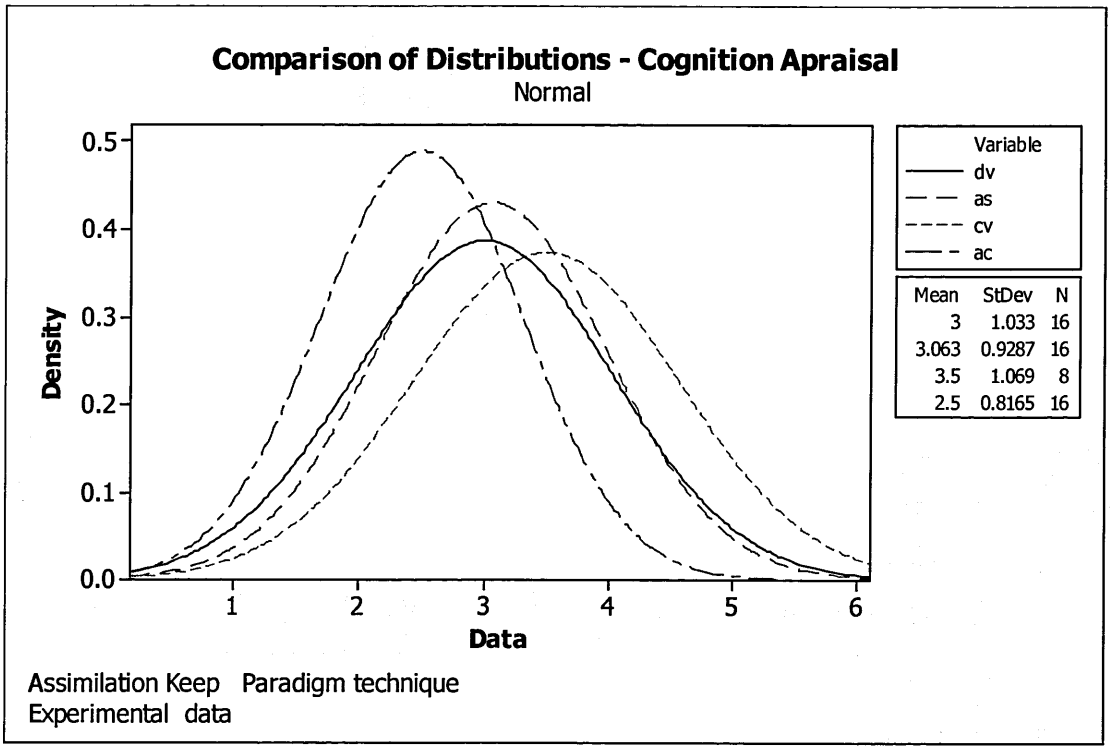
```
Two-sample T for r-as vs r-cv

        N   Mean  StDev  SE Mean
r-as  500   3.11   1.05    0.047
r-cv  500  2.947  0.961    0.043


Difference = mu (r-as) - mu (r-cv)
Estimate for difference:  0.1627
95% upper bound for difference:  0.2675
T-Test of difference = 0 (vs <): T-Value = 2.55  P-Value = 0.995  DF = 990

MTB > TwoSample 'r-as' 'r-ac';
SUBC>   Alternative -1.
```

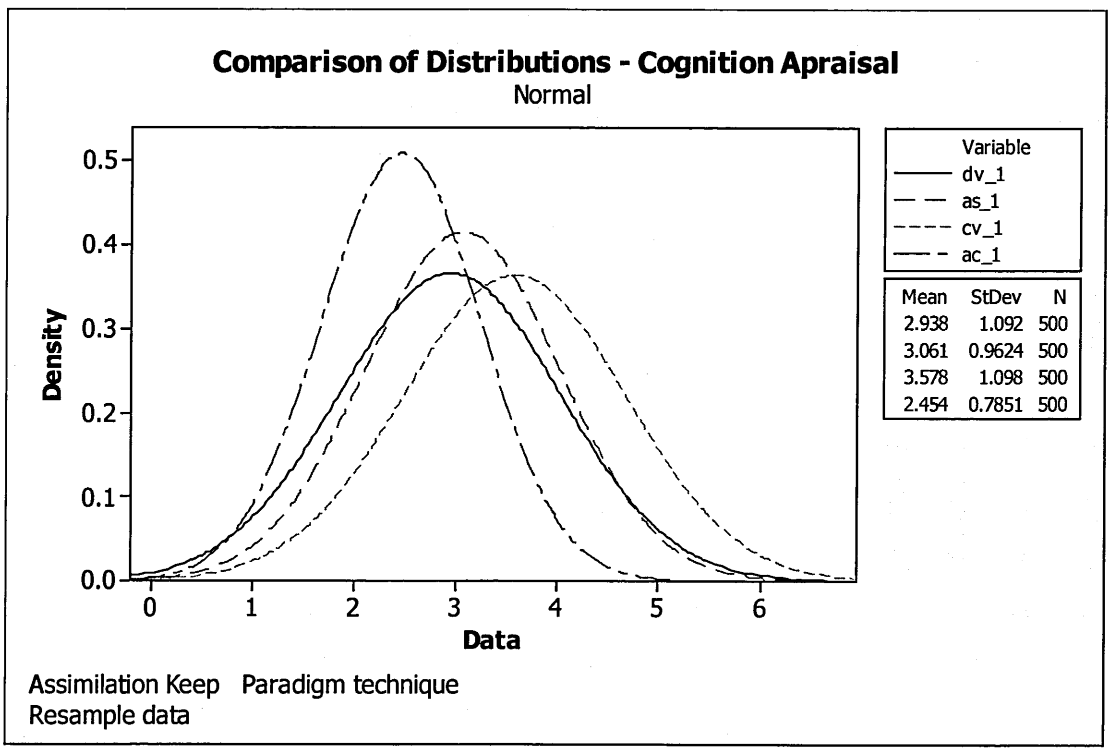
Two-Sample T-Test and CI: r-as, r-ac

```
Two-sample T for r-as vs r-ac

        N   Mean  StDev  SE Mean
r-as  500   3.11   1.05    0.047
r-ac  500  2.347  0.721    0.032


Difference = mu (r-as) - mu (r-ac)
Estimate for difference:  0.7629
95% upper bound for difference:  0.8567
T-Test of difference = 0 (vs <): T-Value = 13.39  P-Value = 1.000  DF = 883
```


Probability Plot of dv, as, cv, ac
Normal - 95% CI
dv
as
cv
ac
Percent
Cognition Assimilation Stretch paradigm
Experimental Data
dv
Mean 3
StDev 1.033
N 16
AD 0.622
P-Value 0.087
as
Mean 3.063
StDev 0.9287
N 16
AD 1.662
P-Value <0.005
cv
Mean 3.5
StDev 1.069
N 8
AD 0.615
P-Value 0.070
ac
Mean 2.5
StDev 0.8165
N 16
AD 2.798
P-Value <0.005


Probability Plot of dv_1, as_1, cv_1, ac_1
Normal - 95% CI
dv_1
as_1
cv_1
ac_1
Percent
Cognition Assimilation Stretch paradigm
Resample Data
dv_1
Mean 2.938
StDev 1.092
N 500
AD 0.194
P-Value 0.893
as_1
Mean 3.061
StDev 0.9624
N 500
AD 0.181
P-Value 0.913
cv_1
Mean 3.578
StDev 1.098
N 500
AD 0.359
P-Value 0.449
ac_1
Mean 2.454
StDev 0.7851
N 500
AD 0.154
P-Value 0.958


Comparison of Distributions - Cognition Apraisal
Normal
Density
Data
Variable
dv
as
cv
ac
Mean StDev N
3 1.033 16
3.063 0.9287 16
3.5 1.069 8
2.5 0.8165 16
Assimilation Keep Paradigm technique
Experimental data


Comparison of Distributions - Cognition Apraisal
Normal
Density
Data
Variable
dv_1
as_1
cv_1
ac_1
Mean StDev N
2.938 1.092 500
3.061 0.9624 500
3.578 1.098 500
2.454 0.7851 500
Assimilation Keep Paradigm technique
Resample data

Two-Sample T-Test and CI: as_1, dv_1

```
Two-sample T for as_1 vs dv_1

        N   Mean  StDev  SE Mean
as_1  500  3.061  0.962    0.043
dv_1  500   2.94   1.09    0.049


Difference = mu (as_1) - mu (dv_1)
Estimate for difference:  0.1235
95% upper bound for difference:  0.2307
T-Test of difference = 0 (vs <): T-Value = 1.90  P-Value = 0.971  DF = 982

MTB > TwoSample 'as_1' 'cv_1';
SUBC>   Alternative -1.
```

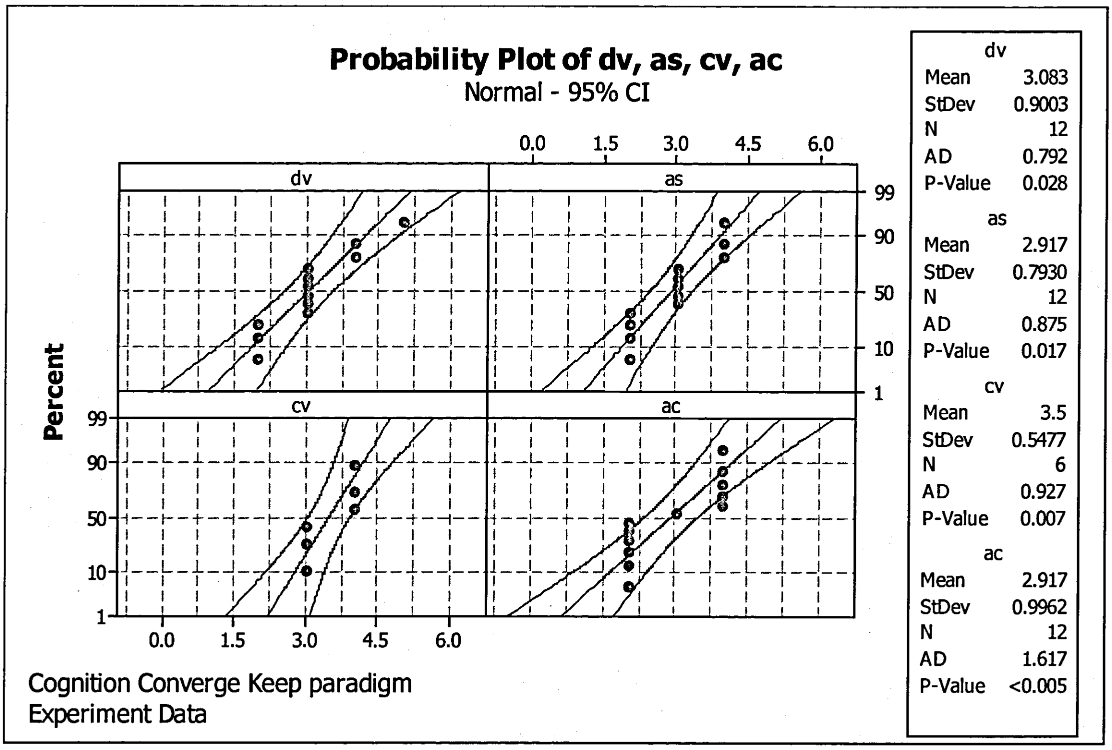
Two-Sample T-Test and CI: as_1, cv_1

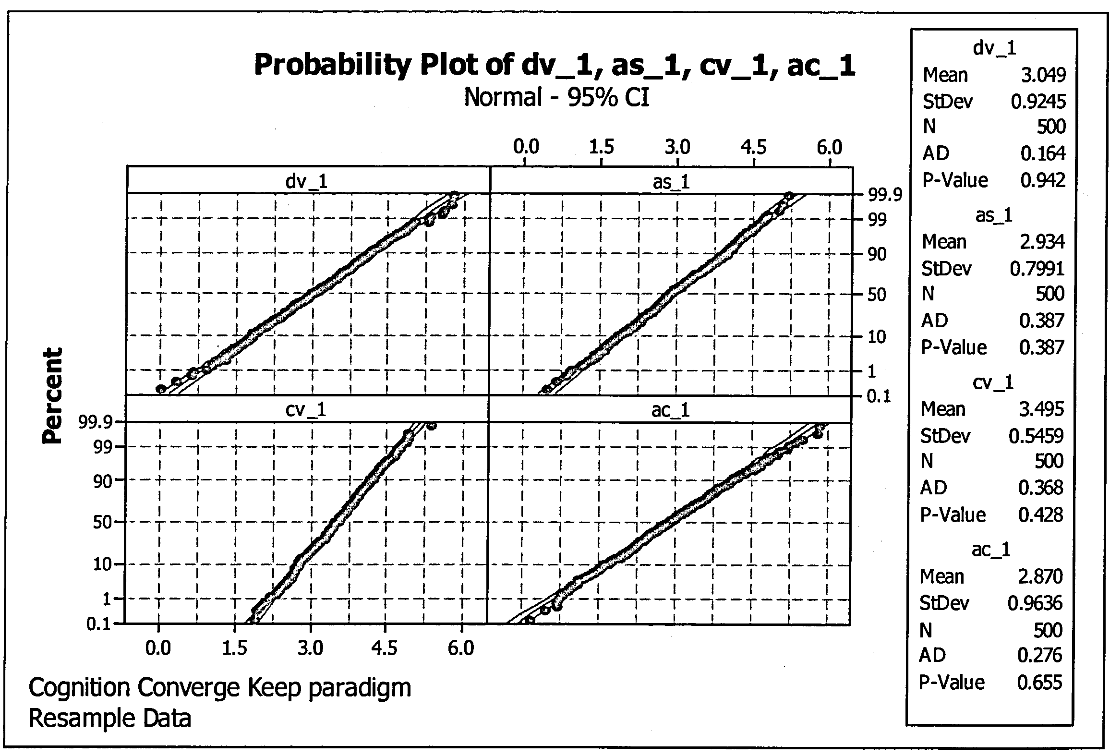
```
Two-sample T for as_1 vs cv_1

        N   Mean  StDev  SE Mean
as_1  500  3.061  0.962    0.043
cv_1  500   3.58   1.10    0.049


Difference = mu (as_1) - mu (cv_1)
Estimate for difference:  -0.5172
95% upper bound for difference:  -0.4096
T-Test of difference = 0 (vs <): T-Value = -7.92  P-Value = 0.000  DF = 981

MTB > TwoSample 'as_1' 'ac_1';
SUBC>   Alternative -1.
```

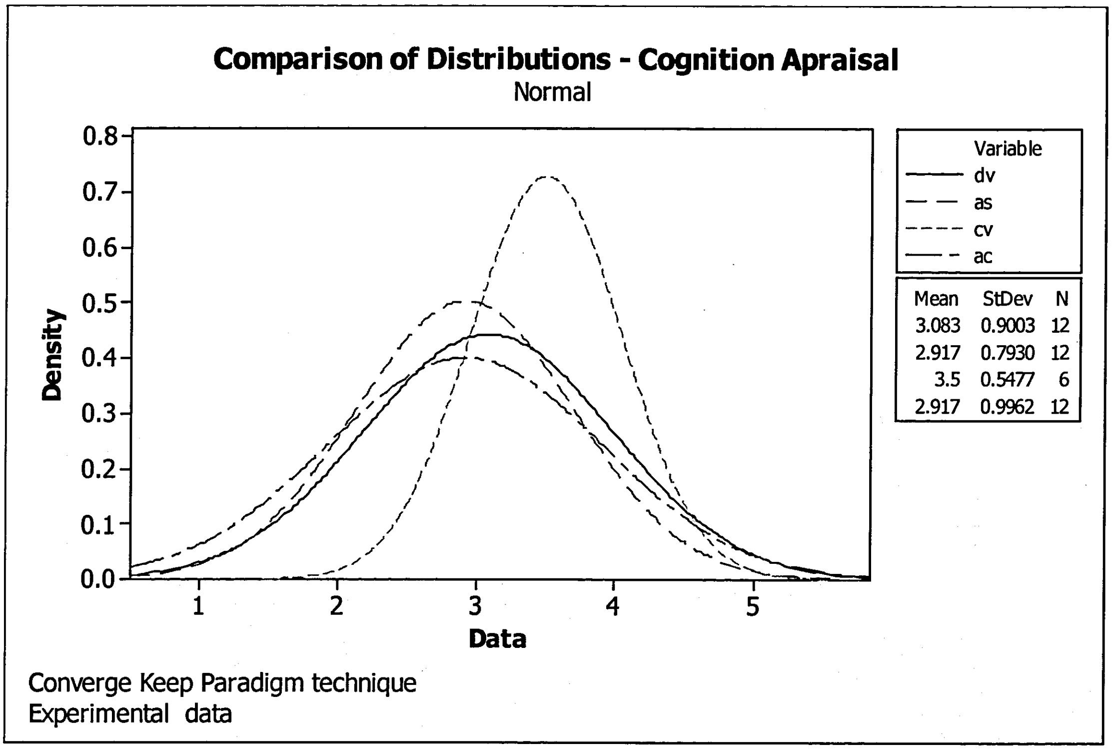
Two-Sample T-Test and CI: as_1, ac_1

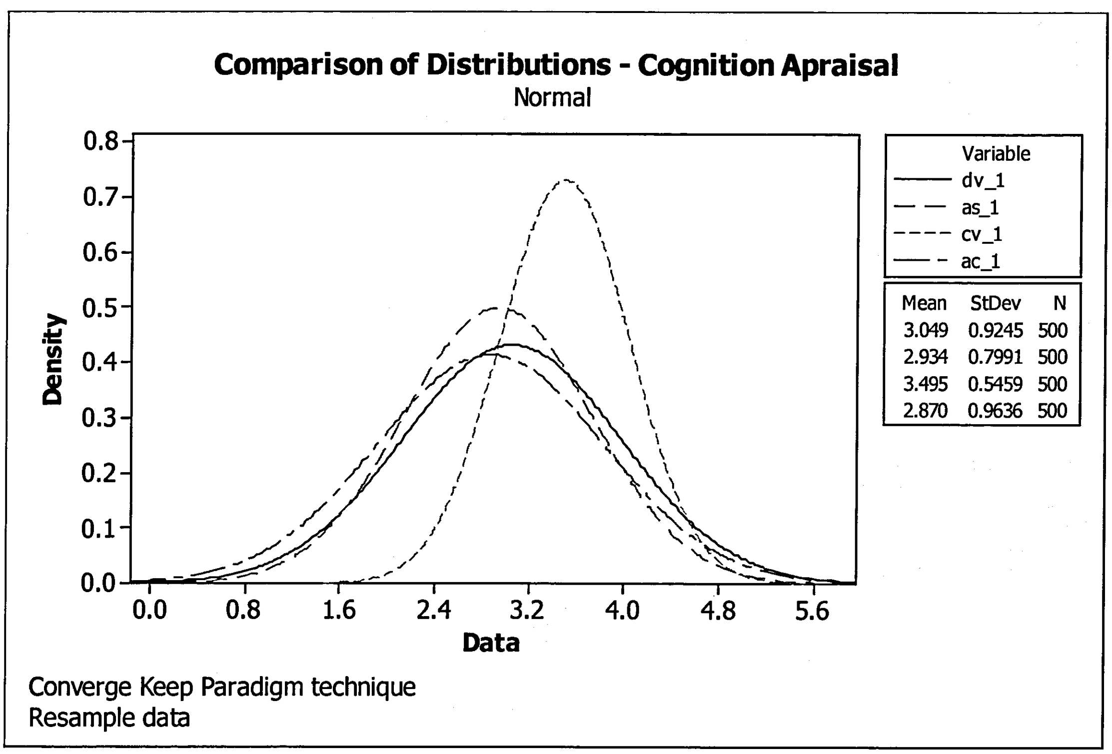
```
Two-sample T for as_1 vs ac_1

        N   Mean  StDev  SE Mean
as_1  500  3.061  0.962    0.043
ac_1  500  2.454  0.785    0.035


Difference = mu (as_1) - mu (ac_1)
Estimate for difference:  0.6076
95% upper bound for difference:  0.6991
T-Test of difference = 0 (vs <): T-Value = 10.94  P-Value = 1.000  DF = 959
```

Appendix 4 Normality & Parametric Testing


Probability Plot of dv, as, cv, ac
Normal - 95% CI
dv
as
cv
ac
Percent
0.0
1.5
3.0
4.5
6.0
99
90
50
10
1
Cognition Converge Keep paradigm
Experiment Data
dv
Mean 3.083
StDev 0.9003
N 12
AD 0.792
P-Value 0.028
as
Mean 2.917
StDev 0.7930
N 12
AD 0.875
P-Value 0.017
cv
Mean 3.5
StDev 0.5477
N 6
AD 0.927
P-Value 0.007
ac
Mean 2.917
StDev 0.9962
N 12
AD 1.617
P-Value <0.005


Probability Plot of dv_1, as_1, cv_1, ac_1
Normal - 95% CI
dv_1
as_1
cv_1
ac_1
Percent
0.0
1.5
3.0
4.5
6.0
99.9
99
90
50
10
1
0.1
Cognition Converge Keep paradigm
Resample Data
dv_1
Mean 3.049
StDev 0.9245
N 500
AD 0.164
P-Value 0.942
as_1
Mean 2.934
StDev 0.7991
N 500
AD 0.387
P-Value 0.387
cv_1
Mean 3.495
StDev 0.5459
N 500
AD 0.368
P-Value 0.428
ac_1
Mean 2.870
StDev 0.9636
N 500
AD 0.276
P-Value 0.655


Comparison of Distributions - Cognition Apraisal
Normal
Density
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
Data
Variable
dv
as
cv
ac
Mean StDev N
3.083 0.9003 12
2.917 0.7930 12
3.5 0.5477 6
2.917 0.9962 12
Converge Keep Paradigm technique
Experimental data


Comparison of Distributions - Cognition Apraisal
Normal
Density
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.8
1.6
2.4
3.2
4.0
4.8
5.6
Data
Variable
dv_1
as_1
cv_1
ac_1
Mean StDev N
3.049 0.9245 500
2.934 0.7991 500
3.495 0.5459 500
2.870 0.9636 500
Converge Keep Paradigm technique
Resample data

Two-Sample T-Test and CI: cv_1, dv_1

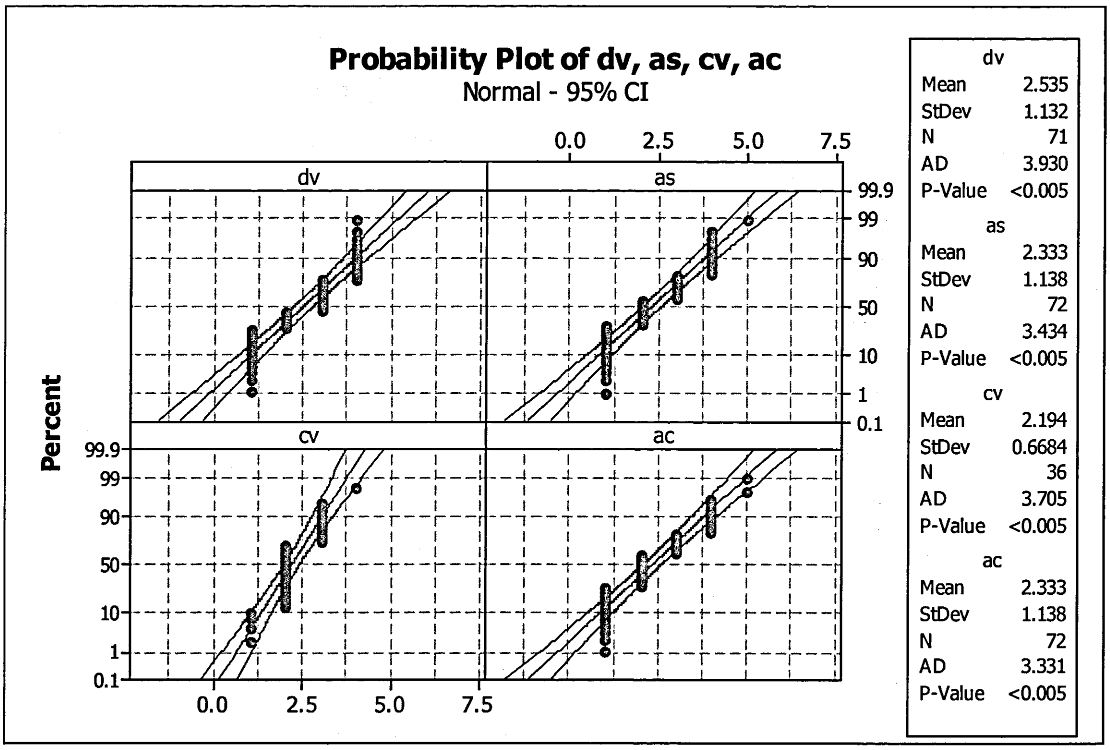
```
Two-sample T for cv_1 vs dv_1

        N   Mean  StDev  SE Mean
cv_1  500  3.495  0.546    0.024
dv_1  500  3.049  0.924    0.041


Difference = mu (cv_1) - mu (dv_1)
Estimate for difference:  0.4459
95% upper bound for difference:  0.5249
T-Test of difference = 0 (vs <): T-Value = 9.29  P-Value = 1.000  DF = 809

MTB > TwoSample 'cv_1' 'as_1';
SUBC>   Alternative -1.
```

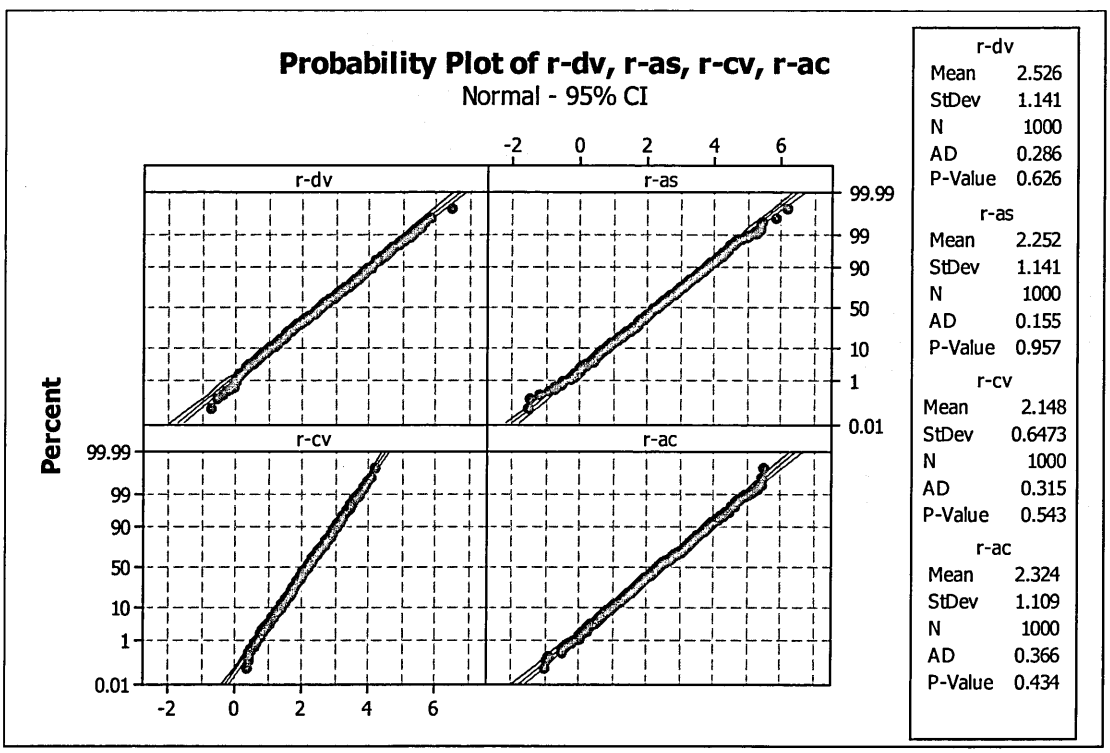
Two-Sample T-Test and CI: cv_1, as_1

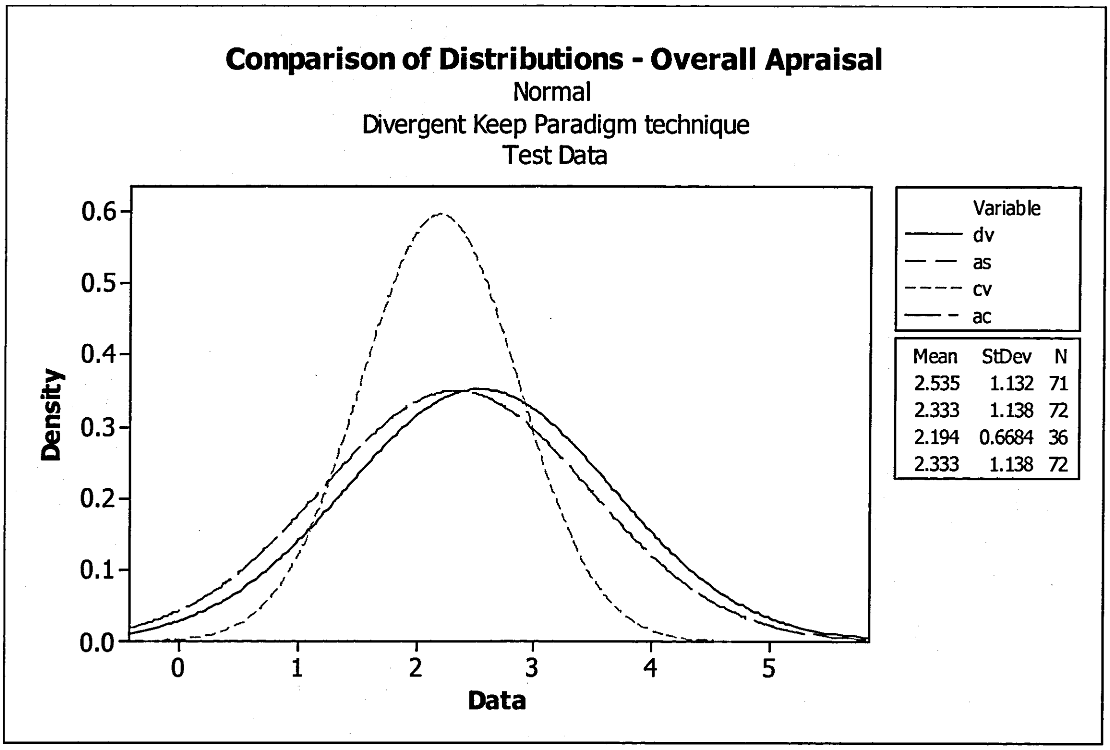
```
Two-sample T for cv_1 vs as_1

        N   Mean  StDev  SE Mean
cv_1  500  3.495  0.546    0.024
as_1  500  2.934  0.799    0.036


Difference = mu (cv_1) - mu (as_1)
Estimate for difference:  0.5606
95% upper bound for difference:  0.6319
T-Test of difference = 0 (vs <): T-Value = 12.95  P-Value = 1.000  DF = 881

MTB > TwoSample 'cv_1' 'ac_1';
SUBC>   Alternative -1.
```

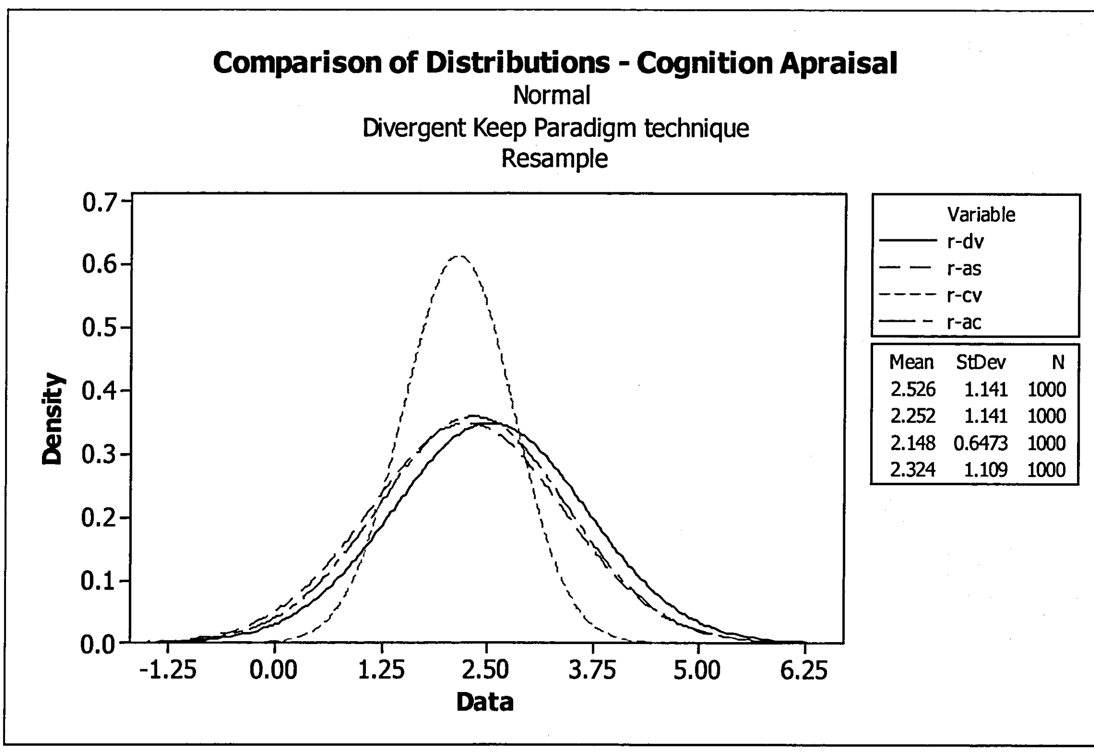
Two-Sample T-Test and CI: cv_1, ac_1

```
Two-sample T for cv_1 vs ac_1

        N   Mean  StDev  SE Mean
cv_1  500  3.495  0.546    0.024
ac_1  500  2.870  0.964    0.043


Difference = mu (cv_1) - mu (ac_1)
Estimate for difference:  0.6249
95% upper bound for difference:  0.7064
T-Test of difference = 0 (vs <): T-Value = 12.62  P-Value = 1.000  DF = 789

MTB >
```


Probability Plot of dv, as, cv, ac
Normal - 95% CI
dv
as
cv
ac
Percent
0.0
2.5
5.0
7.5
99.9
99
90
50
10
1
0.1
dv
Mean 2.535
StDev 1.132
N 71
AD 3.930
P-Value <0.005
as
Mean 2.333
StDev 1.138
N 72
AD 3.434
P-Value <0.005
cv
Mean 2.194
StDev 0.6684
N 36
AD 3.705
P-Value <0.005
ac
Mean 2.333
StDev 1.138
N 72
AD 3.331
P-Value <0.005


Probability Plot of r-dv, r-as, r-cv, r-ac
Normal - 95% CI
r-dv
r-as
r-cv
r-ac
Percent
-2
0
2
4
6
99.99
99
90
50
10
1
0.01
r-dv
Mean 2.526
StDev 1.141
N 1000
AD 0.286
P-Value 0.626
r-as
Mean 2.252
StDev 1.141
N 1000
AD 0.155
P-Value 0.957
r-cv
Mean 2.148
StDev 0.6473
N 1000
AD 0.315
P-Value 0.543
r-ac
Mean 2.324
StDev 1.109
N 1000
AD 0.366
P-Value 0.434


Comparison of Distributions - Overall Apraisal
Normal
Divergent Keep Paradigm technique
Test Data
Density
Data
Variable
dv
as
cv
ac
Mean StDev N
2.535 1.132 71
2.333 1.138 72
2.194 0.6684 36
2.333 1.138 72


Comparison of Distributions - Cognition Apraisal
Normal
Divergent Keep Paradigm technique
Resample
Density
Data
Variable
r-dv
r-as
r-cv
r-ac
Mean StDev N
2.526 1.141 1000
2.252 1.141 1000
2.148 0.6473 1000
2.324 1.109 1000

Two-Sample T-Test and CI: dv, r-dv

```
Two-sample T for dv vs r-dv

         N  Mean  StDev  SE Mean
dv      71  2.54   1.13     0.13
r-dv  1000  2.53   1.14    0.036


Difference = mu (dv) - mu (r-dv)
Estimate for difference:  0.009
95% CI for difference:  (-0.268, 0.286)
T-Test of difference = 0 (vs not =): T-Value = 0.07  P-Value = 0.948  DF = 80

MTB > VarTest 'dv' 'r-dv';
SUBC>   Unstacked.
```

Test for Equal Variances: dv, r-dv

```
95% Bonferroni confidence intervals for standard deviations

         N    Lower    StDev    Upper
  dv    71  0.95092  1.13176  1.39316
r-dv  1000  1.08616  1.14070  1.20080


F-Test (Normal Distribution)
Test statistic = 0.98, p-value = 0.969


Levene's Test (Any Continuous Distribution)
Test statistic = 0.10, p-value = 0.752
```

Two-Sample T-Test and CI: as, r-as

```
Two-sample T for as vs r-as

         N  Mean  StDev  SE Mean
as      72  2.33   1.14     0.13
r-as  1000  2.25   1.14    0.036


Difference = mu (as) - mu (r-as)
Estimate for difference:  0.082
95% CI for difference:  (-0.195, 0.358)
T-Test of difference = 0 (vs not =): T-Value = 0.59  P-Value = 0.558  DF = 81

MTB > VarTest 'as' 'r-as';
SUBC>   Unstacked.
```

Test for Equal Variances: as, r-as

```
95% Bonferroni confidence intervals for standard deviations

         N    Lower    StDev    Upper
  as    72  0.95752  1.13832  1.39898
r-as  1000  1.08656  1.14113  1.20125


F-Test (Normal Distribution)
Test statistic = 1.00, p-value = 0.983
```

```
Levene's Test (Any Continuous Distribution)
Test statistic = 0.21, p-value = 0.647
```

Two-Sample T-Test and CI: cv, r-cv

```
Two-sample T for cv vs r-cv

         N   Mean  StDev  SE Mean
cv      36  2.194  0.668     0.11
r-cv  1000  2.148  0.647    0.020


Difference = mu (cv) - mu (r-cv)
Estimate for difference:  0.047
95% CI for difference:  (-0.183, 0.276)
T-Test of difference = 0 (vs not =): T-Value = 0.41  P-Value = 0.681  DF = 37

MTB > VarTest 'cv' 'r-cv';
SUBC>   Unstacked.
```

Test for Equal Variances: cv, r-cv

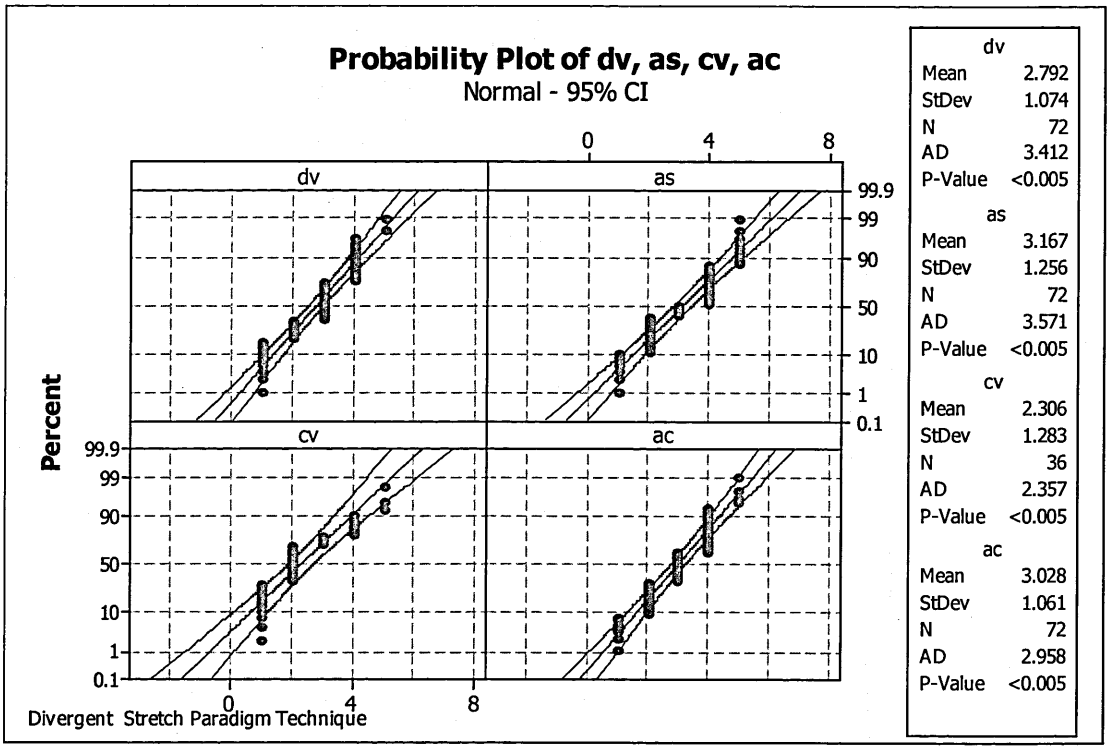
```
95% Bonferroni confidence intervals for standard deviations

         N     Lower     StDev     Upper
  cv    36  0.526743  0.668450  0.907891
r-cv  1000  0.616379  0.647334  0.681439


F-Test (Normal Distribution)
Test statistic = 1.07, p-value = 0.732

Levene's Test (Any Continuous Distribution)
Test statistic = 2.12, p-value = 0.145
```

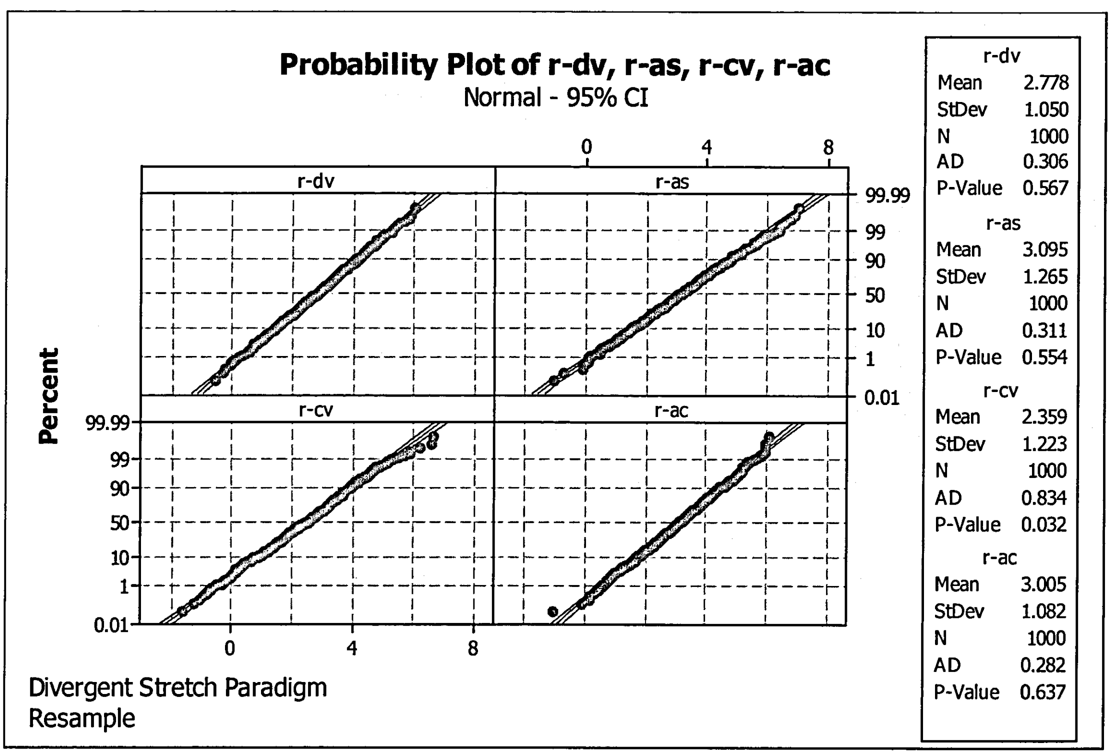
Two-Sample T-Test and CI: ac, r-ac

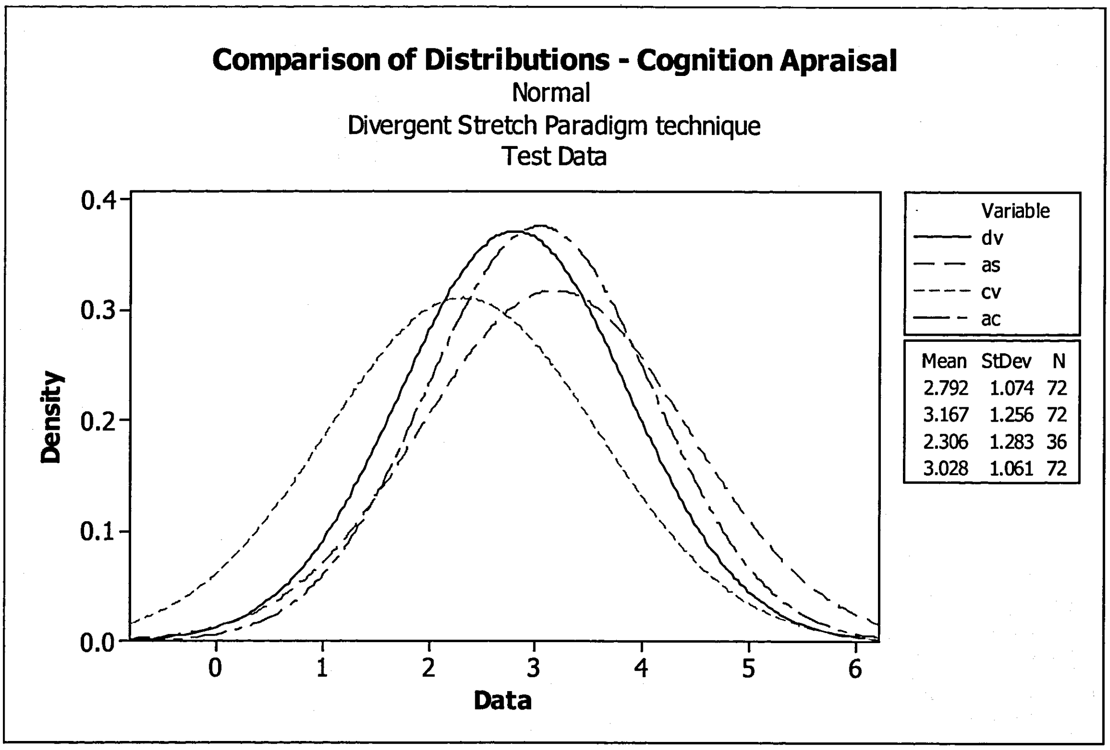
```
Two-sample T for ac vs r-ac

         N  Mean  StDev  SE Mean
ac      72  2.33   1.14     0.13
r-ac  1000  2.32   1.11    0.035

Difference = mu (ac) - mu (r-ac)
Estimate for difference:  0.009
95% CI for difference:  (-0.267, 0.285)
T-Test of difference = 0 (vs not =): T-Value = 0.07  P-Value = 0.948  DF = 81
```

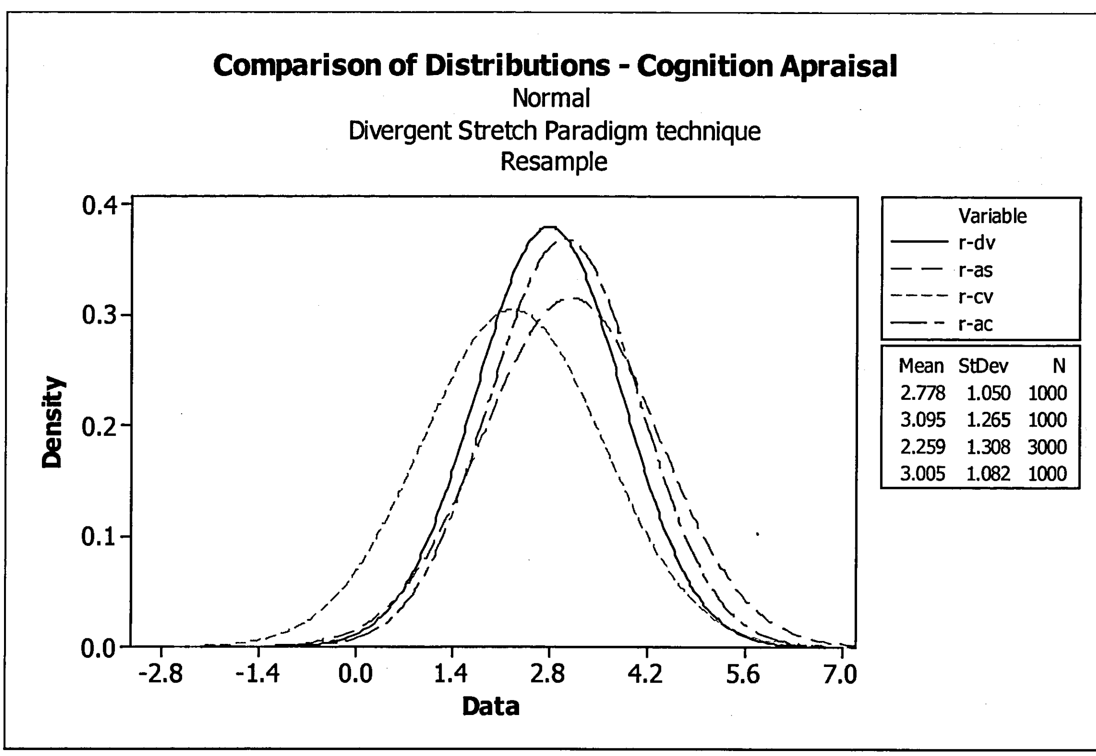
Test for Equal Variances: ac, r-ac

```
95% Bonferroni confidence intervals for standard deviations

         N    Lower    StDev    Upper
  ac    72  0.95752  1.13832  1.39898
r-ac  1000  1.05557  1.10858  1.16699

F-Test (Normal Distribution)
Test statistic = 1.05, p-value = 0.721

Levene's Test (Any Continuous Distribution)
Test statistic = 0.00, p-value = 0.996
```

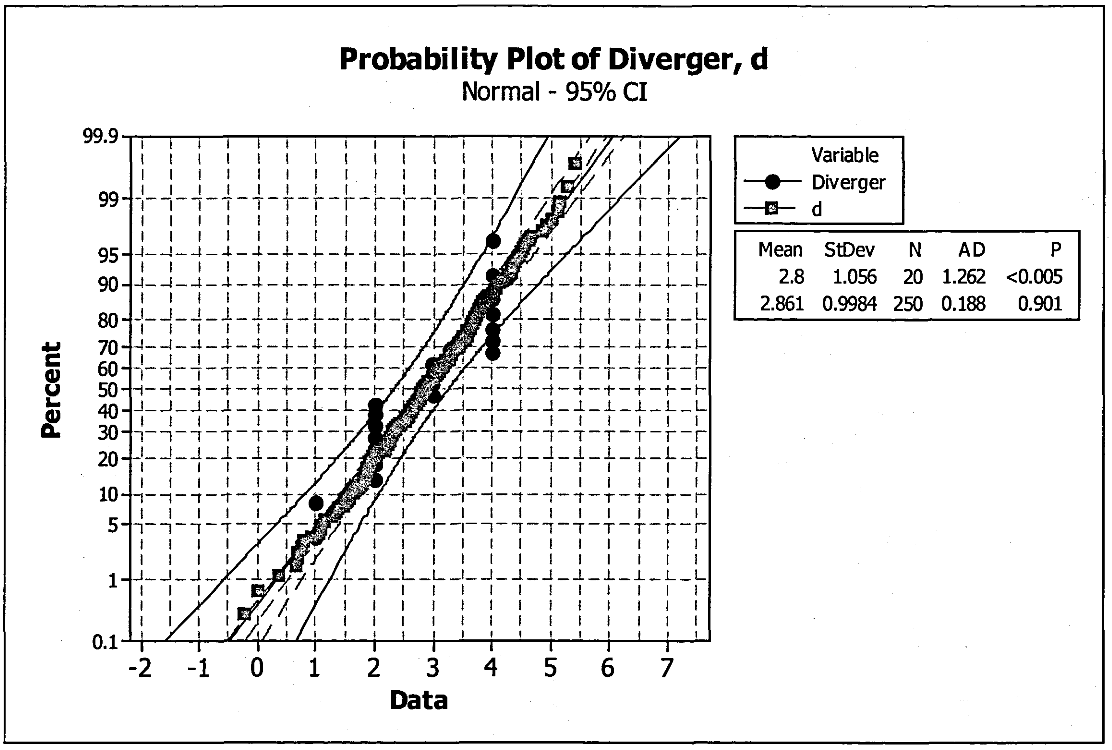

Probability Plot of dv, as, cv, ac
Normal - 95% CI
dv
as
cv
ac
Percent
Divergent Stretch Paradigm Technique
dv
Mean 2.792
StDev 1.074
N 72
AD 3.412
P-Value <0.005
as
Mean 3.167
StDev 1.256
N 72
AD 3.571
P-Value <0.005
cv
Mean 2.306
StDev 1.283
N 36
AD 2.357
P-Value <0.005
ac
Mean 3.028
StDev 1.061
N 72
AD 2.958
P-Value <0.005


Probability Plot of r-dv, r-as, r-cv, r-ac
Normal - 95% CI
r-dv
r-as
r-cv
r-ac
Percent
Divergent Stretch Paradigm
Resample
r-dv
Mean 2.778
StDev 1.050
N 1000
AD 0.306
P-Value 0.567
r-as
Mean 3.095
StDev 1.265
N 1000
AD 0.311
P-Value 0.554
r-cv
Mean 2.359
StDev 1.223
N 1000
AD 0.834
P-Value 0.032
r-ac
Mean 3.005
StDev 1.082
N 1000
AD 0.282
P-Value 0.637


Comparison of Distributions - Cognition Apraisal
Normal
Divergent Stretch Paradigm technique
Test Data
Density
Data
Variable
dv
as
cv
ac
Mean StDev N
2.792 1.074 72
3.167 1.256 72
2.306 1.283 36
3.028 1.061 72


Comparison of Distributions - Cognition Apraisal
Normal
Divergent Stretch Paradigm technique
Resample
Density
Data
Variable
r-dv
r-as
r-cv
r-ac
Mean StDev N
2.778 1.050 1000
3.095 1.265 1000
2.259 1.308 3000
3.005 1.082 1000

Resample Summary Tables Here



Two-Sample T-Test and CI: Diverger, d

```
Two-sample T for Diverger vs d

            N   Mean  StDev  SE Mean
Diverger   20   2.80   1.06     0.24
d         250  2.861  0.998    0.063


Difference = mu (Diverger) - mu (d)
Estimate for difference:  -0.061
95% CI for difference:  (-0.569, 0.448)
T-Test of difference = 0 (vs not =): T-Value = -0.25  P-Value = 0.806  DF = 21
```

Comparison of Sample & Resample Means and variances

Phase	Paradigm	Perspective	User	Sample			Resample			Normality
				n	M	SD	N	M	SD	A-D value
Diverge	Keep	Cognition	*Diverger*	20	2.8	1.056	500	*2.807*	*1.051*	0.255
			Assimilator	20	2.95	0.826	500	*2.974*	*0.8036*	0.231
			Converger	10	2.5	0.707	500	*2.448*	*0.7223*	0.366
			Accom'r	20	2.95	0.999	500	*3.004*	*0.977*	0.100
Diverge	Stretch	Cognition	*Diverger*	20	3.35	0.671	500	*3.338*	*0.6816*	0.233
			Assimilator	20	3.15	1.089	500	*3.157*	*1.079*	0.323
			Converger	10	2.6	0.803	500	*2.569*	*0.8445*	0.538
			Accom'r	20	3.4	0.94	500	*3.469*	*0.9298*	0.287
Assimilate	Keep	Cognition	*Diverger*	16	2.875	1.025	500	*2.896*	*1.032*	0.235
			Assimilator	16	3.125	1.025	500	*3.109*	*1.05*	0.384
			Converger	8	2.875	0.991	500	*2.947*	*0.9611*	0.209
			Accom'r	16	2.375	0.71	500	*2.347*	*0.7211*	0.653
Assimilate	Stretch	Cognition	*Diverger*	16	3	1.033	500	*2.938*	*1.092*	0.194
			Assimilator	16	3.063	0.929	500	*3.061*	*0.9624*	0.181
			Converger	8	3.5	1.096	500	*3.578*	*1.098*	0.359
			Accom'r	16	2.6	0.817	500	*2.454*	*0.7851*	0.154
Converge	Keep	Cognition	*Diverger*	12	3.083	0.9	500	*3.049*	*0.9245*	0.164
			Assimilator	12	2.917	0.793	500	*2.934*	*0.7991*	0.387
			Converger	6	3.5	0.548	500	*3.495*	*0.5459*	0.368
			Accom'r	12	2.917	0.996	500	*2.87*	*0.9636*	0.368
Converge	Stretch	Cognition	*Diverger*	12	3.083	0.9003	500	3.049	0.9245	0.164
			Assimilator	12	2.917	0.7930	500	2.934	0.7991	0.387
			Converger	6	3.5	0.5477	500	3.495	0.5459	0.368
			Accom'r	12	2.917	0.9962	500	2.870	0.9636	0.276

All the computer generated samples passed the Anderson-Darling normality tests, alpha = 0.05. Graphs of the distributions of both experiment and resample data were made.

With 95% confidence that the calculated distributions represent the data, one subtle question remains.

How confident can one be that a calculated distribution represents the population from which the data came? The reason underlying this question is randomness. One can take many independent samples from a common population and end up with different estimations of the position of the population mean.

According to Chatfield (1995) the standard error of an estimated mean with an unknown variance is calculated using Students t-distribution and the sample variance. The standard errors are in Table 37.

Standard Error of Estimates

Phase	Paradigm	Perspective	*User*	Std Errors	
				Sample	Resample
				N= as per sample	*N=500*
Diverge	Keep	Cognition	*Diverger*	0.236129	0.0470021
			Assimilator	0.18461	0.0359381
			Converger	0.223605	0.0323022
			Accom'r	0.223316	0.0436928
Diverge	Stretch	Cognition	*Diverger*	0.149995	0.0304821
			Assimilator	0.243508	0.0482543
			Converger	0.254026	0.0377672
			Accom'r	0.210257	0.0415819
Assimilate	Keep	Cognition	*Diverger*	0.25625	0.0461524
			Assimilator	0.25625	0.0469574
			Converger	0.350371	0.0429817
			Accom'r	0.1775	0.0322486
Assimilate	Stretch	Cognition	*Diverger*	0.25825	0.0488357
			Assimilator	0.232175	0.0430398
			Converger	0.387495	0.0491041
			Accom'r	0.204125	0.0351107
Converge	Keep	Cognition	*Diverger*	0.259894	0.0413449
			Assimilator	0.228919	0.0357368
			Converger	0.223598	0.0244134
			Accom'r	0.287578	0.0430935
Converge	Stretch	Cognition	*Diverger*	0.566	0.081
			Assimilator	0.499	0.07
			Converger	0.5478	0.0478
			Accom'r	0.627	0.09845

Table shows a clear decrease in the size of the standard error the estimation of the means of the calculated distributions from sample, to resample.

Synopsis of Parametric Statistical Analysis Student T-tests

Table 22

H0: Show preference to techniques in accord with personal style *alpha = 5%*					
Technique		Perspective			
		Learning Style		Creative Style	
		Cognition	Action	Ideation	Outcomes
Keep Paradigm	Diverge	Divergers showed greater preference	Divergers showed greater preference	Receptives showed greater preference than Perceptives	Receptives showed greater preference than Perceptives
	Assimilate	Assimilators showed greater preference	Assimilators showed greater preference		
	Converge	Convergers **did not** show greater preference	Convergers showed greater preference		
	Accommodate	Not tested	Not tested		
Stretch Paradigm	Diverge	Divergers, showed greater preference	Divergers showed no preference	Receptives did show greater preference than Perceptives *Much less so than for Keep Paradigms*	Receptives showed greater preference than Perceptives *More so than for Keep Paradigms*
	Assimilate	*The Assimilators "could not be rejected"*	*The Assimilators "could not be rejected"*		
	Converge	Convergers **did not show** greater preference.	Convergers **did show** greater preference		
	Accommodate	Not tested	Not tested		

Appendix 5 Qualitative Analysis

Respondent Appraisals of Divergent Techniques – by Learning Style

Assess Cognition for *Divergent* Technique	Type of Respondent								Totals		
	Divergers		*Assimilators*		*Convergers*		*Accommodators*				
	keep	stretch	keep	stretch	keep	stretch	keep-	stretch	keep-	stretch	all
Strongly Favourable	0	0	0	0	0	0	1	1	1	1	2
Favourable	6	6	3	0	1	2	2	2	12	10	22
Uncertain	4	5	4	1	3	2	3	2	14	10	24
Unfavourable	5	1	3	7	6	4	4	3	18	15	33
Strongly Unfavourable	0	0	0	0	0	0	0	0	0	0	0
Total	**15**	**12**	**10**	**8**	**10**	**8**	**10**	**8**	**45**	**36**	**81**

Respondent Appraisals of Assimilation Techniques– by Learning Style

Assess Cognition for *Converge* Technique	Type of Respondent								Totals		
	Divergers		*Assimilators*		*Convergers*		*Accommodators*				
	keep	stretch	keep	stretch	keep	stretch	Keep	stretch	keep	stretch	all
Strongly Favourable	1	2	0	0	0	3	0	0	1	5	6
Favourable	2	1	1	0	3	2	0	0	6	3	9
Uncertain	3	3	2	2	3	1	0	2	8	8	16
Unfavourable	3	3	3	4	0	0	6	4	12	11	23
Strongly Unfavourable	0	0	0	0	0	0	0	0	0	0	0
Total	**9**	**9**	**6**	**6**	**6**	**6**	**6**	**6**	**27**	**27**	**54**

Appraisals of Convergent Techniques – by Learning Style

Assess Cognition for *Assimilation* Technique	Type of Respondent								Totals		
	Divergers		*Assimilators*		*Convergers*		*Accommodators*				
	keep	stretch	keep	stretch	keep	stretch	keep-	stretch	keep-	stretch	all
Strongly Favourable	0	1	0	0	0	2	0	0	0	3	3
Favourable	3	4	1	1	3	1	0	1	7	7	14
Uncertain	2	5	3	2	1	4	1	0	7	11	18
Unfavourable	7	2	4	5	4	1	7	7	22	15	37
Strongly Unfavourable	0	0	0	0	0	0	0	0	0	0	0
Total	**12**	**12**	**8**	**8**	**8**	**8**	**8**	**8**	**36**	**36**	**72**

Respondent Appraisals of Divergent Techniques – by Style Similarity

Assess Cognition for *Divergent* Technique	Type of Respondent						Totals		
	Match		*Neighbour*		*Oppose*				
	keep	stretch	keep	stretch	keep	stretch	keep-	Stretch	all
Strongly Favourable	0	0	1	1	0	0	1	1	2
Favourable	6	6	5	2	1	2	12	10	22
Uncertain	4	5	7	3	3	2	14	10	24
Unfavourable	5	1	7	10	6	4	18	15	33
Strongly Unfavourable	0	0	0	0	0	0	0	0	0
Total	**15**	**12**	**20**	**16**	**10**	**8**	45	36	**81**

Respondent Appraisals of Assimilation Techniques – by Style Similarity

Assess Cognition for *Assimilation* Technique	Type of Respondent						Totals		
	Match		*Neighbour*		*Oppose*				
	keep	stretch			keep	stretch	keep-	Stretch	all
Strongly Favourable	0	0	0	1	0	2	0	3	3
Favourable	1	1	3	5	3	1	7	7	14
Uncertain	3	2	3	5	1	4	7	11	18
Unfavourable	4	5	14	9	4	1	22	15	37
Strongly Unfavourable	0	0	0	0	0	0	0	0	0
Total	**8**	**8**	**20**	**20**	**8**	**8**	36	36	**72**

Respondent Appraisals of Convergent Techniques – by Style Similarity

Assess Cognition for *Converge* Technique	Type of Respondent						Totals		
	Match		*Neighbour*		*Oppose*				
	keep	stretch	keep	stretch	keep	stretch	keep-	Stretch	all
Strongly Favourable	0	3	0	0	1	2	1	5	6
Favourable	3	2	1	0	2	1	6	3	9
Uncertain	3	1	2	4	3	3	8	8	16
Unfavourable	0	0	9	8	3	3	12	11	23
Strongly Unfavourable	0	0	0	0	0	0	0	0	0
Total	**6**	**6**	**12**	**12**	**9**	**9**	**27**	**27**	**54**

	accommodator	assimilate	Assimilator	converge	converger	diverge	experience negative	experience positive	keep	perceptive	Receptive	stretch	technique negative	technique positive	TOTALS:
accommodator	0	0.22	0	0.2	0	0.25	0.12	0	0.17	0.5	0	0.33	0.2	0.15	2.14
assimilate	0.22	0	0.22	0.06	0.13	0.05	0.14	0.08	0.33	0.4	0.13	0.44	0.13	0.18	2.52
Assimilator	0	0.22	0	0.33	0	0.25	0.12	0.33	0.75	0.29	0.33	0.6	0.2	0.25	3.68
converge	0.2	0.06	0.33	0	0.11	0.11	0.14	0.17	0.3	0.5	0.11	0.4	0.2	0.05	2.68
converger	0	0.13	0	0.11	0	0.08	0.06	0.2	0	0.17	0	0	0	0	0.75
diverge	0.25	0.05	0.25	0.11	0.08	0	0.33	0.31	0.33	0.5	0.08	0.42	0.17	0.26	3.15
experience negative	0.12	0.14	0.12	0.14	0.06	0.33	0	0.11	0.11	0.29	0	0.11	0	0	1.53
experience positive	0	0.08	0.33	0.17	0.2	0.31	0.11	0	0.13	0.22	0.2	0.11	0	0	1.85
keep	0.17	0.33	0.75	0.3	0	0.33	0.11	0.13	0	0.43	0.25	0	0.18	0.23	3.21
perceptive	0.5	0.4	0.29	0.5	0.17	0.5	0.29	0.22	0.43	0	0	0.57	0.36	0.29	4.52
Receptive	0	0.13	0.33	0.11	0	0.08	0	0.2	0.25	0	0	0.2	0	0.08	1.39
stretch	0.33	0.44	0.6	0.4	0	0.42	0.11	0.11	0	0.57	0.2	0	0.17	0.31	3.66
technique negative	0.2	0.13	0.2	0.2	0	0.17	0	0	0.18	0.36	0	0.17	0	0	1.61
technique positive	0.15	0.18	0.25	0.05	0	0.26	0	0	0.23	0.29	0.08	0.31	0	0	1.8

	P 4: comments list.doc	TOTALS:
**experience negative WITHIN accommodator WITHIN assimila..	6	6
**experience negative WITHIN accommodator WITHIN converge..	4	4
**experience negative WITHIN accommodator WITHIN diverge..	4	4
**experience negative WITHIN Assimilator WITHIN assimilat..	2	2
**experience negative WITHIN Assimilator WITHIN converge..	0	0
**experience negative WITHIN Assimilator WITHIN diverge..	5	5
**experience negative WITHIN converger WITHIN assimilate..	1	1
**experience negative WITHIN converger WITHIN converge	1	1
**experience negative WITHIN converger WITHIN diverge	2	2
**experience negative WITHIN diverger WITHIN assimilate..	1	1
**experience negative WITHIN diverger WITHIN converge	2	2
**experience negative WITHIN diverger WITHIN diverge	1	1
**experience negative WITHIN keep WITHIN perceptive	9	9
**experience negative WITHIN keep WITHIN Receptive	7	7
**experience negative WITHIN stretch WITHIN perceptive	7	7
**experience negative WITHIN stretch WITHIN Receptive	2	2
**experience positive WITHIN accommodator WITHIN assimila..	0	0
**experience positive WITHIN accommodator WITHIN converge..	0	0
**experience positive WITHIN accommodator WITHIN diverge..	0	0
**experience positive WITHIN Assimilator WITHIN assimilat..	0	0
**experience positive WITHIN Assimilator WITHIN converge..	0	0
**experience positive WITHIN Assimilator WITHIN diverge..	4	4
**experience positive WITHIN converger WITHIN assimilate..	1	1
**experience positive WITHIN converger WITHIN converge	2	2
**experience positive WITHIN converger WITHIN diverge	1	1
**experience positive WITHIN keep WITHIN perceptive	0	0
**experience positive WITHIN keep WITHIN Receptive	1	1
**experience positive WITHIN stretch WITHIN perceptive	3	3
**experience positive WITHIN stretch WITHIN Receptive	1	1
**technique negative WITHIN accommodator WITHIN assimilat..	6	6
**technique negative WITHIN accommodator WITHIN converge..	1	1
**technique negative WITHIN accommodator WITHIN diverge..	3	3
**technique negative WITHIN Assimilator WITHIN assimilate..	0	0
**technique negative WITHIN Assimilator WITHIN converge..	1	1
**technique negative WITHIN Assimilator WITHIN diverge	1	1
**technique negative WITHIN converger WITHIN assimilate..	0	0
**technique negative WITHIN converger WITHIN converge	0	0
**technique negative WITHIN converger WITHIN diverge	0	0
**technique negative WITHIN diverger WITHIN assimilate	0	0
**technique negative WITHIN diverger WITHIN converge	1	1
**technique negative WITHIN diverger WITHIN diverge	2	2
**technique positive WITHIN accommodator WITHIN assimilat..	2	2
**technique positive WITHIN accommodator WITHIN converge..	0	0

**technique positive WITHIN accommodator WITHIN diverge..	3	3
**technique positive WITHIN Assimilator WITHIN assimilate..	3	3
**technique positive WITHIN Assimilator WITHIN converge..	1	1
**technique positive WITHIN Assimilator WITHIN diverge	5	5
**technique positive WITHIN converger WITHIN assimilate..	0	0
**technique positive WITHIN converger WITHIN converge	0	0
**technique positive WITHIN converger WITHIN diverge	0	0
**technique positive WITHIN diverger WITHIN assimilate	2	2
**technique positive WITHIN diverger WITHIN converge	3	3
**technique positive WITHIN diverger WITHIN diverge	2	2
*experience negative WITHIN accommodator	18	18
*experience negative WITHIN Assimilator	7	7
*experience negative WITHIN converger	2	2
*experience negative WITHIN diverger	4	4
*experience negative WITHIN keep	16	16
*experience negative WITHIN stretch	11	11
*experience positive WITHIN accommodator	0	0
*experience positive WITHIN Assimilator	5	5
*experience positive WITHIN converger	3	3
*experience positive WITHIN diverger	1	1
*experience positive WITHIN keep	1	1
*experience positive WITHIN stretch	4	4
*technique negative WITHIN accommodator	10	10
*technique negative WITHIN Assimilator	2	2
*technique negative WITHIN converger	0	0
*technique negative WITHIN diverger	3	3
*technique positive WITHIN accommodator	5	5
*technique positive WITHIN Assimilator	9	9
*technique positive WITHIN converger	0	0
*technique positive WITHIN diverger	7	7
accommodator	5	5
assimilate	14	14
Assimilator	4	4

Code-Filter: All [92]

CODES-PRIMARY-DOCUMENTS-TABLE

converge	19	19
converger	1	1
diverge	24	24
diverger	3	3
experience negative	33	33
experience positive	9	9

HU: [C:\Documents and Settings\Steve Moran\Desktop\Comments Hermeneutic Unit.hpr6]

keep	10	10
negative	50	50
PD-Filter: All [1]		
perceptive	9	9
positive	36	36
Quotation-Filter: All [184]		
Receptive	4	4
Report created by Super - 08/01/10 21:43:31		
stretch	11	11
technique negative	17	17
technique positive	27	27
TOTALS:		

	div +	div -	assim +	assim -	conv +	conv -	totals
diverger	0	1	0	1	0	2	4
Assimilator	4	5	0	2	0	0	11
converger	1	2	1	1	2	1	8
accommodator	0	4	0	6	0	4	14
totals	5	12	1	10	2	7	37

	keep +	keep -	stretch +	stretch -	totals	keep	Stretch
perceptive	0	9	3	7	19	-9	-4
receptive	1	7	1	2	11	-6	-1
totals	1	16	4	9	30	-15	-5

Person of set style freely describes experiences per phase

	Positive			Negative		
	diverge	*assimilate*	*converge*	*diverge*	*assimilate*	*converge*
Diverger	0	0	0	1	1	2
Assimilator	4	0	0	5	2	0
Converger	1	1	2	2	1	1
Accommodator	0	0	0	4	6	4
Totals	5	1	2	12	10	7

Set style freely describes experiences when phases match/neighbour/oppose style

	Positive Experiences			Negative Experiences		
Technique/Style	match	neighbour	oppose	match	neighbour	oppose
Diverging	0	4	1	1	9	2
Assimilating	2	1	0	2	2	6
Converging	0	0	0	1	4	2
Totals	2	5	1	4	15	10

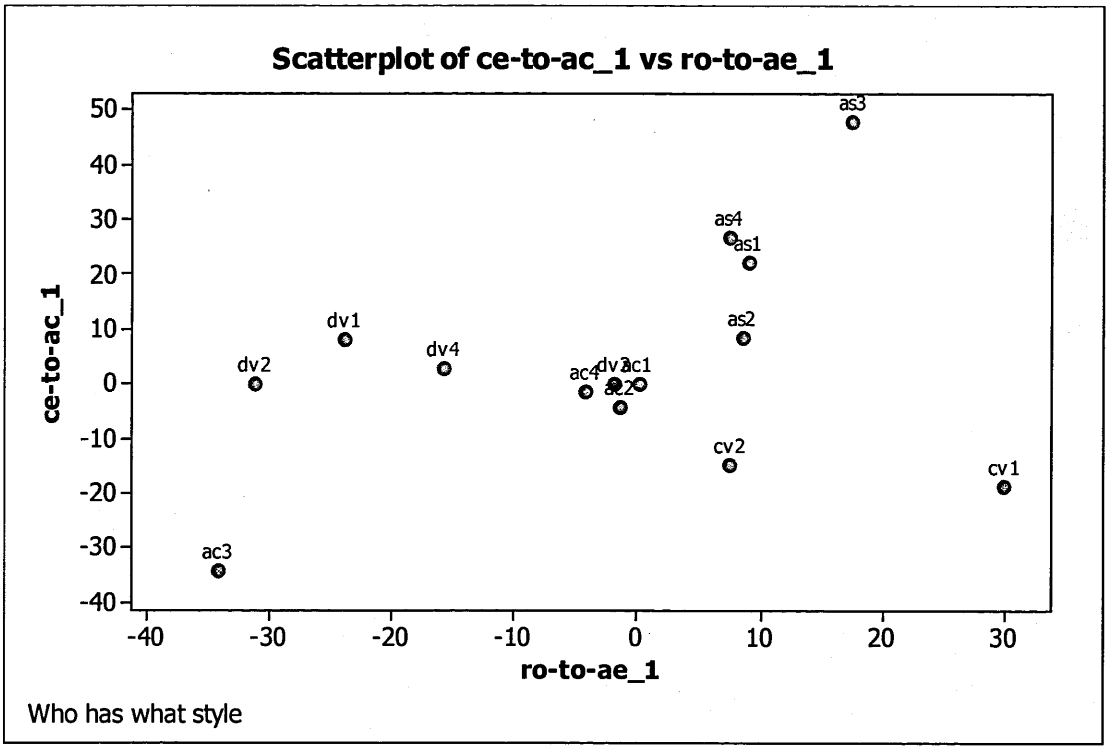
dealing with paradigms

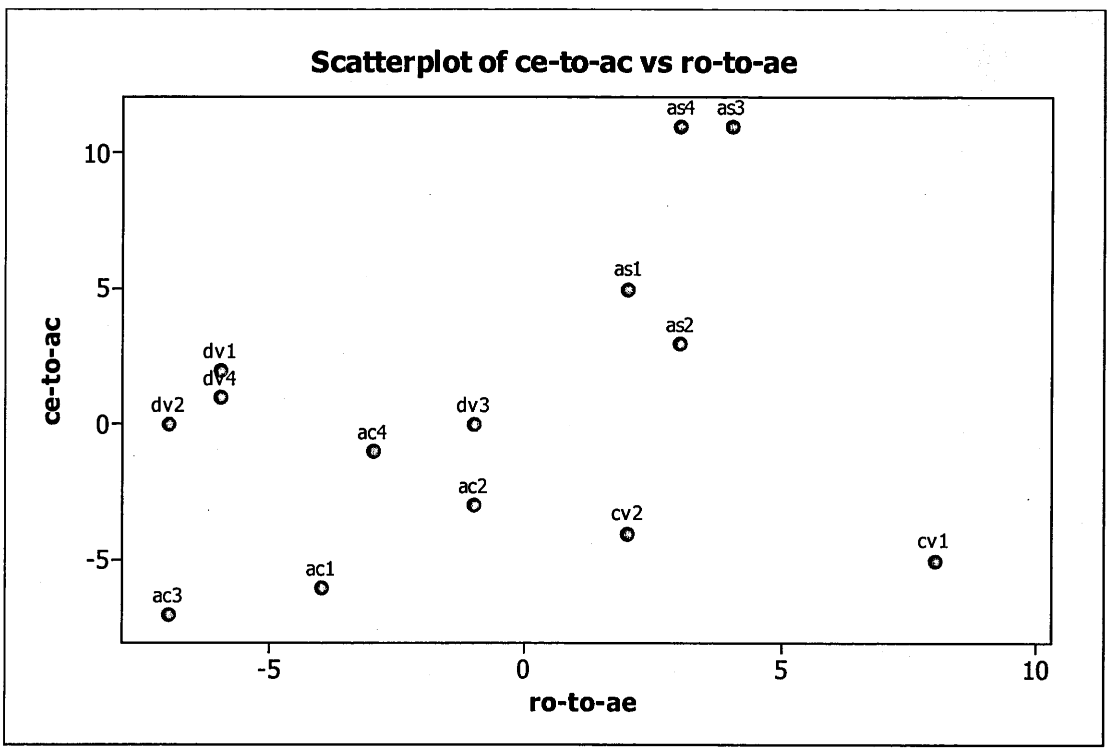
	Positive		Negative.	
	keep	stretch	keep	stretch
perceptive	0	3	9	7
receptive	1	1	7	2

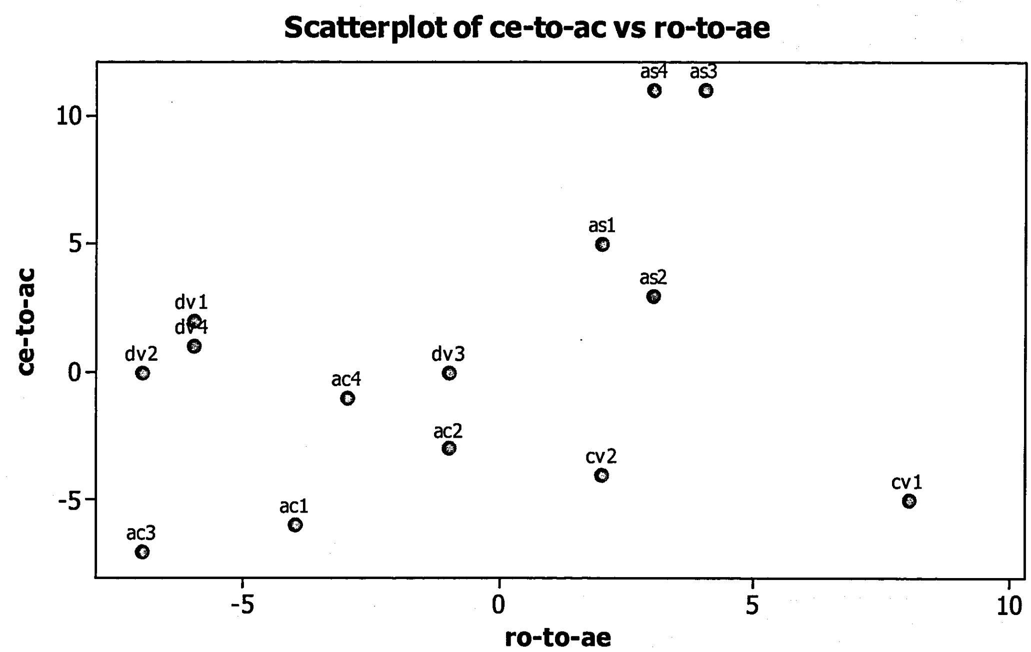
Synthesis of Qualitative Analysis

Ordinal Data	• **Diverging**: popularity wanes when done by non-Divergers o In keeping with Kolb (1978) • **Assimilating**: seems to largely unpopular for all • **Converging**: opinions polarised. o Divergers & convergers show favour ▪ ***unexpected*** o accommodators & assimilators show disfavour	**Match, Neighbour and Oppose.** • across all phase. 30% of neighbours show favourable opinions • styles overlap the phase boundaries. • A gradient of change exists. • Possibility of assigning a wider scope of human resource to a phase
Free Comments	Unease throughout the system Mostly occurred from accommodators assimilators and perceptives	High increase in unrest occurs when activity does not match style In keeping with Kolb (1978) In keeping with McFadzean (2002)

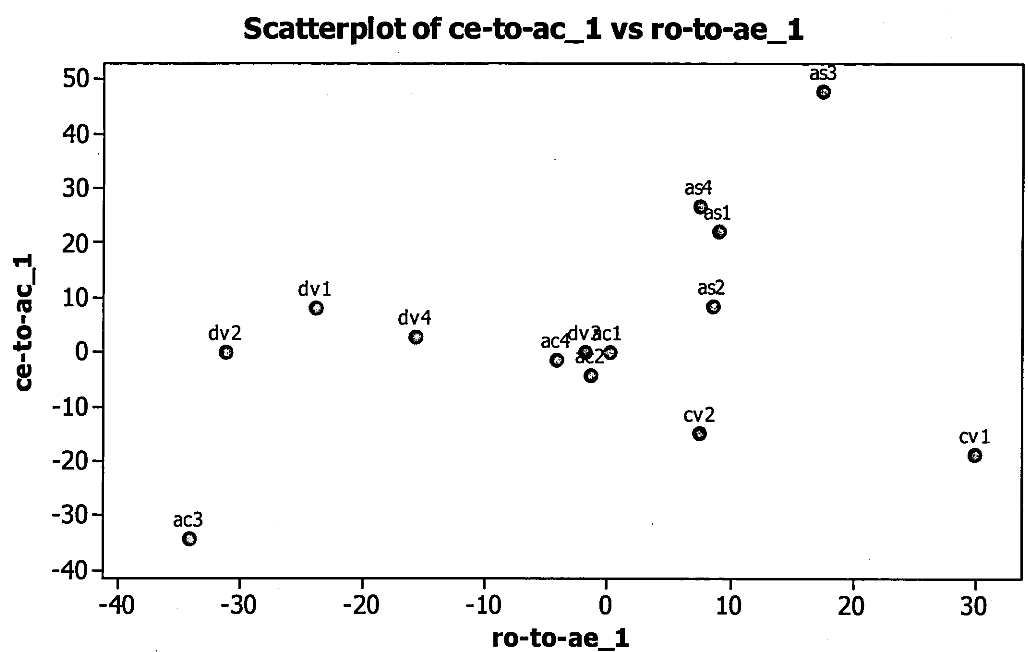
Appendix 6 Plots Dendrograms & Maps


Scatterplot of ce-to-ac_1 vs ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
50
40
30
20
10
0
-10
-20
-30
-40
-40
-30
-20
-10
0
10
20
30
as3
as4
as1
as2
dv1
dv4
dv2
ac4
dv3
ac1
ac2
cv2
cv1
ac3
Who has what style

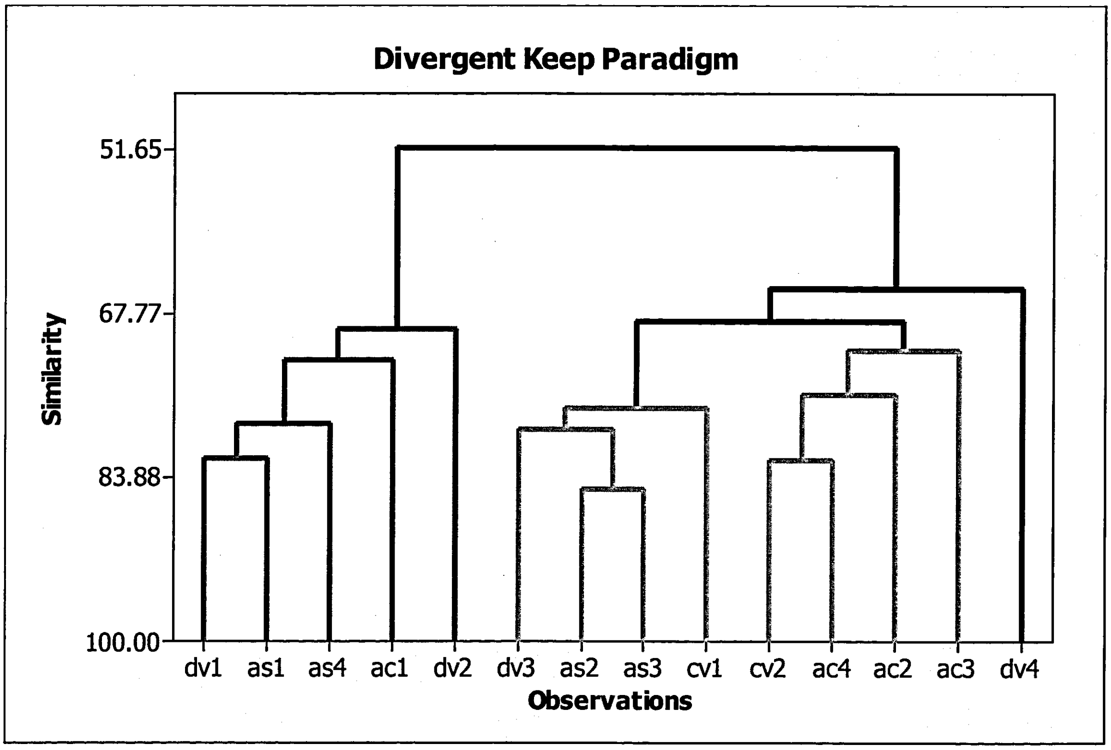

Scatterplot of ce-to-ac vs ro-to-ae
ce-to-ac
ro-to-ae
10
5
0
-5
-5
0
5
10
as4
as3
as1
as2
dv1
dv4
dv2
dv3
ac4
ac2
cv2
cv1
ac1
ac3

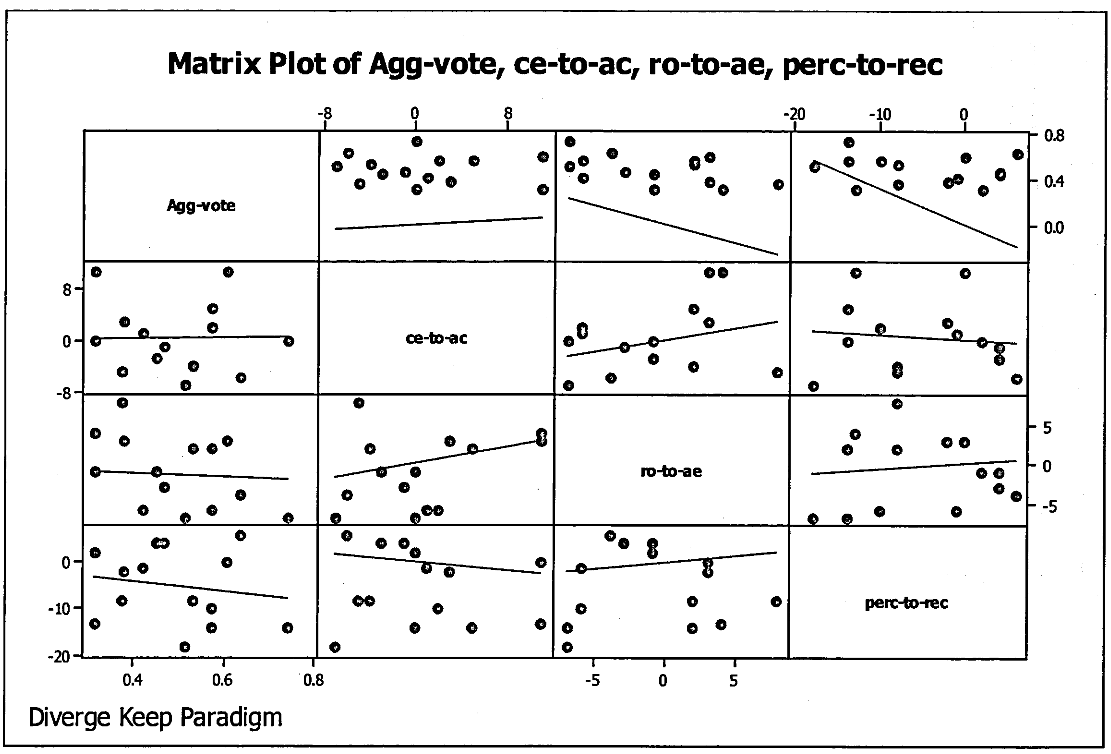


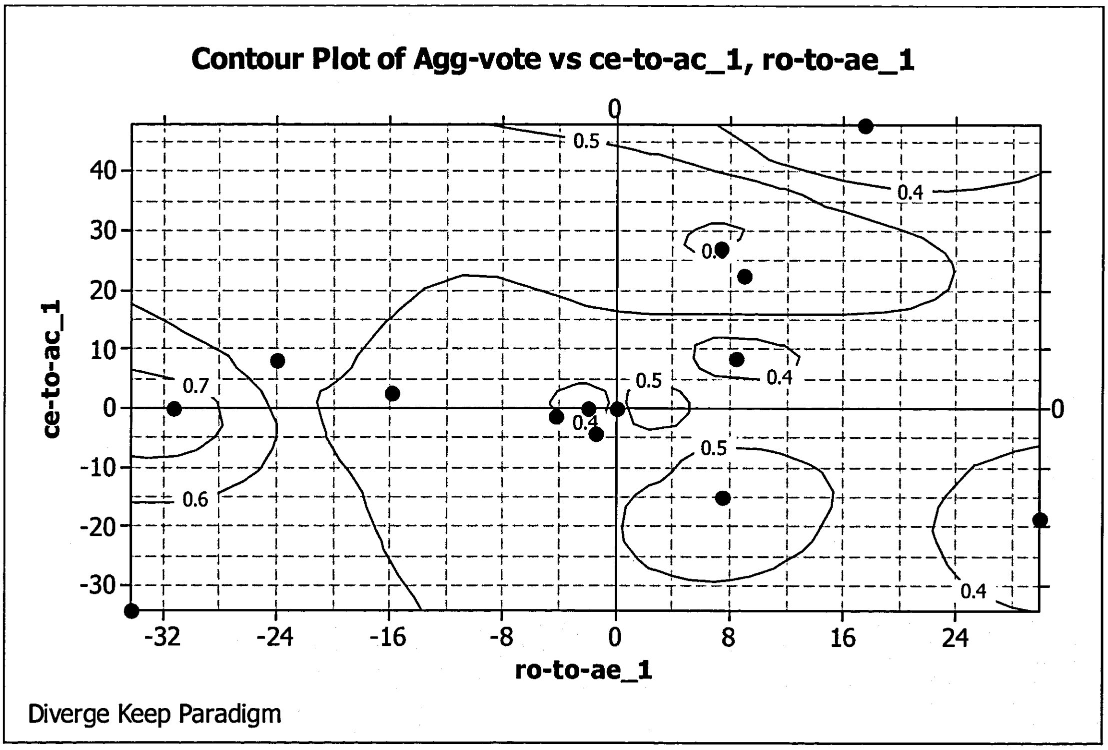
Learning Styles (KOLB)



Who has what Learning & Creative Styles


Divergent Keep Paradigm
Similarity
51.65
67.77
83.88
100.00
dv1 as1 as4 ac1 dv2 dv3 as2 as3 cv1 cv2 ac4 ac2 ac3 dv4
Observations


Matrix Plot of Agg-vote, ce-to-ac, ro-to-ae, perc-to-rec
Agg-vote
ce-to-ac
ro-to-ae
perc-to-rec
Diverge Keep Paradigm


Contour Plot of Agg-vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
Diverge Keep Paradigm
0.5
0.4
0.7
0.6
0
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30
20
10
-10
-20
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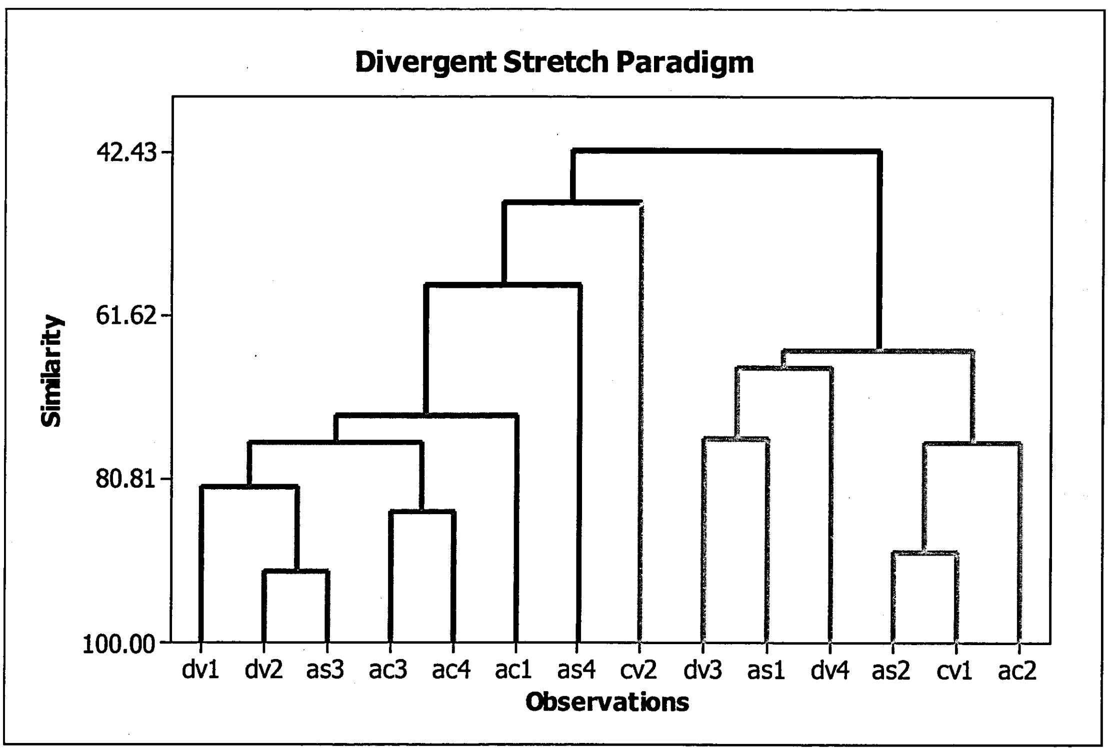
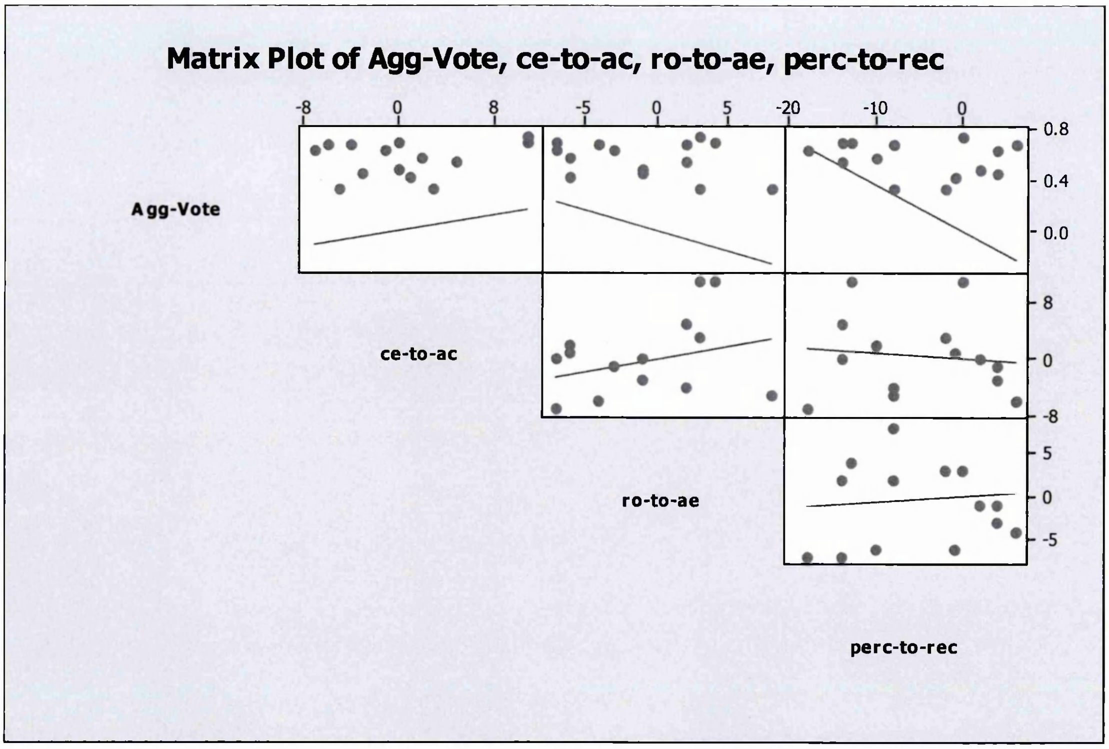
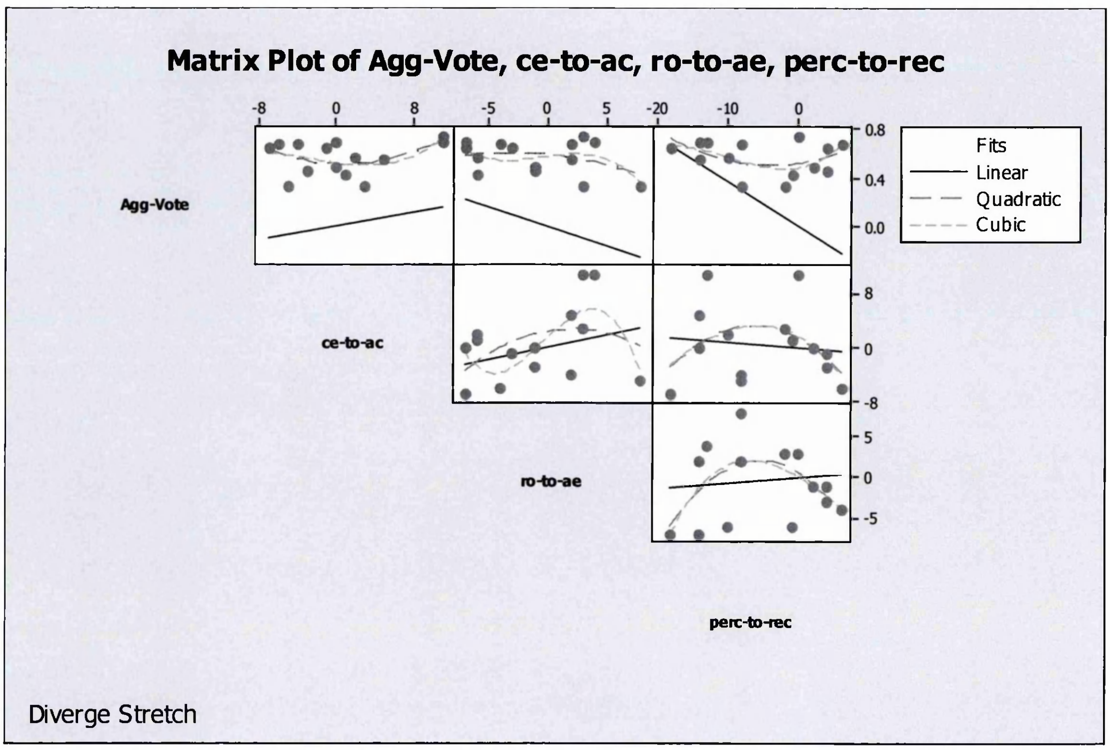
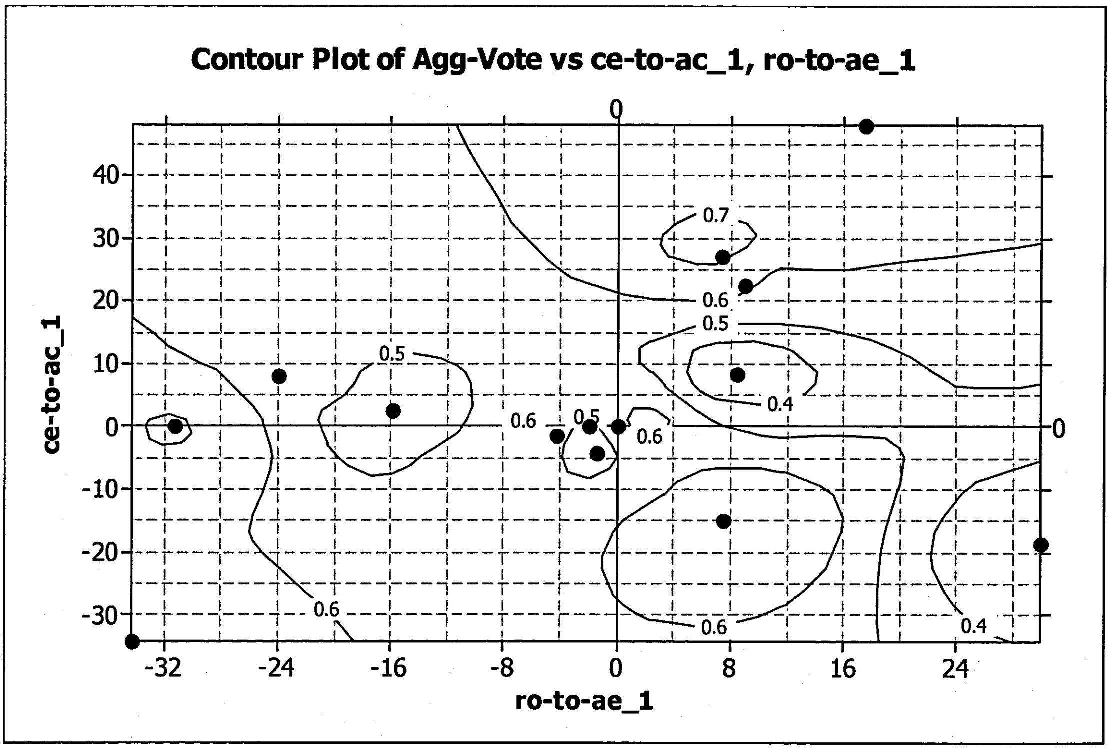
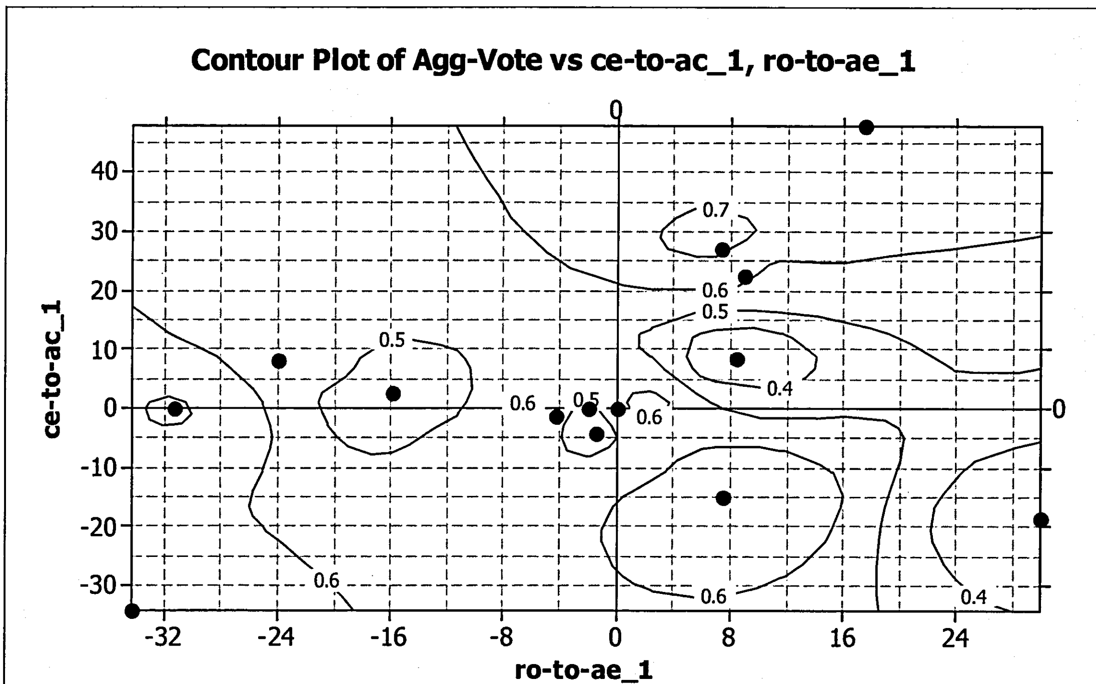
-24
-16
-8
8
16
24


Divergent Stretch Paradigm
Similarity
42.43
61.62
80.81
100.00
dv1
dv2
as3
ac3
ac4
ac1
as4
cv2
dv3
as1
dv4
as2
cv1
ac2
Observations

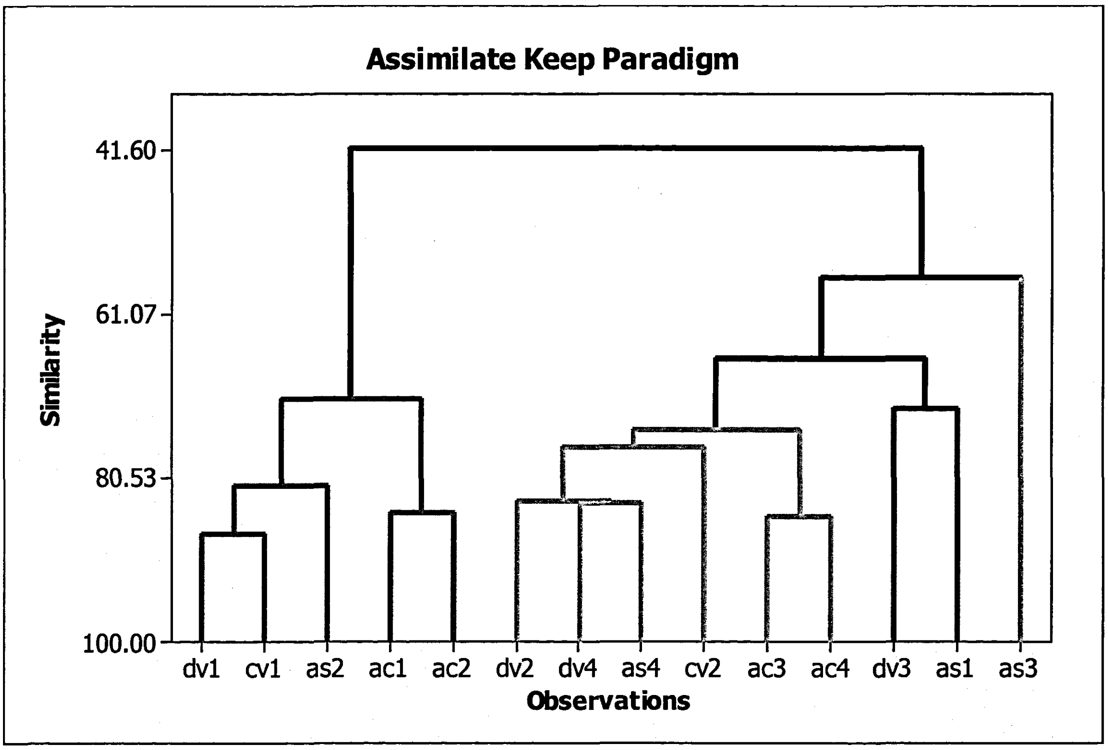

Matrix Plot of Agg-Vote, ce-to-ac, ro-to-ae, perc-to-rec
Agg-Vote
ce-to-ac
ro-to-ae
perc-to-rec

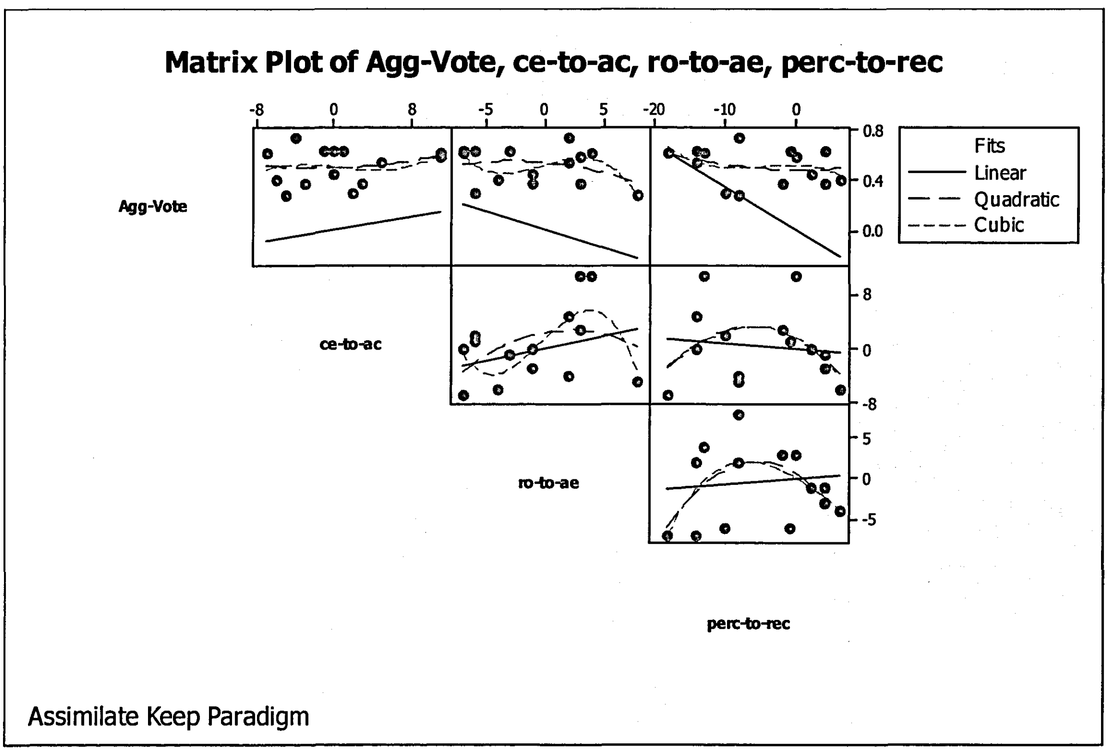

Matrix Plot of Agg-Vote, ce-to-ac, ro-to-ae, perc-to-rec
Fits
Linear
Quadratic
Cubic
Agg-Vote
ce-to-ac
ro-to-ae
perc-to-rec
Diverge Stretch

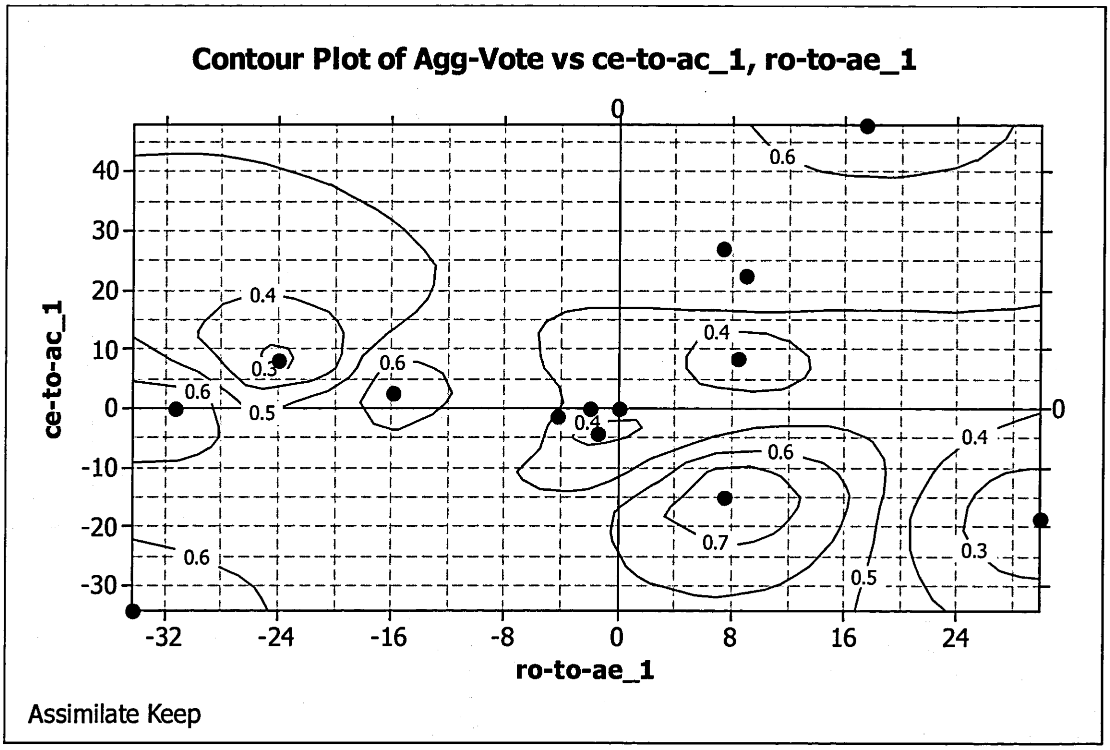


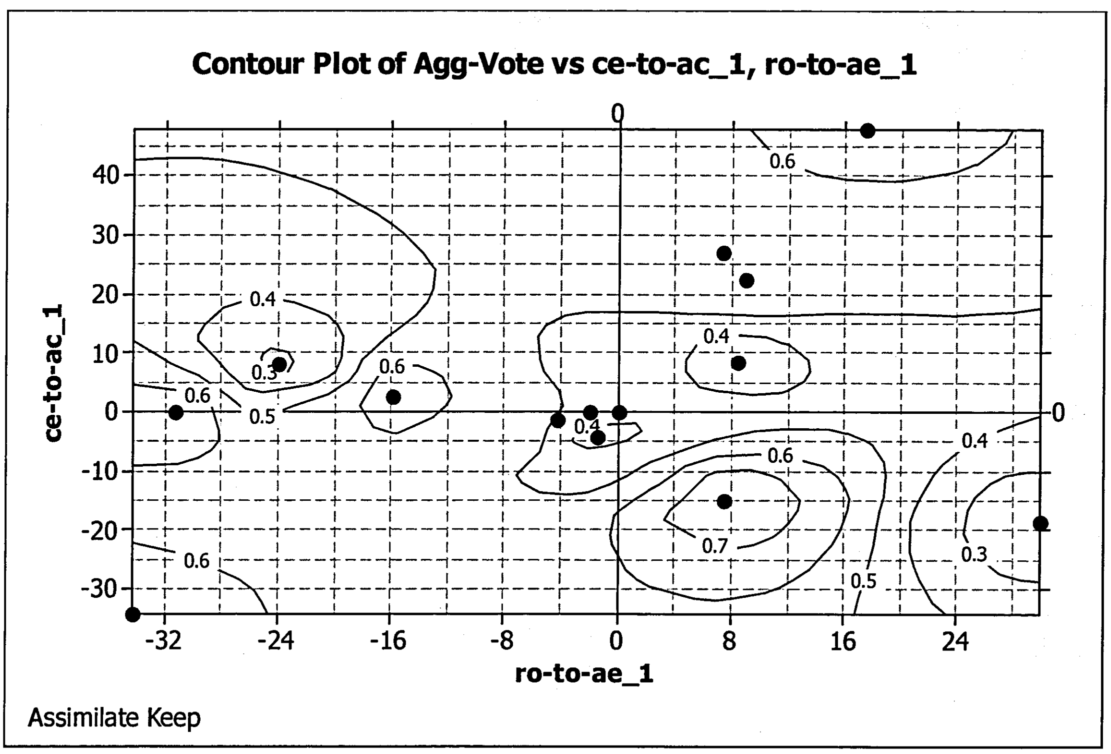


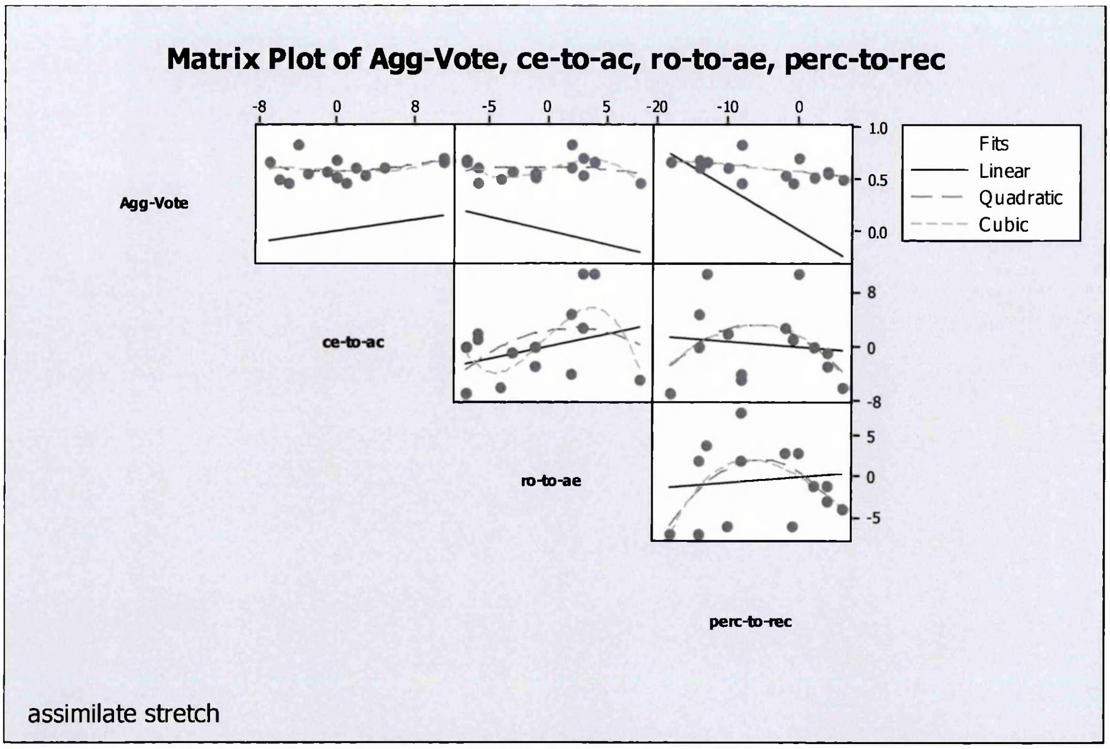
Diverge Stretch

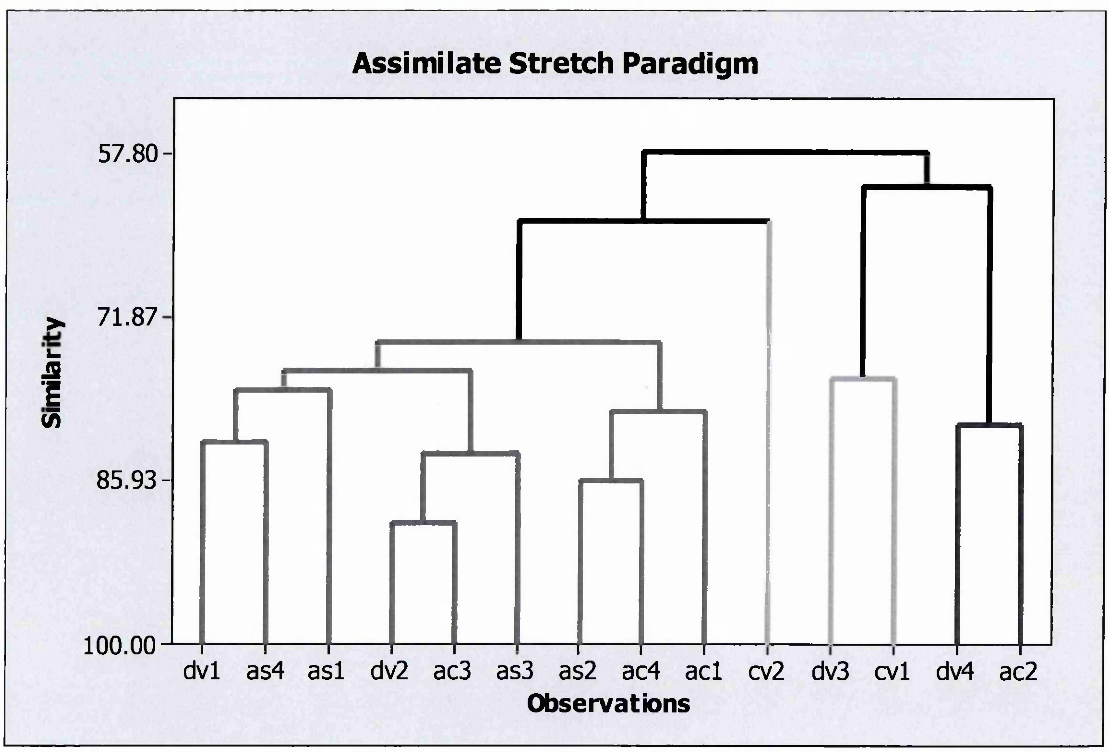

Assimilate Keep Paradigm
Similarity
41.60
61.07
80.53
100.00
dv1 cv1 as2 ac1 ac2 dv2 dv4 as4 cv2 ac3 ac4 dv3 as1 as3
Observations

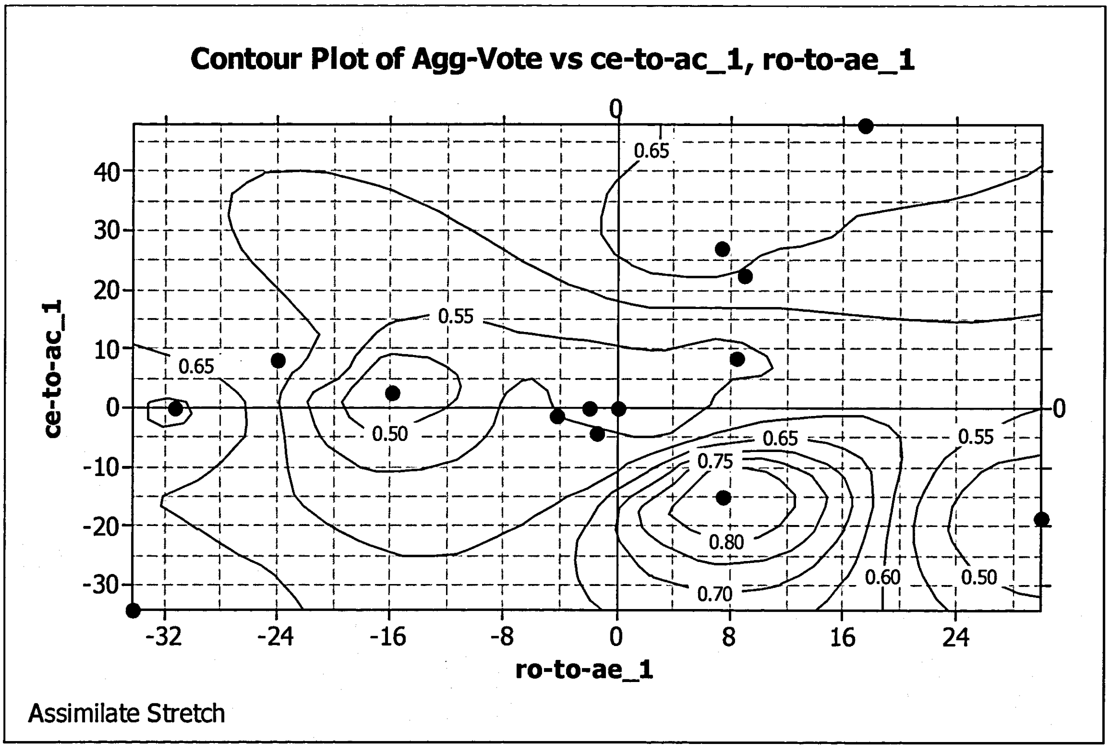

Matrix Plot of Agg-Vote, ce-to-ac, ro-to-ae, perc-to-rec
Agg-Vote
ce-to-ac
ro-to-ae
perc-to-rec
Fits
Linear
Quadratic
Cubic
Assimilate Keep Paradigm

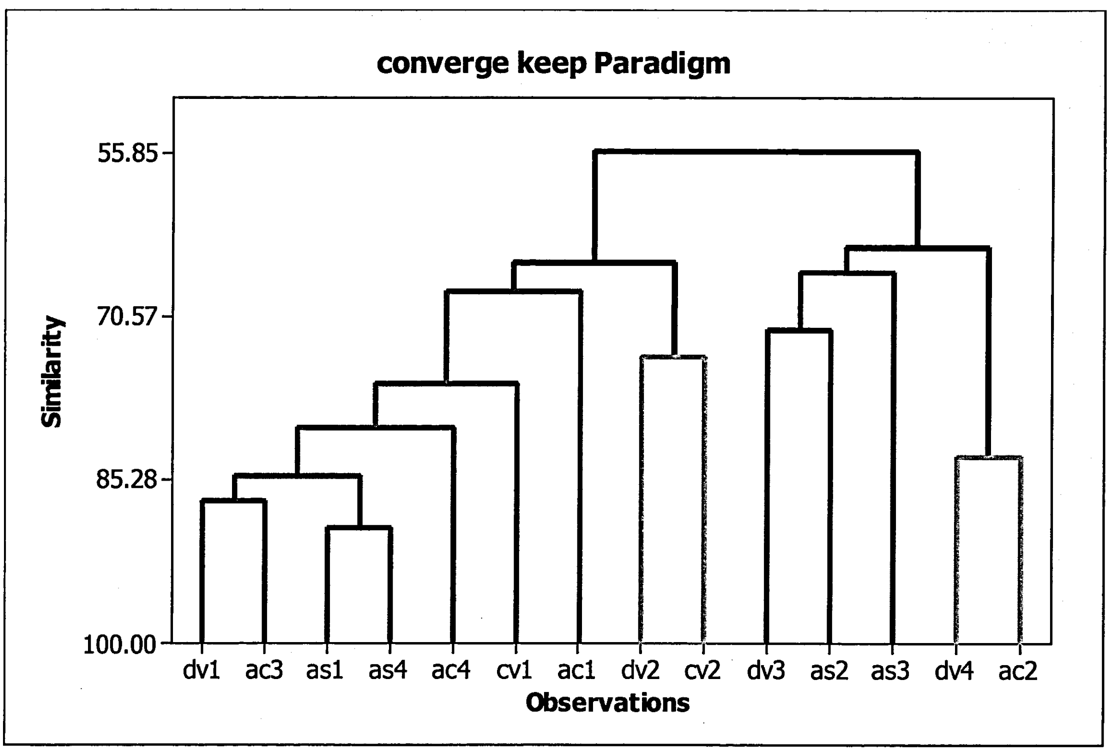

Contour Plot of Agg-Vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
40
30
20
10
0
-10
-20
-30
-32
-24
-16
-8
0
8
16
24
0.3
0.4
0.5
0.6
0.7
Assimilate Keep

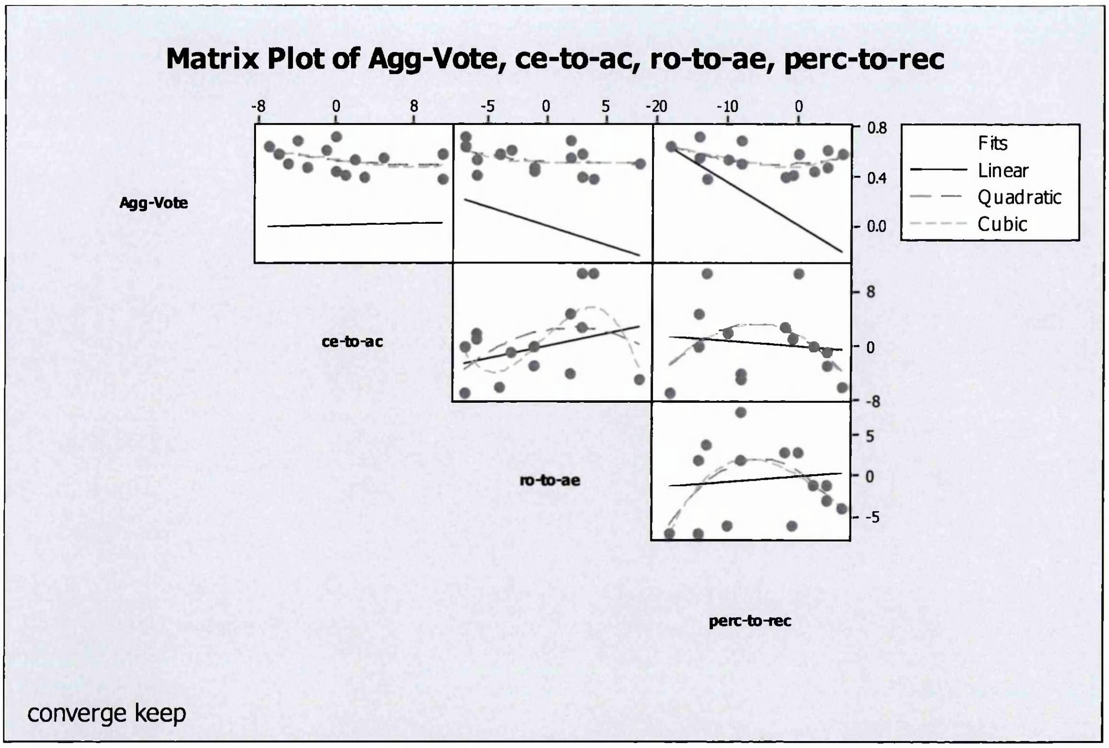

Contour Plot of Agg-Vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
40
30
20
10
0
-10
-20
-30
-32
-24
-16
-8
0
8
16
24
0.3
0.4
0.5
0.6
0.7
Assimilate Keep

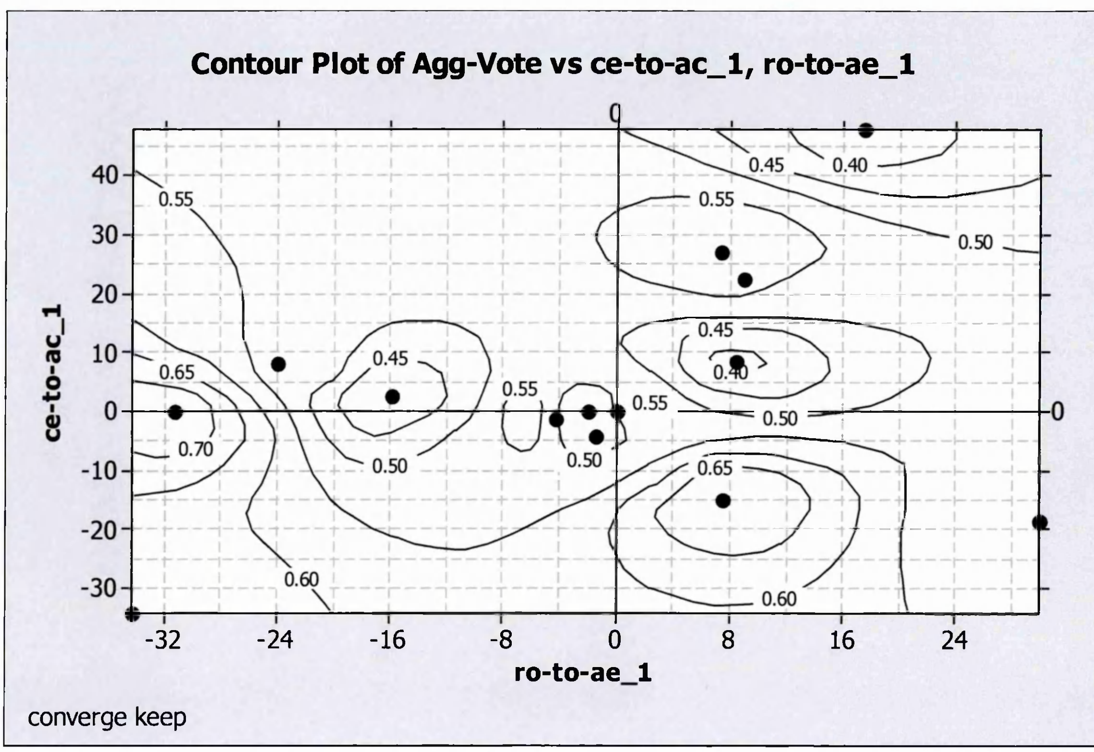

Matrix Plot of Agg-Vote, ce-to-ac, ro-to-ae, perc-to-rec
Agg-Vote
ce-to-ac
ro-to-ae
perc-to-rec
Fits
Linear
Quadratic
Cubic
assimilate stretch

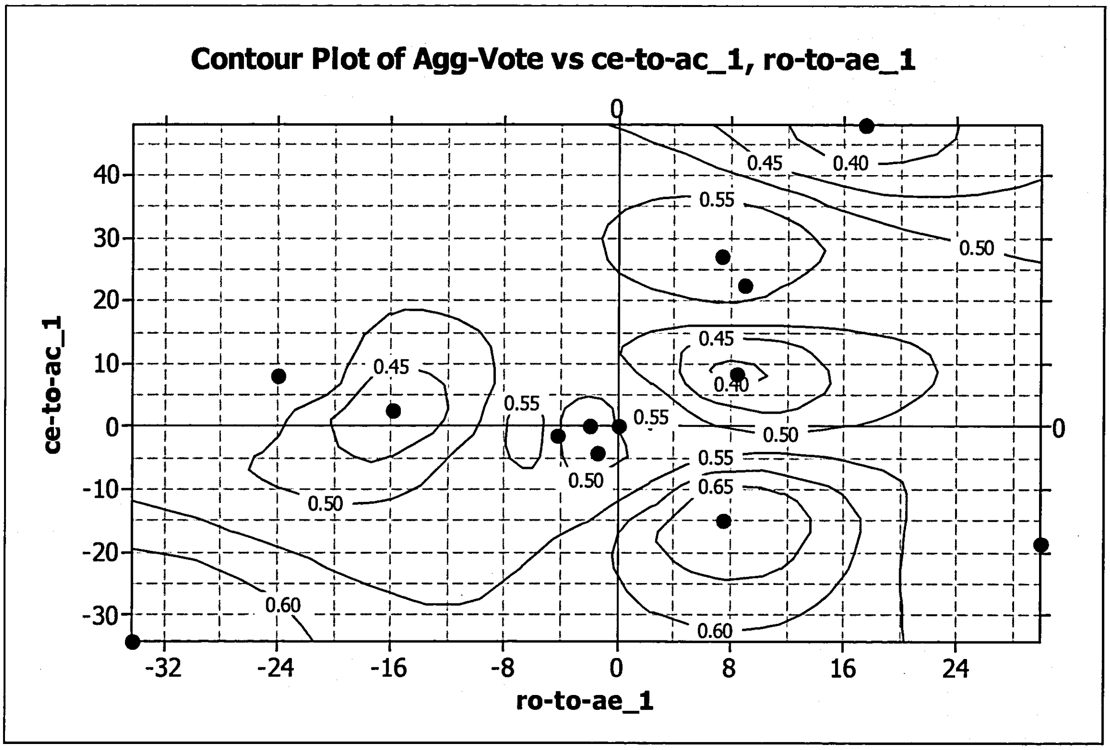

Assimilate Stretch Paradigm
Similarity
57.80
71.87
85.93
100.00
dv1 as4 as1 dv2 ac3 as3 as2 ac4 ac1 cv2 dv3 cv1 dv4 ac2
Observations


Contour Plot of Agg-Vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
40
30
20
10
0
-10
-20
-30
-32
-24
-16
-8
0
8
16
24
0.65
0.55
0.65
0.50
0.65
0.55
0.75
0.80
0.70
0.60
0.50
Assimilate Stretch

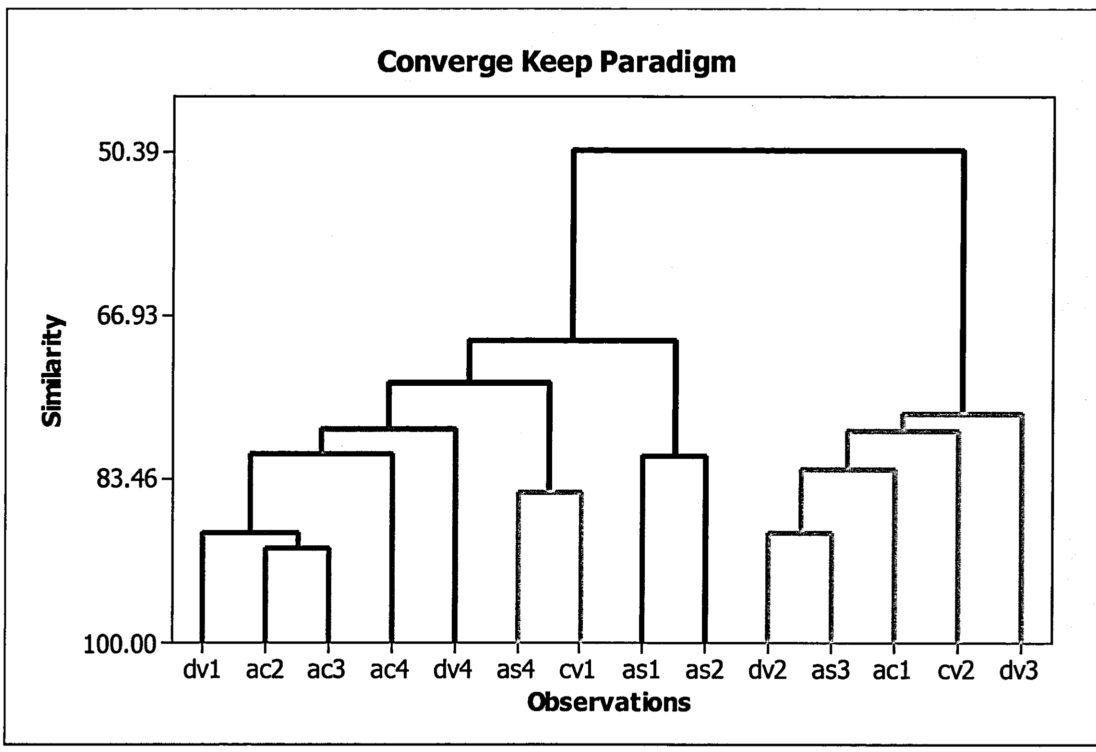

converge keep Paradigm
Similarity
55.85
70.57
85.28
100.00
dv1 ac3 as1 as4 ac4 cv1 ac1 dv2 cv2 dv3 as2 as3 dv4 ac2
Observations


Matrix Plot of Agg-Vote, ce-to-ac, ro-to-ae, perc-to-rec
Agg-Vote
ce-to-ac
ro-to-ae
perc-to-rec
Fits
Linear
Quadratic
Cubic
converge keep

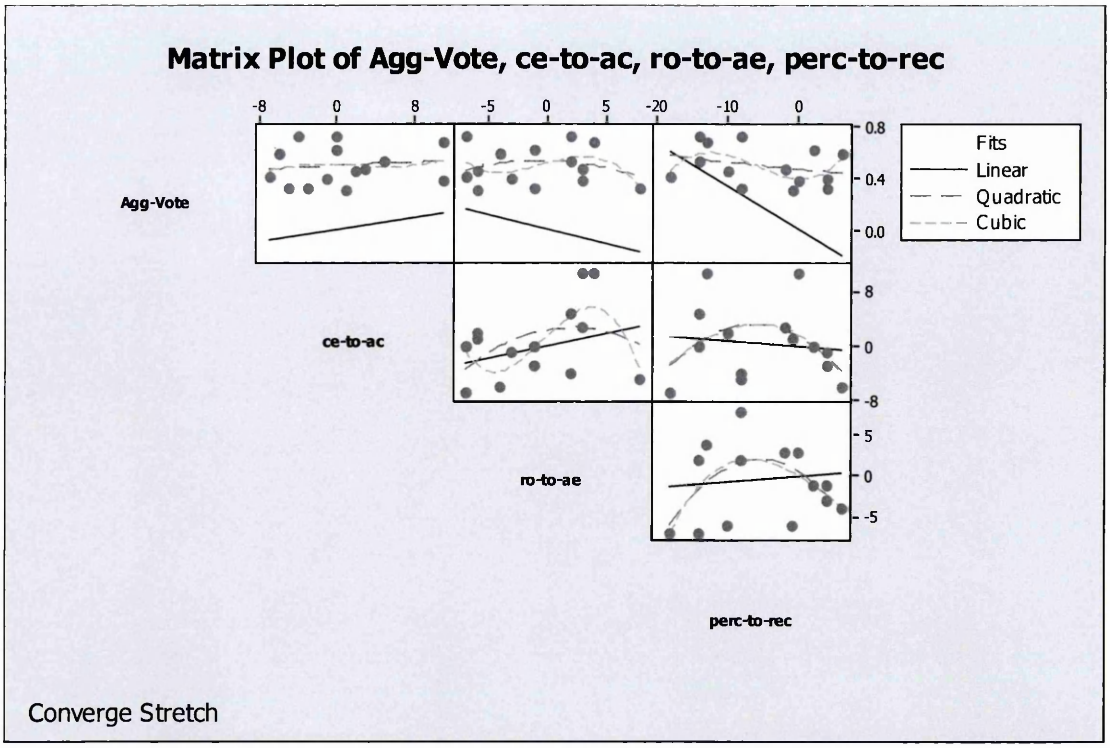

Contour Plot of Agg-Vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
converge keep

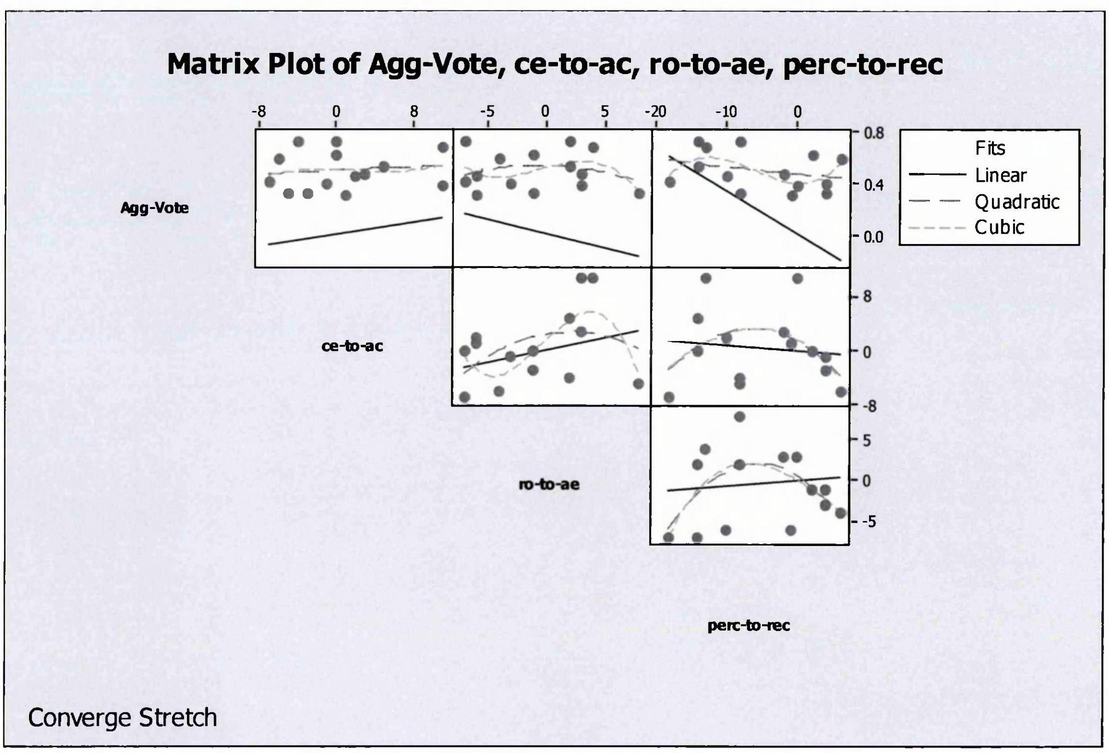


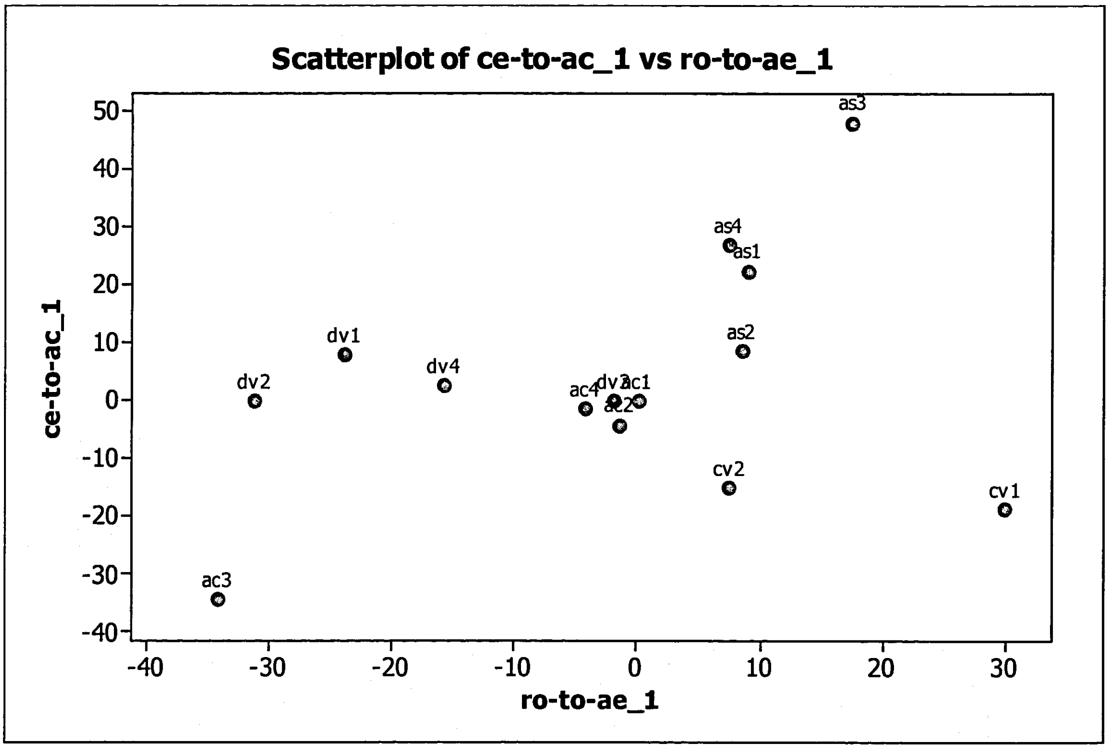
Contour Plot of Agg-Vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
0.45
0.40
0.55
0.50
0.45
0.40
0.45
0.55
0.55
0.50
0.50
0.55
0.65
0.50
0.60
0.60
40
30
20
10
0
-10
-20
-30
-32
-24
-16
-8
0
8
16
24

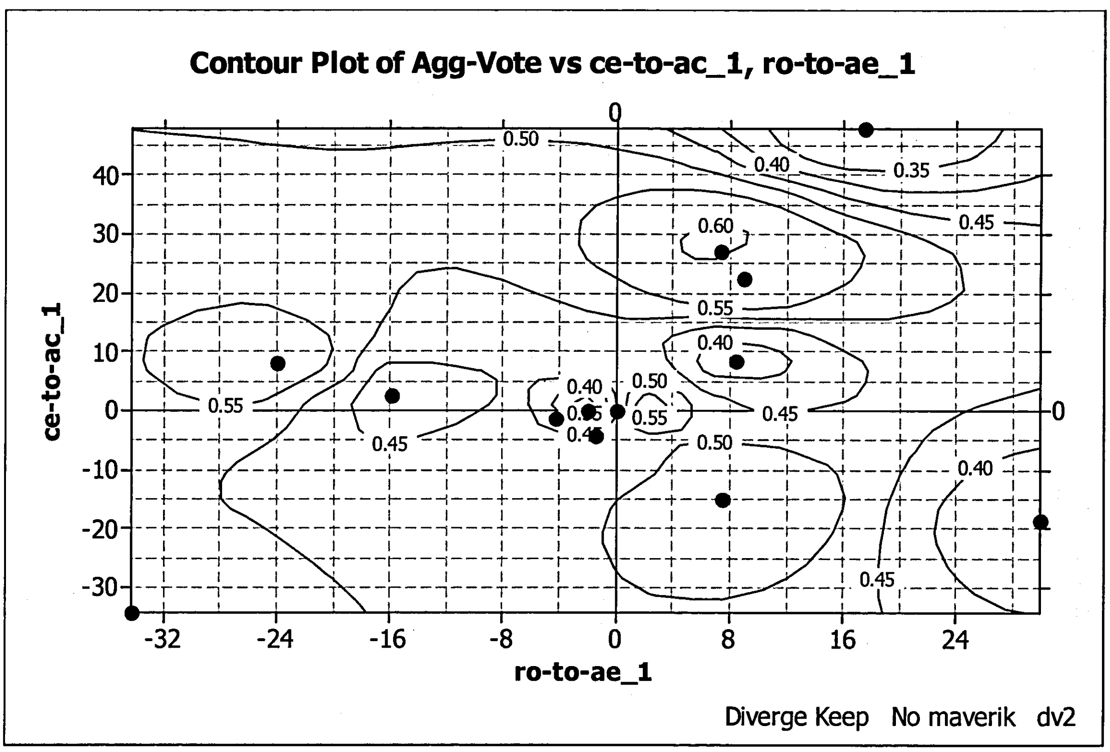


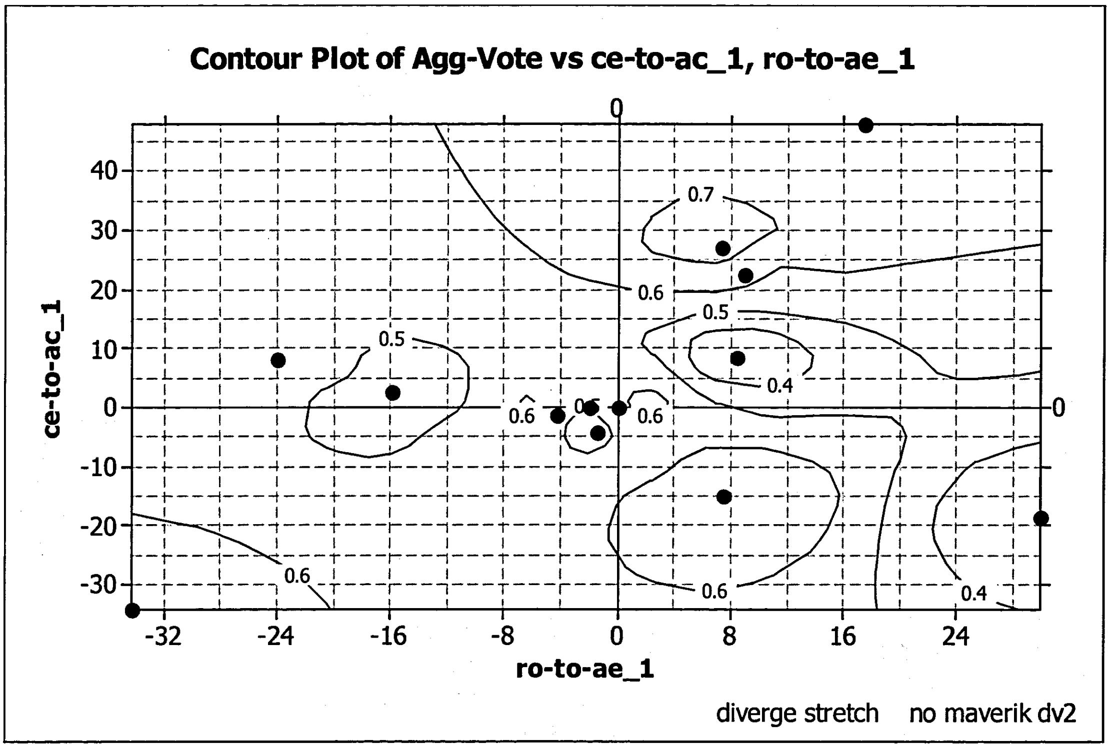
Converge Keep Paradigm
Similarity
50.39
66.93
83.46
100.00
dv1 ac2 ac3 ac4 dv4 as4 cv1 as1 as2 dv2 as3 ac1 cv2 dv3
Observations

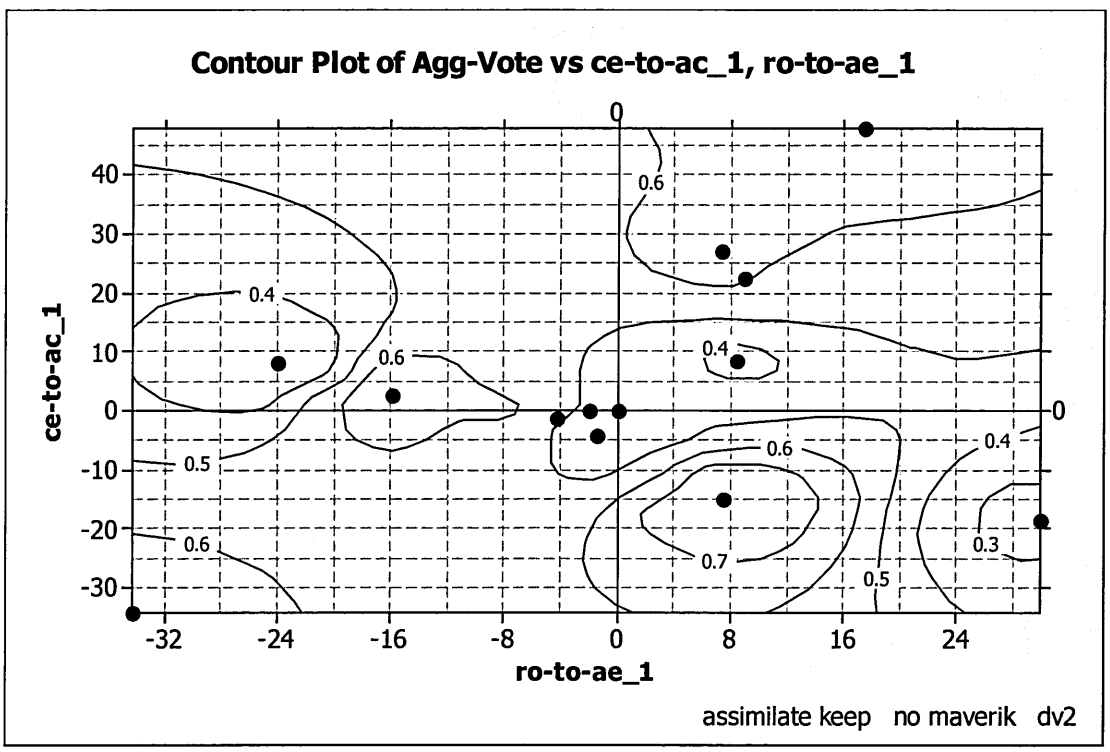

Matrix Plot of Agg-Vote, ce-to-ac, ro-to-ae, perc-to-rec
Agg-Vote
ce-to-ac
ro-to-ae
perc-to-rec
-8
0
8
-5
0
5
-20
-10
0
0.8
0.4
0.0
8
0
-8
5
0
-5
Fits
Linear
Quadratic
Cubic
Converge Stretch


Matrix Plot of Agg-Vote, ce-to-ac, ro-to-ae, perc-to-rec
Agg-Vote
ce-to-ac
ro-to-ae
perc-to-rec
-8
0
8
-5
0
5
-20
-10
0
0.8
0.4
0.0
8
0
-8
5
0
-5
Fits
Linear
Quadratic
Cubic
Converge Stretch


Scatterplot of ce-to-ac_1 vs ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
as3
as4
as1
as2
dv1
dv2
dv4
ac4
dv3
ac1
ac2
cv2
cv1
ac3


Contour Plot of Agg-Vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
0.50
0.40
0.35
0.45
0.60
0.55
0.40
0.50
0.55
0.45
0.45
0.40
0.45
Diverge Keep No maverik dv2


Contour Plot of Agg-Vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
40
30
20
10
0
-10
-20
-30
-32
-24
-16
-8
0
8
16
24
0.7
0.6
0.5
0.4
diverge stretch no maverik dv2


Contour Plot of Agg-Vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
40
30
20
10
0
-10
-20
-30
-32
-24
-16
-8
0
8
16
24
0.6
0.4
0.5
0.7
0.3
assimilate keep no maverik dv2

Data Display

Row	Labels_1_1	ce-to-ac	ro-to-ae	perc-to-rec
1	dv1	2	-6	-10
2	dv2	0	-7	-14
3	dv3	0	-1	2
4	dv4	1	-6	-1
5	as1	5	2	-14
6	as2	3	3	-2
7	as3	11	4	-13
8	as4	11	3	0
9	cv1	-5	8	-8
10	cv2	-4	2	-8
11	ac1	-6	-4	6
12	ac2	-3	-1	4
13	ac3	-7	-7	-18
14	ac4	-1	-3	4

Row	Labels_1_1	ce-to-ac	ro-to-ae	perc-to-rec	perc-to-rec_1	ce-to-ac_1
1	dv1	2	-6	-10	16	8.0000
2	dv2	0	-7	-14	20	0.0000
3	dv3	0	-1	2	4	0.0000
4	dv4	1	-6	-1	7	2.6458
5	as1	5	2	-14	20	22.3607
6	as2	3	3	-2	8	8.4853
7	as3	11	4	-13	19	47.9479
8	as4	11	3	0	6	26.9444
9	cv1	-5	8	-8	14	-18.7083
10	cv2	-4	2	-8	14	-14.9666
11	ac1	-6	-4	6	0	0.0000
12	ac2	-3	-1	4	2	-4.2426
13	ac3	-7	-7	-18	24	-34.2929
14	ac4	-1	-3	4	2	-1.4142

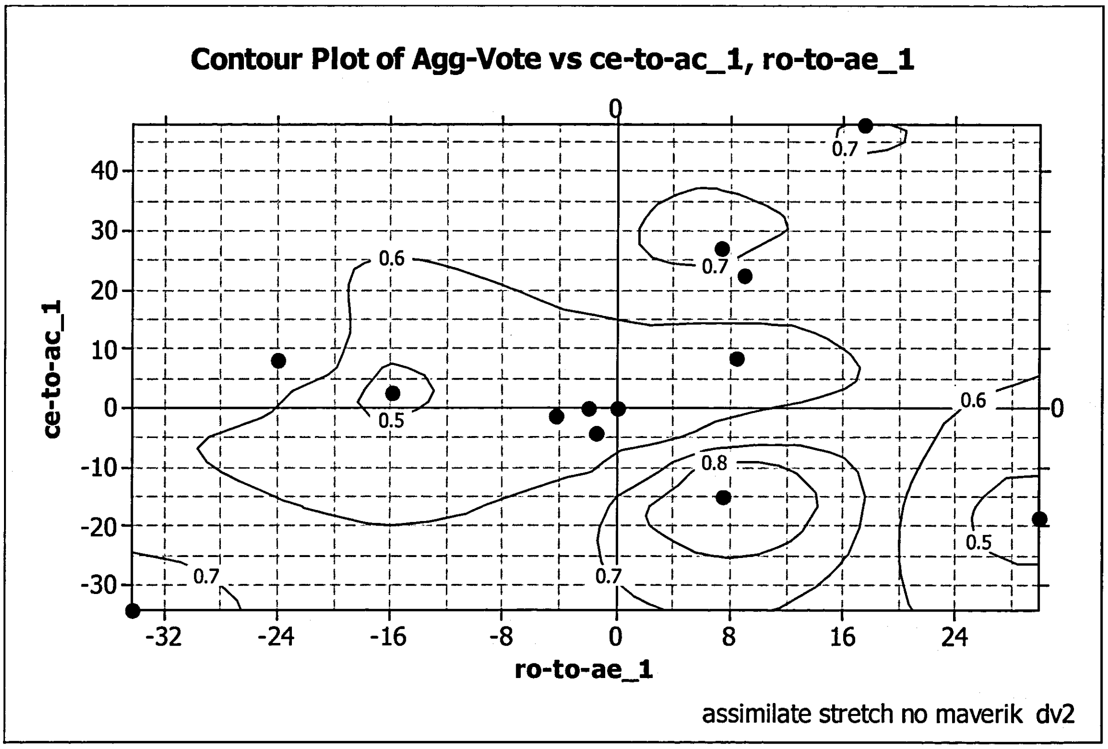
Row	ro-to-ae_1
1	-24.0000
2	-31.3050
3	-2.0000
4	-15.8745
5	8.9443
6	8.4853
7	17.4356
8	7.3485
9	29.9333
10	7.4833
11	0.0000
12	-1.4142
13	-34.2929
14	-4.2426

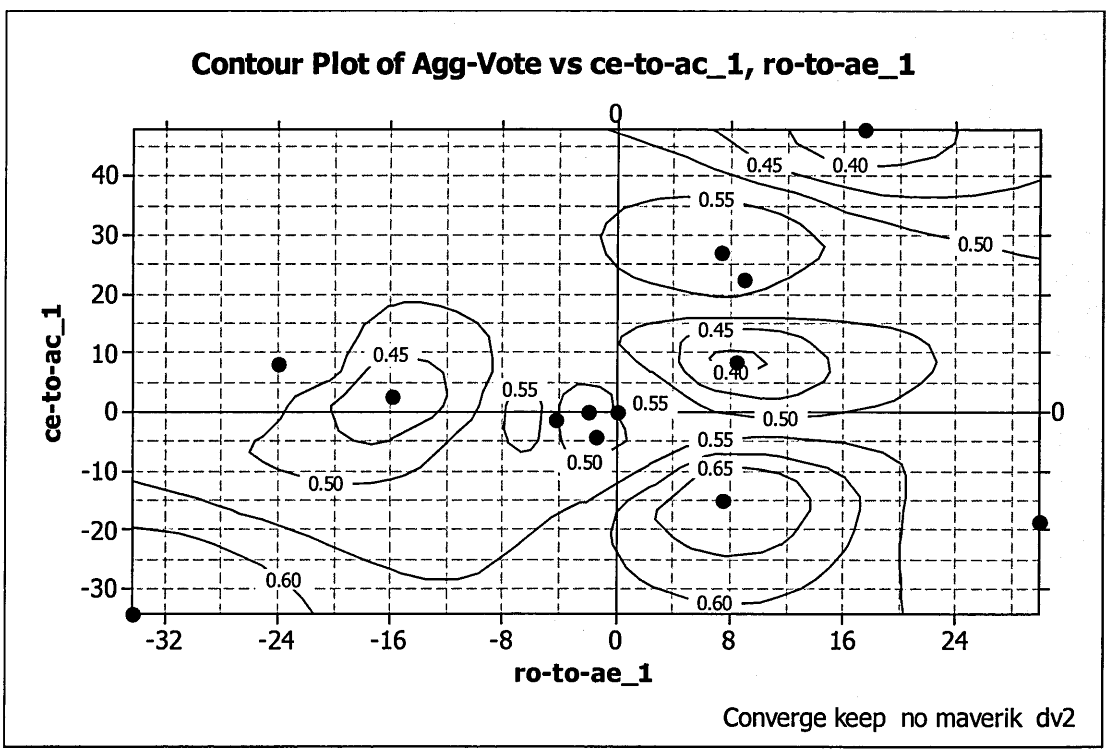
Data Display

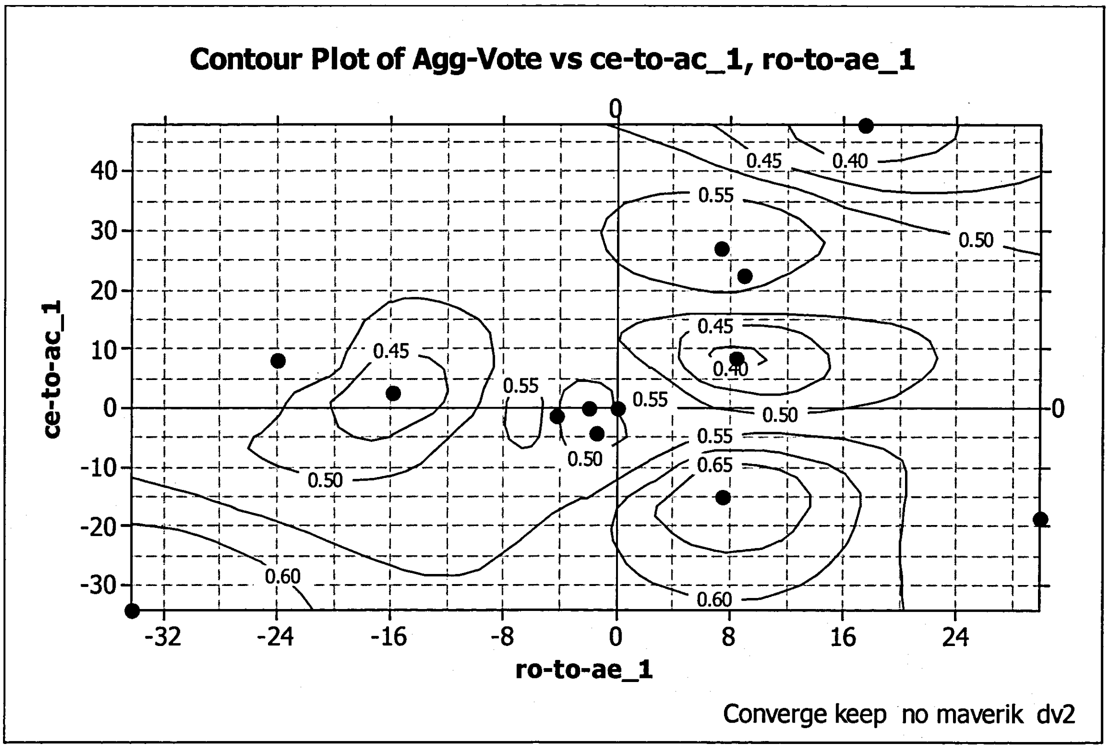
Row	Labels_1_1	ce-to-ac	ro-to-ae	perc-to-rec	perc-to-rec_1	ce-to-ac_1
1	dv1	2	-6	-10	16	8.0000
2	dv2	0	-7	-14	20	0.0000
3	dv3	0	-1	2	4	0.0000
4	dv4	1	-6	-1	7	2.6458
5	as1	5	2	-14	20	22.3607
6	as2	3	3	-2	8	8.4853
7	as3	11	4	-13	19	47.9479
8	as4	11	3	0	6	26.9444
9	cv1	-5	8	-8	14	-18.7083
10	cv2	-4	2	-8	14	-14.9666
11	ac1	-6	-4	6	0	0.0000
12	ac2	-3	-1	4	2	-4.2426
13	ac3	-7	-7	-18	24	-34.2929
14	ac4	-1	-3	4	2	-1.4142

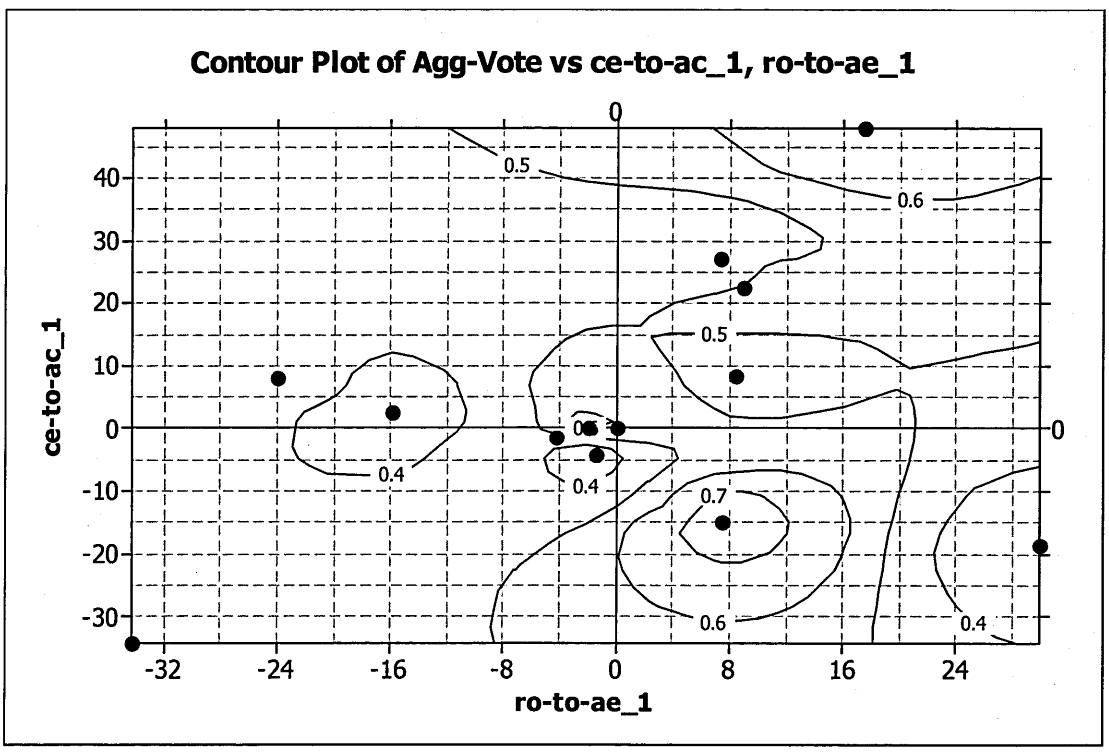
Row	ro-to-ae_1
1	-24.0000
2	-31.3050
3	-2.0000
4	-15.8745
5	8.9443
6	8.4853
7	17.4356
8	7.3485
9	29.9333
10	7.4833
11	0.0000
12	-1.4142
13	-34.2929
14	-4.2426

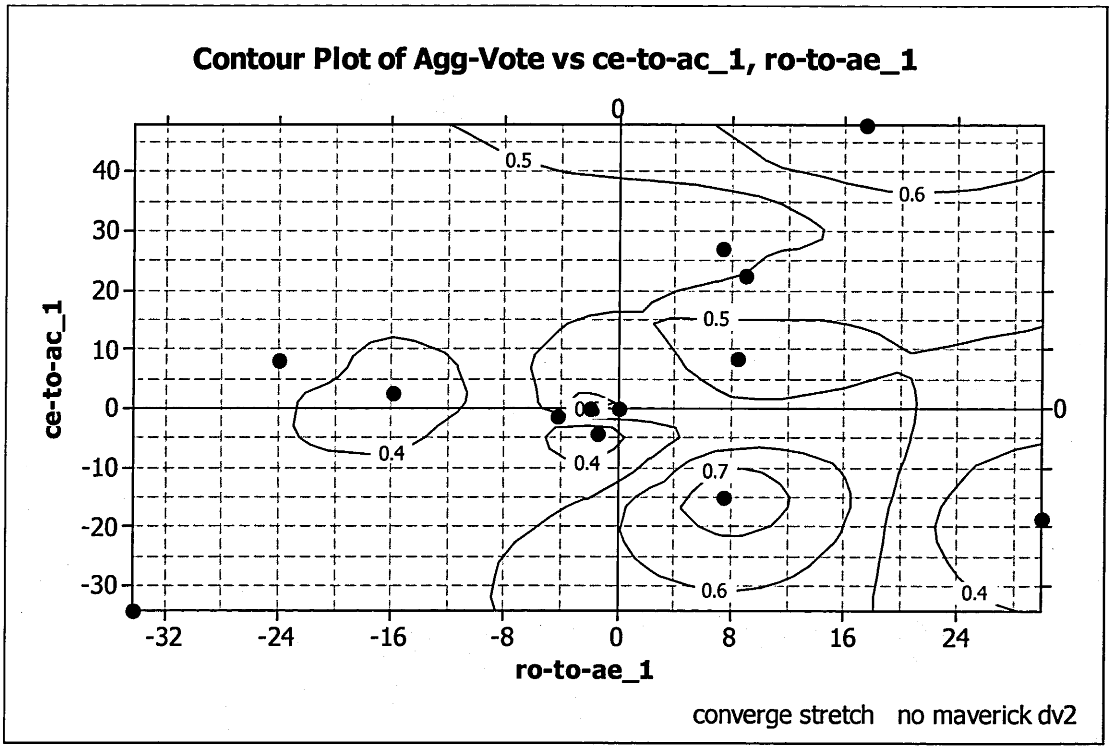
MTB >


Contour Plot of Agg-Vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
0.7
0.6
0.5
0.8
assimilate stretch no maverik dv2


Contour Plot of Agg-Vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
0.45
0.40
0.55
0.50
0.60
0.65
Converge keep no maverik dv2


Contour Plot of Agg-Vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
0.45
0.40
0.55
0.50
0.45
0.40
0.45
0.55
0.55
0.50
0.50
0.55
0.65
0.50
0.60
0.60
40
30
20
10
0
-10
-20
-30
-32
-24
-16
-8
0
8
16
24
Converge keep no maverik dv2


Contour Plot of Agg-Vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
0.5
0.6
0.5
0.4
0.4
0.7
0.6
0.4
40
30
20
10
0
-10
-20
-30
-32
-24
-16
-8
0
8
16
24


Contour Plot of Agg-Vote vs ce-to-ac_1, ro-to-ae_1
ce-to-ac_1
ro-to-ae_1
40
30
20
10
0
-10
-20
-30
-32
-24
-16
-8
0
8
16
24
0.5
0.6
0.5
0.4
0.4
0.7
0.6
0.4
converge stretch no maverick dv2

Appendix 7 Group Analysis

Group – Group Analysis

Divergers-Convergers, No Assimilators Available,

Phase Divergence, Assess Cognition

Minitab Project Report

Descriptive Statistics: DIVERGERS, CONVERGERS

Variable	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3
DIVERGERS	4.0000	0.000000	0.000000	4.0000	4.0000	4.0000	4.0000
CONVERGERS	3.733	0.267	1.033	2.000	3.000	4.000	5.000

Variable	Maximum	Mode	N for Mode	Skewness	Kurtosis
DIVERGERS	4.0000	4	10	*	*
CONVERGERS	5.000	4	5	-0.28	-0.92

Mann-Whitney Test and CI: DIVERGERS, CONVERGERS

	N	Median
DIVERGERS	10	4.000
CONVERGERS	15	4.000

```
Point estimate for ETA1-ETA2 is 0.000
95.1 Percent CI for ETA1-ETA2 is (-0.990,1.000)
W = 140.0
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.2991
The test is significant at 0.2840 (adjusted for ties)
```

```
MTB > TwoSample 'DIVERGERS' 'CONVERGERS';
SUBC>   Alternative 1;
SUBC>   GBoxplot.
```

Two-Sample T-Test and CI: DIVERGERS, CONVERGERS

```
Two-sample T for DIVERGERS vs CONVERGERS

             N     Mean    StDev  SE Mean
DIVERGERS   10  4.00000  0.00471   0.0015
CONVERGERS  15     3.73     1.03     0.27


Difference = mu (DIVERGERS) - mu (CONVERGERS)
Estimate for difference:  0.267
95% lower bound for difference:  -0.203
T-Test of difference = 0 (vs >): T-Value = 1.00  P-Value = 0.167  DF = 14
```

Group-Group Analysis Divergers – Convergers No Assimilators Available

Phase Convergence Assess Cognition

Descriptive Statistics: DIVERGERS_1, CONVERGERS_1

```
Variable       Mean  SE Mean  StDev  Minimum     Q1  Median     Q3  Maximum
DIVERGERS_1   4.167    0.307  0.753    3.000  3.750   4.000  5.000    5.000
CONVERGERS_1  4.222    0.401  1.202    2.000  3.000   5.000  5.000    5.000

                     N for
Variable      Mode   Mode  Skewness  Kurtosis
DIVERGERS_1      4      3     -0.31     -0.10
CONVERGERS_1     5      6     -1.09     -0.59
```

Mann-Whitney Test and CI: CONVERGERS_1, DIVERGERS_1

```
              N  Median
CONVERGERS_1  9   5.000
DIVERGERS_1   6   4.000


Point estimate for ETA1-ETA2 is -0.000
96.1 Percent CI for ETA1-ETA2 is (-1.000,1.001)
W = 76.0
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.3400
The test is significant at 0.3259 (adjusted for ties)


MTB > TwoSample 'CONVERGERS_1' 'DIVERGERS_1';
SUBC>   Alternative 1;
SUBC>   GBoxplot.
```

Two-Sample T-Test and CI: CONVERGERS_1, DIVERGERS_1

```
Two-sample T for CONVERGERS_1 vs DIVERGERS_1

              N   Mean  StDev  SE Mean
CONVERGERS_1  9   4.22   1.20     0.40
DIVERGERS_1   6  4.167  0.753     0.31


Difference = mu (CONVERGERS_1) - mu (DIVERGERS_1)
Estimate for difference:  0.056
95% lower bound for difference:  -0.844
T-Test of difference = 0 (vs >): T-Value = 0.11  P-Value = 0.457  DF = 12
```

Group-Group Analysis Divergers – Convergers, No Assimilators Phase Divergence, Assess Activity

Descriptive Statistics: DIVERGERS_2_1_1, CONVERGERS_2_1_1

```
Variable           Mean  SE Mean  StDev  Minimum     Q1  Median     Q3  Maximum
DIVERGERS_2_1_1   3.962    0.152  0.774    1.000  4.000   4.000  4.000    5.000
CONVERGERS_2_1_1  3.974    0.135  0.843    2.000  4.000   4.000  5.000    5.000

                         N for
Variable          Mode   Mode  Skewness  Kurtosis
DIVERGERS_2_1_1      4     19     -2.18      8.43
CONVERGERS_2_1_1     4     21     -0.78      0.49
```

Descriptive Statistics: DIVERGERS_2_1_1, CONVERGERS_2_1_1

```
Variable           Mean  SE Mean  StDev  Minimum     Q1  Median     Q3  Maximum
DIVERGERS_2_1_1   3.962    0.152  0.774    1.000  4.000   4.000  4.000    5.000
CONVERGERS_2_1_1  3.974    0.135  0.843    2.000  4.000   4.000  5.000    5.000

                         N for
Variable          Mode   Mode  Skewness  Kurtosis
DIVERGERS_2_1_1      4     19     -2.18      8.43
CONVERGERS_2_1_1     4     21     -0.78      0.49
```


Mann-Whitney Test and CI: DIVERGERS_2_1_1, CONVERGERS_2_1_1

```
                   N  Median
DIVERGERS_2_1_1   26  4.0000
CONVERGERS_2_1_1  39  4.0000


Point estimate for ETA1-ETA2 is 0.0000
95.0 Percent CI for ETA1-ETA2 is (-0.0000,0.0002)
W = 849.5
Test of ETA1 = ETA2 vs ETA1 > ETA2


Cannot reject since W is < 858.0

MTB > Mann-Whitney 95.0 'DIVERGERS_2_1_1' 'CONVERGERS_2_1_1';
```

```
SUBC>   Alternative -1.
```

Mann-Whitney Test and CI: DIVERGERS_2_1_1, CONVERGERS_2_1_1

```
                   N  Median
DIVERGERS_2_1_1   26  4.0000
CONVERGERS_2_1_1  39  4.0000


Point estimate for ETA1-ETA2 is 0.0000
95.0 Percent CI for ETA1-ETA2 is (-0.0000,0.0002)
W = 849.5
Test of ETA1 = ETA2 vs ETA1 < ETA2 is significant at 0.4573
The test is significant at 0.4510 (adjusted for ties)

MTB >
```

Two-Sample T-Test and CI: DIVERGERS_2_1_1, CONVERGERS_2_1_1

```
Two-sample T for DIVERGERS_2_1_1 vs CONVERGERS_2_1_1

                   N   Mean  StDev  SE Mean
DIVERGERS_2_1_1   26  3.962  0.774     0.15
CONVERGERS_2_1_1  39  3.974  0.843     0.13


Difference = mu (DIVERGERS_2_1_1) - mu (CONVERGERS_2_1_1)
Estimate for difference:  -0.013
95% lower bound for difference:  -0.352
T-Test of difference = 0 (vs >): T-Value = -0.06  P-Value = 0.525  DF = 56
```

Two-Sample T-Test and CI: DIVERGERS_2_1_1, CONVERGERS_2_1_1

```
Two-sample T for DIVERGERS_2_1_1 vs CONVERGERS_2_1_1

                   N   Mean  StDev  SE Mean
DIVERGERS_2_1_1   26  3.962  0.774     0.15
CONVERGERS_2_1_1  39  3.974  0.843     0.13


Difference = mu (DIVERGERS_2_1_1) - mu (CONVERGERS_2_1_1)
Estimate for difference:  -0.013
95% upper bound for difference:  0.327
T-Test of difference = 0 (vs <): T-Value = -0.06  P-Value = 0.475  DF = 56
```

Group-Group Analysis Divergers – Convergers No Assimilators Available

Phase Convergence Assess Activity

Descriptive Statistics: DIVERGERS_2_1, CONVERGERS_2_1

Variable	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3	Maximum
DIVERGERS_2_1	3.389	0.231	0.979	2.000	2.750	3.500	4.000	5.000
CONVERGERS_2_1	3.600	0.306	1.183	1.000	3.000	4.000	4.000	5.000

Variable	Mode	N for Mode	Skewness	Kurtosis
DIVERGERS_2_1	4	7	-0.07	-0.92
CONVERGERS_2_1	4	7	-0.87	0.20

Mann-Whitney Test and CI: CONVERGERS_2_1, DIVERGERS_2_1

	N	Median
CONVERGERS_2_1	15	4.000
DIVERGERS_2_1	18	3.500

```
Point estimate for ETA1-ETA2 is -0.000
95.1 Percent CI for ETA1-ETA2 is (-0.000,1.000)
W = 275.5
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.2348
The test is significant at 0.2236 (adjusted for ties)
```

Two-Sample T-Test and CI: CONVERGERS_2_1, DIVERGERS_2_1

Two-sample T for CONVERGERS_2_1 vs DIVERGERS_2_1

	N	Mean	StDev	SE Mean
CONVERGERS_2_1	15	3.60	1.18	0.31
DIVERGERS_2_1	18	3.389	0.979	0.23

```
Difference = mu (CONVERGERS_2_1) - mu (DIVERGERS_2_1)
Estimate for difference:  0.211
95% lower bound for difference:  -0.441
T-Test of difference = 0 (vs >): T-Value = 0.55  P-Value = 0.293  DF = 27
```

Group - Individual Analysis

Mann-Whitney Test and CI: I-div, DIVERGERS

```
             N  Median
I-div       20  3.0000
DIVERGERS   10  4.0000


Point estimate for ETA1-ETA2 is -1.0000
95.5 Percent CI for ETA1-ETA2 is (-1.9996,0.0002)
W = 245.0
Test of ETA1 = ETA2 vs ETA1 > ETA2


Cannot reject since W is < 310.0

MTB > Mann-Whitney 95.0 'I-div' 'DIVERGERS';
SUBC>   Alternative -1.
```

Mann-Whitney Test and CI: I-div, DIVERGERS

```
             N  Median
I-div       20  3.0000
DIVERGERS   10  4.0000


Point estimate for ETA1-ETA2 is -1.0000
95.5 Percent CI for ETA1-ETA2 is (-1.9996,0.0002)
W = 245.0
Test of ETA1 = ETA2 vs ETA1 < ETA2 is significant at 0.0023
The test is significant at 0.0011 (adjusted for ties)

MTB > TwoSample 'I-div' 'DIVERGERS';
SUBC>   Alternative 1;
SUBC>   GBoxplot.
```

Two-Sample T-Test and CI: I-div, DIVERGERS

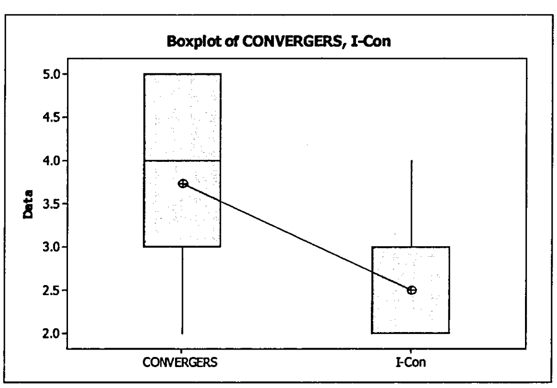
```
Two-sample T for I-div vs DIVERGERS

             N     Mean    StDev  SE Mean
I-div       20     2.80     1.06     0.24
DIVERGERS   10  4.00000  0.00471   0.0015


Difference = mu (I-div) - mu (DIVERGERS)
Estimate for difference:  -1.200
95% lower bound for difference:  -1.608
T-Test of difference = 0 (vs >): T-Value = -5.08  P-Value = 1.000  DF = 19
```

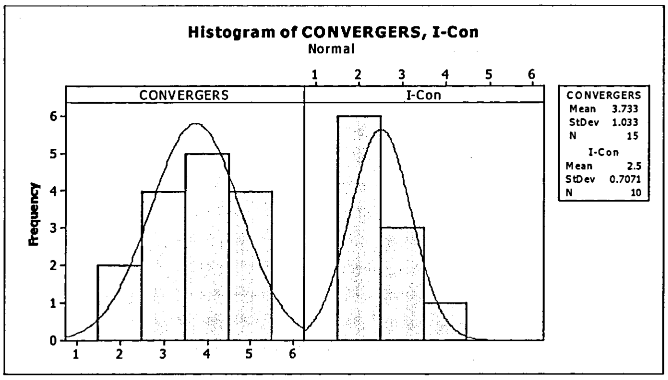
Mann-Whitney Test and CI: CONVERGERS, I-Con

```
              N  Median
CONVERGERS   15   4.000
I-Con        10   2.000


Point estimate for ETA1-ETA2 is 1.000
95.1 Percent CI for ETA1-ETA2 is (0.000,2.000)
W = 243.5
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.0039
The test is significant at 0.0029 (adjusted for ties)

MTB > TwoSample 'CONVERGERS' 'I-Con';
SUBC>   Alternative 1;
SUBC>   GBoxplot.
```

Two-Sample T-Test and CI: CONVERGERS, I-Con

```
Two-sample T for CONVERGERS vs I-Con

              N   Mean  StDev  SE Mean
CONVERGERS   15   3.73   1.03     0.27
I-Con        10  2.500  0.707     0.22


Difference = mu (CONVERGERS) - mu (I-Con)
Estimate for difference:  1.233
95% lower bound for difference:  0.636
T-Test of difference = 0 (vs >): T-Value = 3.54  P-Value = 0.001  DF = 22
```



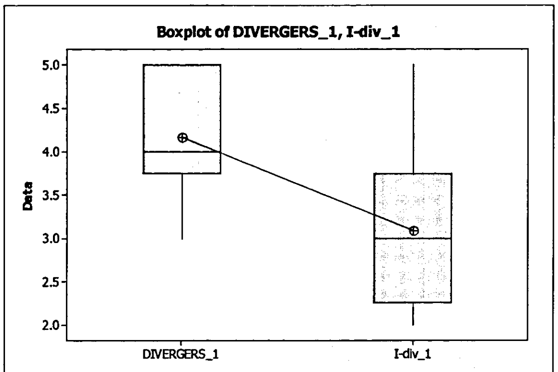


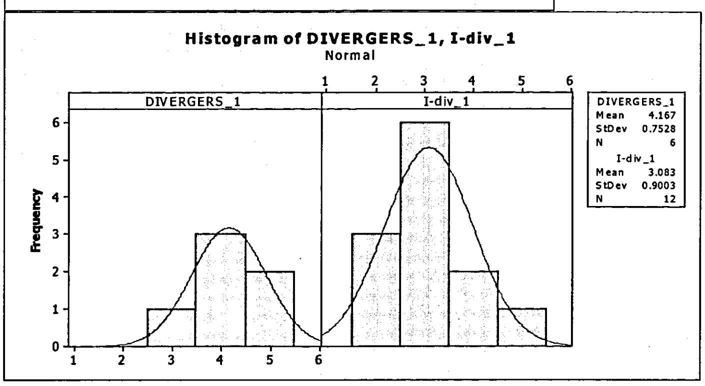
Mann-Whitney Test and CI: DIVERGERS_1, I-div_1

```
               N  Median
DIVERGERS_1    6   4.000
I-div_1       12   3.000


Point estimate for ETA1-ETA2 is 1.000
95.6 Percent CI for ETA1-ETA2 is (-0.000,2.000)
W = 80.0
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.0175
The test is significant at 0.0137 (adjusted for ties)

MTB > TwoSample 'DIVERGERS_1' 'I-div_1';
SUBC>   Alternative 1;
SUBC>   GBoxplot.
```

Two-Sample T-Test and CI: DIVERGERS_1, I-div_1

```
Two-sample T for DIVERGERS_1 vs I-div_1

               N   Mean  StDev  SE Mean
DIVERGERS_1    6  4.167  0.753     0.31
I-div_1       12  3.083  0.900     0.26


Difference = mu (DIVERGERS_1) - mu (I-div_1)
Estimate for difference:  1.083
95% lower bound for difference:  0.361
T-Test of difference = 0 (vs >): T-Value = 2.69  P-Value = 0.010  DF = 11
```



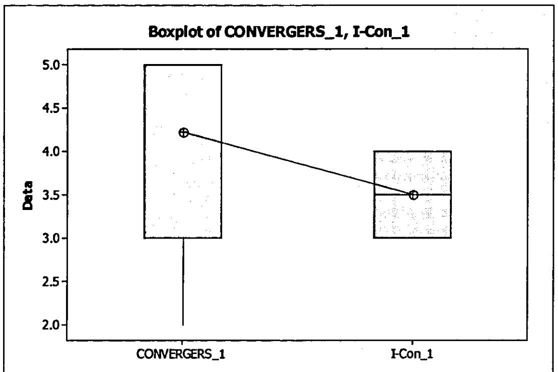


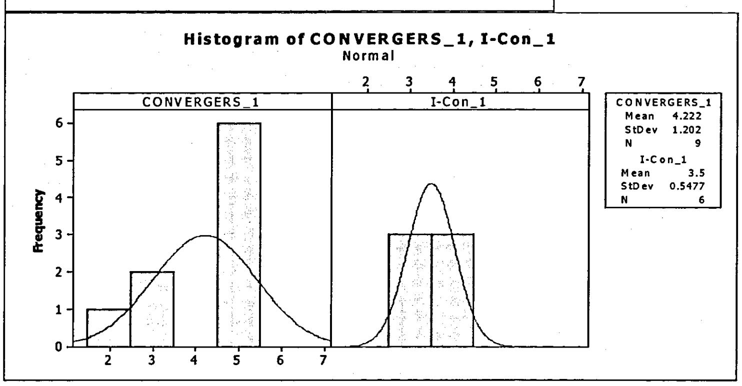
Mann-Whitney Test and CI: CONVERGERS_1, I-Con_1

```
               N  Median
CONVERGERS_1  9   5.000
I-Con_1       6   3.500


Point estimate for ETA1-ETA2 is 1.000
96.1 Percent CI for ETA1-ETA2 is (-1.001,1.999)
W = 84.0
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.0877
The test is significant at 0.0759 (adjusted for ties)

MTB > TwoSample 'CONVERGERS_1' 'I-Con_1';
SUBC>   Alternative 1;
SUBC>   GBoxplot.
```

Two-Sample T-Test and CI: CONVERGERS_1, I-Con_1

```
Two-sample T for CONVERGERS_1 vs I-Con_1

               N   Mean  StDev  SE Mean
CONVERGERS_1  9   4.22   1.20     0.40
I-Con_1       6  3.500  0.548     0.22


Difference = mu (CONVERGERS_1) - mu (I-Con_1)
Estimate for difference:  0.722
95% lower bound for difference:  -0.102
T-Test of difference = 0 (vs >): T-Value = 1.57  P-Value = 0.072  DF = 11
```



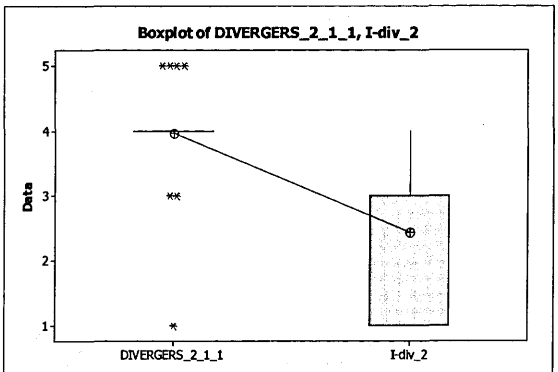


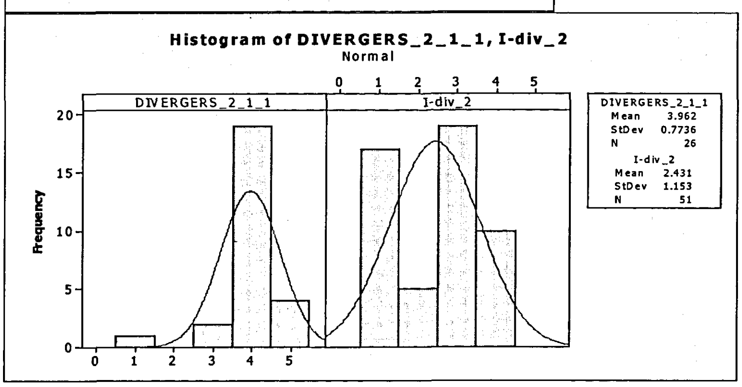
Mann-Whitney Test and CI: DIVERGERS_2_1_1, I-div_2

```
                   N  Median
DIVERGERS_2_1_1   26  4.0000
I-div_2           51  3.0000


Point estimate for ETA1-ETA2 is 1.0000
95.1 Percent CI for ETA1-ETA2 is (1.0002,2.0001)
W = 1500.5
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.0000
The test is significant at 0.0000 (adjusted for ties)

MTB > TwoSample 'DIVERGERS_2_1_1' 'I-div_2';
SUBC>   Alternative 1;
SUBC>   GBoxplot.
```

Two-Sample T-Test and CI: DIVERGERS_2_1_1, I-div_2

```
Two-sample T for DIVERGERS_2_1_1 vs I-div_2

                   N   Mean  StDev  SE Mean
DIVERGERS_2_1_1   26  3.962  0.774     0.15
I-div_2           51   2.43   1.15     0.16


Difference = mu (DIVERGERS_2_1_1) - mu (I-div_2)
Estimate for difference:  1.530
95% lower bound for difference:  1.161
T-Test of difference = 0 (vs >): T-Value = 6.91  P-Value = 0.000  DF = 69
```


Boxplot of DIVERGERS_2_1_1, I-div_2
Data
DIVERGERS_2_1_1
I-div_2


Histogram of DIVERGERS_2_1_1, I-div_2
Normal
DIVERGERS_2_1_1
I-div_2
Frequency
DIVERGERS_2_1_1
Mean 3.962
StDev 0.7736
N 26
I-div_2
Mean 2.431
StDev 1.153
N 51

Mann-Whitney Test and CI: CONVERGERS_2_1_1, I-Con_2

```
                   N  Median
CONVERGERS_2_1_1  39  4.0000
I-Con_2           26  2.0000


Point estimate for ETA1-ETA2 is 2.0000
95.0 Percent CI for ETA1-ETA2 is (2.0000,2.0001)
W = 1737.0
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.0000
The test is significant at 0.0000 (adjusted for ties)

MTB > Mann-Whitney 95.0 'CONVERGERS_2_1_1' 'I-Con_2';
SUBC>   Alternative -1.
```

Mann-Whitney Test and CI: CONVERGERS_2_1_1, I-Con_2

```
                   N  Median
CONVERGERS_2_1_1  39  4.0000
I-Con_2           26  2.0000


Point estimate for ETA1-ETA2 is 2.0000
95.0 Percent CI for ETA1-ETA2 is (2.0000,2.0001)
W = 1737.0
Test of ETA1 = ETA2 vs ETA1 < ETA2


Cannot reject since W is > 1287.0

MTB > Mann-Whitney 95.0 'CONVERGERS_2_1_1' 'I-Con_2';
SUBC>   Alternative 0.
```

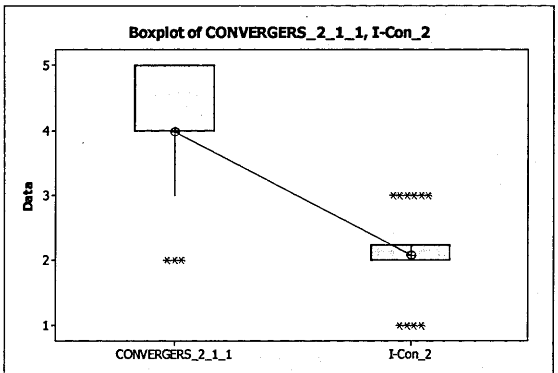
Mann-Whitney Test and CI: CONVERGERS_2_1_1, I-Con_2

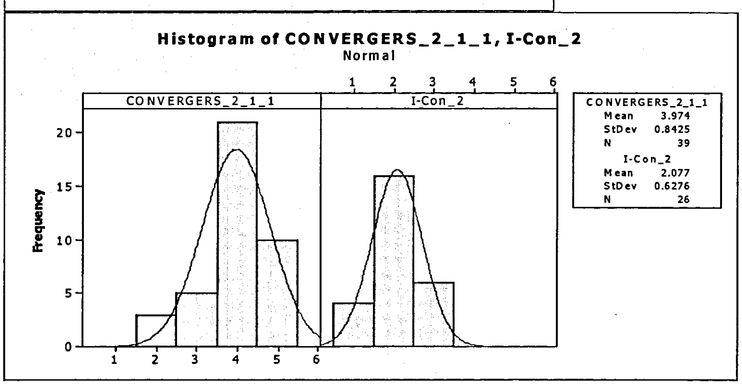
```
                   N  Median
CONVERGERS_2_1_1  39  4.0000
I-Con_2           26  2.0000


Point estimate for ETA1-ETA2 is 2.0000
95.0 Percent CI for ETA1-ETA2 is (2.0000,2.0001)
W = 1737.0
Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at 0.0000
The test is significant at 0.0000 (adjusted for ties)

MTB > TwoSample 'CONVERGERS_2_1_1' 'I-Con_2';
SUBC>   Alternative 1;
SUBC>   GBoxplot.
```

Two-Sample T-Test and CI: CONVERGERS_2_1_1, I-Con_2

```
Two-sample T for CONVERGERS_2_1_1 vs I-Con_2

                   N   Mean  StDev  SE Mean
CONVERGERS_2_1_1  39  3.974  0.843     0.13
I-Con_2           26  2.077  0.628     0.12


Difference = mu (CONVERGERS_2_1_1) - mu (I-Con_2)
Estimate for difference:  1.897
95% lower bound for difference:  1.592
```

```
T-Test of difference = 0 (vs >): T-Value = 10.39  P-Value = 0.000  DF = 62
```





Mann-Whitney Test and CI: DIVERGERS_2_1, I-div_1_1

```
                 N  Median
DIVERGERS_2_1   18   3.500
I-div_1_1       35   3.000


Point estimate for ETA1-ETA2 is 1.000
95.0 Percent CI for ETA1-ETA2 is (-0.000,1.000)
W = 585.5
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.0315
The test is significant at 0.0276 (adjusted for ties)

MTB > Mann-Whitney 95.0 'DIVERGERS_2_1' 'I-div_1_1';
SUBC>   Alternative -1.
```

Mann-Whitney Test and CI: DIVERGERS_2_1, I-div_1_1

```
                 N  Median
DIVERGERS_2_1   18   3.500
I-div_1_1       35   3.000


Point estimate for ETA1-ETA2 is 1.000
95.0 Percent CI for ETA1-ETA2 is (-0.000,1.000)
W = 585.5
Test of ETA1 = ETA2 vs ETA1 < ETA2


Cannot reject since W is > 486.0

MTB > Mann-Whitney 95.0 'DIVERGERS_2_1' 'I-div_1_1';
```

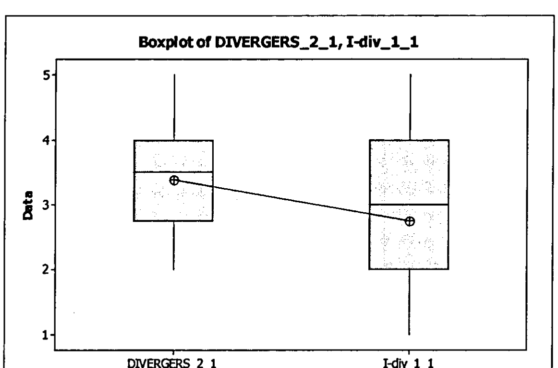
```
SUBC>   Alternative 0.
```

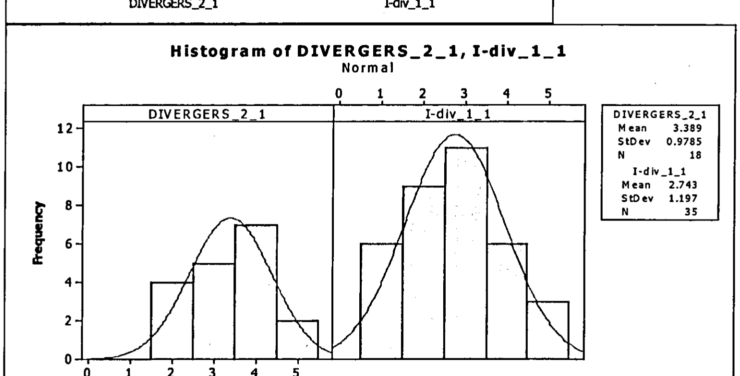
Mann-Whitney Test and CI: DIVERGERS_2_1, I-div_1_1

```
                N  Median
DIVERGERS_2_1  18   3.500
I-div_1_1      35   3.000


Point estimate for ETA1-ETA2 is 1.000
95.0 Percent CI for ETA1-ETA2 is (-0.000,1.000)
W = 585.5
Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at 0.0630
The test is significant at 0.0553 (adjusted for ties)

MTB > TwoSample 'DIVERGERS_2_1' 'I-div_1_1';
SUBC>   Alternative 1;
SUBC>   GBoxplot.
```

Two-Sample T-Test and CI: DIVERGERS_2_1, I-div_1_1

```
Two-sample T for DIVERGERS_2_1 vs I-div_1_1

                N   Mean  StDev  SE Mean
DIVERGERS_2_1  18  3.389  0.979     0.23
I-div_1_1      35   2.74   1.20     0.20


Difference = mu (DIVERGERS_2_1) - mu (I-div_1_1)
Estimate for difference:  0.646
95% lower bound for difference:  0.130
T-Test of difference = 0 (vs >): T-Value = 2.11  P-Value = 0.021  DF = 41
```



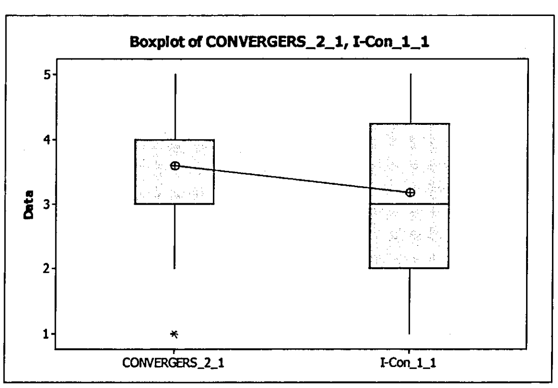


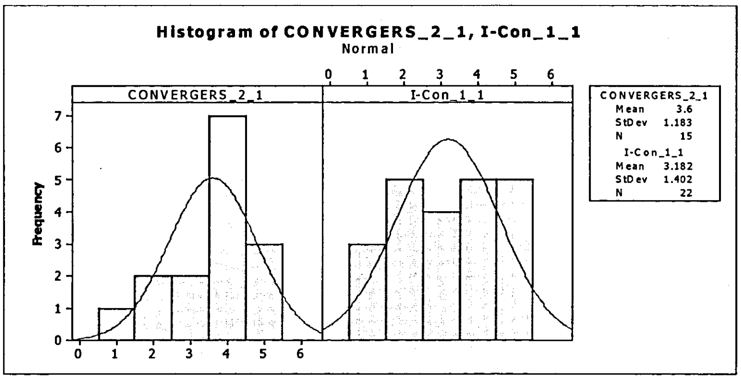
Mann-Whitney Test and CI: CONVERGERS_2_1, I-Con_1_1

```
                 N  Median
CONVERGERS_2_1  15   4.000
I-Con_1_1       22   3.000


Point estimate for ETA1-ETA2 is -0.000
95.1 Percent CI for ETA1-ETA2 is (-1.000,1.000)
W = 312.5
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.2018
The test is significant at 0.1950 (adjusted for ties)

MTB > TwoSample 'CONVERGERS_2_1' 'I-Con_1_1';
SUBC>   Alternative 1;
SUBC>   GBoxplot.
```

Two-Sample T-Test and CI: CONVERGERS_2_1, I-Con_1_1

```
Two-sample T for CONVERGERS_2_1 vs I-Con_1_1

                 N  Mean  StDev  SE Mean
CONVERGERS_2_1  15  3.60   1.18     0.31
I-Con_1_1       22  3.18   1.40     0.30


Difference = mu (CONVERGERS_2_1) - mu (I-Con_1_1)
Estimate for difference:  0.418
95% lower bound for difference:  -0.305
T-Test of difference = 0 (vs >): T-Value = 0.98  P-Value = 0.167  DF = 33



MTB >
```





Results for: Worksheet 6

Chi-Square Test: C1, C2 Match styles to technique

```
Expected counts are printed below observed counts
Chi-Square contributions are printed below expected counts

          C1      C2  Total
    1      6      47     53
       23.96   29.04
      13.461  11.106

    2     22      17     39
       17.63   21.37
       1.083   0.894

    3     36      52     88
       39.78   48.22
       0.359   0.296

    4     50      35     85
       38.42   46.58
       3.487   2.877

    5     18       9     27
       12.21   14.79
       2.751   2.270

Total    132     160    292

Chi-Sq = 38.584, DF = 4, P-Value = 0.000
```

Chi-Square Test: C4, C5 Non Match Style to technique

```
Expected counts are printed below observed counts
Chi-Square contributions are printed below expected counts

          C4      C5  Total
    1     13      73     86
       38.90   47.10
      17.245  14.244

    2     40      69    109
       49.30   59.70
       1.756   1.450

    3     63      85    148
```

```
        66.95   81.05
        0.233   0.192

    4     105      42    147
        66.49   80.51
       22.299  18.418

    5      21      24     45
        20.36   24.64
        0.020   0.017

Total     242     293    535

Chi-Sq = 75.874, DF = 4, P-Value = 0.000
```

Appendix 8 Taxonomizing Techniques

Process

Re-assess definitions for overlaps >>

Technique	Environmental Analysis	Rrecognition & Identification	Assumptions & Generation	Evaluate Choice Implement	Paradigms	Users	Environmental Analysis	Problem recognition	Problem identification	Making Assumptions	Alternative Generation Randomisation	Evaluate & Choice	Implement	Control	Paradigms	Helps Condition & Motivate	Helps Moral	Helps Workplace layout	Helps Focussing	Helps Point-Direct-Inspire	Helps Encourage lateral thinking	Relies on Users	Relies on Learning Style used	Relies on Creative Style used
	yes = 1 no = 0	yes = 1 no = 0	yes = 1 no = 0	yes = 1 no = 0	Keep=0 Stretch=1 Break=2	Individual=1 Group=2 Either=0	no = 0 possibly=0.3 probably=0.6 yes =0.9	no = 0 possibly=0.3 probably=0.6 yes =0.9	no = 0 possibly=0.3 probably=0.6 yes =0.9	no = 0 possibly=0.3 probably=0.6 yes =0.9	no = 0 possibly=0.3 probably=0.6 yes =0.9	no = 0 possibly=0.3 probably=0.6 yes =0.9	no = 0 possibly=0.3 probably=0.6 yes =0.9	no = 0 possibly=0.3 probably=0.6 yes =0.9	Keep=.3 Stretch=.6 Break=.9	no = 0 possibly=0.3 probably=0.6 yes =0.9	negative -1 ? = 0 positively = 1	Low = 0 Moderate =1 very=2	no = 0 possibly=0.3 probably=0.6 yes =0.9	no = 0 possibly=0.3 probably=0.6 yes =0.9	Low = 0 Moderate =1 very=2	Individual=1 Group=2 Either=0	Accom=1 Diverge=2 Assim=3 Converge=4	receptive=1 perceptive=2
	Process	Process	Process	Process	Process	Process	Process	Process	Process	Process	Process	Process	Process	Process	Process	People	People	People	People	People	People	People	People	People
Source	D	D	D	D	C	B	BL	BL	BL	BL	BAL	BL	BL	B	CL	AL	L	K	AL	AL	KL	BL	D	D
5W+H	1	1	1	1	1	0	0.6	0.6	0	0	0.6	0.6	0.6	0	1	1	0	0	0	0	0	0	0	0
7x7 matrix	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	1	0	0	1	0	0
Affinity Diagram	0	1	1	1	1	0	0	0	0.6	0	0.6	0.6	0.6	0	1	0	0	0	0	0	0	0	0	0
AIDA	0	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0
Analogies & Metaphors	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Analysis of past solutions	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	1	1	0	1	0	0
Anonymous Voting	0	0	0	1	0	2	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	2	0	0
Arrow diagram	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Associations	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Assumption Reversals	0	0	1	0	2	0	0	0	0	0	0.6	0	0	0	2	0	0	0	1	0	0	0	0	0
Assumption Smashing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Assumption Surfacing	0	0	1	0	0	0	0	0	0	0.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
Attribute Association Chains	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Attribute Listing	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
Back to the customer	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Back to the Sun	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	1	0	0	1	0	0
Baron's Psychic Creation Model	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Be a Warrior	0	0	0	1	0	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0
Benchmarking	1	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Bkwards Fwards Planning	0	1	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bounce it off someone else	0	1	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boundary exam'n (DeBono 82)	0	1	1	0	0	0	0	0	0.6	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boundary Relaxation	0	1	1	0	0	0	0	0	0.6	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brainsketching	0	0	1	0	3	0	0	0	0	0	0.6	0	0	0	3	0	0	0	0	1	0	0	0	0

0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	L	Relies on	random stimuli catalyst	yes = 1 no = 0	People
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*Scope*	*Involve passive people*	Low = 0 Moderate =1 very=2	People
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	L	*Scope*	respect individual viewpoint	no =0 possibly=0.3 probably=0.6 yes =0.9	People
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*Scope*	*Deal with opposing influences*	Low = 0 Moderate =1 very=2	Problem
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	AL	*IT IS*	*Knowledge based*	no =0 possibly=0.3 probably=0.6 yes =0.9	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	KL	*IT IS*	*Descriptive*	no =0 possibly=0.3 probably=0.6 yes =0.9	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*IT IS*	*Analytical*	no =0 possibly=0.3 probably=0.6 yes =0.9	Process
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*IT IS*	*Creative or expansive*	no =0 possibly=0.3 probably=0.6 yes =0.9	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*Used for*	*Mistake Proofing*	no =0 possibly=0.3 probably=0.6 yes =0.9	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*Used for*	*Compare methods, defects*	Low = 0 Moderate =1 very=2	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*Used for*	*Defect prevention*	Low = 0 Moderate =1 very=2	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*Used for*	*Discover characteristics*	Low = 0 Moderate =1 very=2	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	KL	*Used for*	*Discover causal linkage*	Low = 0 Moderate =1 very=2	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*Used for*	*Quantify causal linkage*	Low = 0 Moderate =1 very=2	Process
0	0.3	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	L	*Used for*	Identify factors of opportunity	no =0 possibly=0.3 probably=0.6 yes =0.9	Process
0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	L	*Used for*	Identify latent problems	no =0 possibly=0.3 probably=0.6 yes =0.9	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*Used for*	*Decide Priorities*	Low = 0 Moderate =1 very=2	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	KL	*Used for*	*Handle chaos*	Low = 0 Moderate =1 very=2	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*Used for*	*Handle unmeasurable information*	Low = 0 Moderate =1 very=2	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	KL	*Used for*	*How is time spent?*	Low = 0 Moderate =1 very=2	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*Used for*	*Prevent intermittent errors*	Low = 0 Moderate =1 very=2	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*Used for*	*Ranking features*	Low = 0 Moderate =1 very=2	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	L	*Used for*	Identify underlying assumptions	no =0 possibly=0.3 probably=0.6 yes =0.9	Process
0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	L	*Used for*	explore combinations	no =0 possibly=0.3 probably=0.6 yes =0.9	Process
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	L	*Used for*	reflect users bias & concerns	no =0 possibly=0.3 probably=0.6 yes =0.9	Process
0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	L	*Used for*	what is/is not relevant	no =0 possibly=0.3 probably=0.6 yes =0.9	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	KL	*Used for*	*Relate discrete factors*	Low = 0 Moderate =1 very=2	Process
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*Used for*	*Invent new ways to do things*	Low = 0 Moderate =1 very=2	Problem
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	KL	*Used for*	*Satisfy stakeholder needs*	Low = 0 Moderate =1 very=2	Problem
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	KL	*Used for*	*Organise & Planning*	no =0 possibly=0.3 probably=0.6 yes =0.9	Problem
																										Application is social=1 technical=2		

Brainstorming	0	1	1	0	1	2	0	0	0.6	0	0.6	0	0	0	1	0	0	1	0	0	0	2	0	0
Brainwriting	0	1	1	0	1	2	0	0	0.6	0	0.6	0	0	0	1	0	0	0	0	0	0	2	0	0
Brainwriting 6-3-5	0	1	1	0	1	2	0	0	0.6	0	0.6	0	0	0	1	0	0	0	0	0	0	2	0	0
BrainWriting Constrained	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
BrainWriting constraint Varied	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
BrainWriting Game	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
BrainWriting Idea Card	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
BrainWriting Pool	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
Browsing	1	0	0	1	0	0	0.6	0	0	0	0	0.3	0	0	0	0	0	0	0	1	0	0	0	0
Brutethink	1	1	0	0	0	0	0.3	0.3	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bug Listing	1	1	0	0	0	0	0.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BulletProofing	0	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	-1	0	0	0	0	0	0	0
Bunches of bananas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Camelot	0	1	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Card Story Boards	0	1	0	0	1	2	0	0.6	0.6	0	0	0	0	0	1	0	0	0	0	1	0	2	0	0
Cartoon Story Board	1	1	0	0	3	0	0.6	0.6	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0
CATWOE	1	1	1	0	0	0	0.6	0.6	0.6	0.6	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Causal-cognitive Mapping	1	1	0	0	0	0	0.6	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Checklist	0	1	0	1	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cherry Split	0	0	1	0	1	0	0	0	0	0.6	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Chunking	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Circle of Opportunity	0	0	1	0	0	0.6	0	0	0	0	0.9	0	0	0	0	0.9	0	0	0.3	0	0	0.6	0	0
Clarification	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
cognitive mapping	1	1	0	0	0	0	0.6	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collage	0	1	1	0	3	0	0	0	0.6	0	0.6	0	0	0	3	0	0	0	0	0	0	0	0	0
Collective Notebook	1	1	0	0	0	0	0.6	0.6	0.6	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
Compare to others	1	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
Comparison tables	0	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	1	0	0	0	0	0
Component Detailing	0	1	1	0	2	0	0	0.6	0	0	0.6	0	0	0	2	0	0	0	0	0	1	0	0	0
concensus bulding	0	1	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Concept Fan	0	1	1	0	1	0	0	0	0.6	0.6	0.6	0	0	0	1	1	0	0	1	1	0	0	0	0
Consensus Mapping	0	1	1	0	0	0	0	0	0.6	0.6	0	0	0	0	0	1	0	0	0	1	0	0	0	0
Contradiction Analysis	1	1	0	1	0	0	0.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Control charts	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crawford Slip Writing	0	0	1	0	0	2	0	0	0	0	0.9	0	0	0	0	0.3	0	0	0	0.3	0	2	0	0
Creative circles	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Creative Imaging	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Creative leap	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	1	1	0	2	0	0
Criteria for idea-finding potential	0	1	0	0	0	0	0	0.6	0.6	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0
Critical Path Diagrams	0	0	0	1	0	0	0	0	0	0	0	0.6	0.6	0	0	0	0	0	0	0	0	0	0	0
de Bonos 'Po'	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
de Bonos Six Thinking Hats	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deadlines	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	1	0	0	0	0	0	1	0	0
Delphi	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Deployment chart	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Design of experiments	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dialectical Approaches	0	0	0	1	0	2	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	2	0	0
Dimensional Analysis	0	1	0	1	0	0	0	0	0.6	0	0	0.6	0	0	0	0	0	0	1	0	0	0	0	0
Direct Analogies	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
DO IT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
Dot voting	0	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	1	0	0	0	0
Draw a picture/Visual Thinking	0	1	0	0	0	0	0	0.9	0.9	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0
Ergonomics	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Establish Idea Sources	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Estimate-Discuss-Estimate	0	0	0	1	0	0	0	0	0	0	0	0	0.6	0	0	1	1	0	1	1	0	0	0	0
Examine it with the senses	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Excursion technique	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	1	0	0	0	0	0	2	0	0
Experience kit	0	1	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FCB Grid	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	1	0	0	1	0	0	1	0	0
Fishbone diagram	0	1	0	0	0	0	0	0	0.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Five Whys	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flow diagram	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Focussed Object	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	1	0	0	0	0	0	1	0	0
Force Field Analysis	0	1	0	1	1	0	0	0	0.6	0	0	0	0.6	0	1	0	0	0	0	0	0	0	0	0
Forced Analogy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fresh eye	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	1	0	0	0	1	0	1	0	0
Futurist	1	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	
0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	
0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	1	0	
0	0	0	0	0	0.3	0.3	0	0	0	0	0	0.3	0	0.3	0.3	0	0	0.3	0	0	0	0.3	0	0.3	0	0	0	0.3	0	
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0	1	0	1	1	1	1	0	0	1	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	1	0	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0.3	0	0	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0	0	0	0.3	0	
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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
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0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
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0	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	0	0	0	1	0	1	0	1	1	0	0	0	0	0
0	0	1	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	1	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	0	1	0	2	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	1	1	0	0	1	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	2	0	0	1	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Fuzzy Logic (Fuzzy Thinking)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Force-Fit Game	0	0	1	0K		0	0	0	0	0	0.6	0	0	0K		1	1	0	0	0	1	0	0	0
Free Association	0	0	1	0S		0	0	0	0	0	0.3	0	0	0S		0	0	0	0	0	0	0	0	0
False faces	0	1	1	1	2	0	0	0	0.6	0	0.6	0	0.6	0B		1	0	0	0	0	1	0	0	0
Gallery Method	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Goal Orientation	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Gordon Little	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	1	0	2	0	0
Group decision support systems	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	1	0	0	0	0	0	2	0	0
Heuristic Ideation Technique	0	1	1	0	2	0	0	0	0.6	0	0.6	0	0	0	2	1	0	0	0	0	0	0	0	0
Hexagons	0	1	1	1	1	0	0	0	0.6	0	0.6	0.6	0.6	0	1	0	0	0	0	1	0	0	0	0
Histogram	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
How-How Diagram	0	0	0	1	0	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0
Idea bits and racking	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Idea board	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Idea notebook	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Idea triggers	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Imagining	0	0	1	0	3	0	0	0	0	0	0.6	0	0	0	3	0	0	0	0	0	0	0	0	0
Imitation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
In the realm of the senses	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	1	1	0	0	0	0
Innovation committee	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	1	0	0	0	0	0	2	0	0
Input-output	0	0	1	0	1	1	0	0	0	0	0.6	0	0	0	1	0	0	0	1	0	0	1	0	0
Inter -companyInnovation groups	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	1	0	0	2	0	0
Intercompany innovation groups	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Inverse Brainstorming	0	1	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Kepner-Trego	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	1	0	0	0	0	0	0	0	0
King of the moubtain	0	1	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
King of the mountain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
LARC	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
Lateral Thinking	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limericks and parodies	0	1	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lion's den	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Listening to music	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Listing Complaints	0	1	1	0	0	0	0	0.6	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
Lotus Blossom	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	1	0	1	0	0
Matrix data analysis	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Matrix diagram	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Measles chart	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metaphors	0	1	1	0	2	0	0	0	0.6	0	0.6	0	0	0	2	0	0	0	1	0	0	0	0	0
Mind Maps	0	1	1	1	2	1	0	0	0.6	0	0.6	0	0.6	0	2	0	0	0	0	0	0	1	0	0
Mitsubishi Method	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Monitor weak signals	1	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morphological Analysis	0	0	1	0	1	2	0	0	0	0	0.6	0	0	0	1	0	0	0	0	0	0	2	0	0
Morphological Forced Connections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morphology chart	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Name possible uses	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Neuro-Linguistic Programming (NLP)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
NHK method	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Nominal Group Evaluation	0	0	0	1	2	0	0	0	0	0	0	0.6	0	0	2	0	0	0	0	0	0	0	0	0
Nominal group technique	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	1	1	0	2	0	0
Object Stimulation	0	0	1	0	2	0	0	0	0	0	0.6	0	0	0	2	0	0	0	0	0	0	0	0	0
Opportunity Searches	1	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Organised Random Search	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	1	0	0	1	0	0
Pareto diagram	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PDPC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Personal Analogies	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Philips 66	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Photo ecursion	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Picture Stimulation	0	0	1	0	2	1	0	0	0	0	0.6	0	0	0	2	1	0	0	0	0	0	1	0	0
Pin Card Technique	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Poka-Yoke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prioritization matrices	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Problem reversal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Product improvement checklist	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Progressive Abstraction	0	1	1	1	1	0	0	0	0.6	0	0.6	0.6	0	0	1	0	0	0	0	1	0	0	0	0
Pugh Matrix	0	1	1	1	2	0	0	0	0.6	0	0.6	0.6	0	0	2	0	0	0	0	0	0	0	0	0
Quality function deployment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Questions Ask	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Random input	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Reclassification chart	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Redefining a problem/opportunity	0	1	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Related Words	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	1	0	1	0	0
Relatedness	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Relations diagram	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Respond to someone else	0	1	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Reversal	0	1	1	1	2	0	0	0	0.6	0	0.6	0	0.6	0	2	1	0	0	0	0	0	0	0	0
Reversal — dereversal	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Rewrite objective many ways	0	1	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rich Pictures	0	1	1	0	3	0	0	0	0.6	0	0.6	0	0	0	3	0	0	0	0	0	0	0	0	0
Robert Fritz's Process for creation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Role playing	0	1	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rolestorming	0	1	1	0	2	0	0	0.6	0	0	0.6	0	0	0	2	0	0	0	0	0	0	0	0	0
Rolling in the grass for ideas	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Run chart	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scatter diagram	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario analysis	1	1	0	0	0	0	0.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario writing	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Screening Matrix of ideas	0	0	0	1	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0
SERENDIPITY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seven Steps by Roger von Oech	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SIL method (combining)	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Sleeping/dreaming on it	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
Squeeze & Stretch	0	1	0	0	0	0	0	0	0.6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Squeeze and stretch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Star Cruising	0	0	1	0	3	0	0	0	0	0	0.6	0	0	0	3	1	0	0	0	0	0	0	0	0
Sticky Dots	0	0	0	1	1	0	0	0	0	0	0	0.6	0	0	1	0	0	0	1	0	0	0	0	0
Storyboarding	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	1	0	0	2	0	0
Suggestion techniques	0	1	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synectics	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Take five	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	1	0	0	0	0	0	2	0	0
The Discontinuity Principle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
The Napoleon technique	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	1	0	0	0	0	0	1	0	0
The two-words technique	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	1	0	1	0	0
Thinkertoys	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
TKJ	0	0	1	0	0	2	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	2	0	0
Tree diagram	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unconcious Problem Solving	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Visualization	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	1	0	0	0	0	0	1	0	0
What do you know	0	1	0	0	0	0	0	0	0.6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
What if?	0	0	1	0	0	1	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	1	0	0
What patterns eist?	0	1	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Why-why diagram	0	1	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wildest Ideas	0	0	1	0	3	0	0	0	0	0	0.6	0	0	0	3	0	0	0	0	0	0	0	0	0
Wishful Thinking	0	0	1	0	3	0	0	0	0	0	0.6	0	0	0	3	0	0	0	0	0	0	0	0	0
Word Diamond	0	0	1	0	1	0	0	0	0	0	0.6	0	0	0	1	0	0	0	0	0	0	0	0	0
Work sampling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Workout/retreats	0	1	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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Source a = Zusman & Zlotin 1998 G= Rickards 1974 K= allison 1993 J = O'dell 2001 b = Higgins 1994 M= Rickards 1985 c = Mcfadzean 2000,2002 H= jones 1992 F=marconi six sigma handbook

The Creative Problem Solving Strategy and Technique Taxonomy

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0	1	1	0	0	0	Boundary exam'n (DeBono 82)	22
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0	0	0	1	0	0	Dot voting	75
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0	0	0	0	0	0	Forced Analogy	89

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0	1	1	1	2	0	Reversal	166
0	0	1	0	0	1	Reversal — dereversal	167
0	1	0	0	0	0	Rewrite objective many ways	168
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0	0	0	0	0	0	Robert Fritz's Process for creation	170
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0	0	0	0	0	0	Squeeze and stretch	184
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0	0	0	1	1	0	Sticky Dots	186
0	0	1	0	0	2	Storyboarding	187
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0	0	1	0	0	2	Synectics	189
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0	0	1	0	0	1	The Napoleon technique	192
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0	0	0	0	0	0	Tree diagram	196
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0	1	0	0	0	0	What do you know	199
0	0	1	0	0	1	What if?	200
0	1	0	0	0	0	What patterns eist?	201
0	1	0	0	0	0	Why-why diagram	202
0	0	1	0	3	0	Wildest Ideas	203
0	0	1	0	3	0	Wishful Thinking	204
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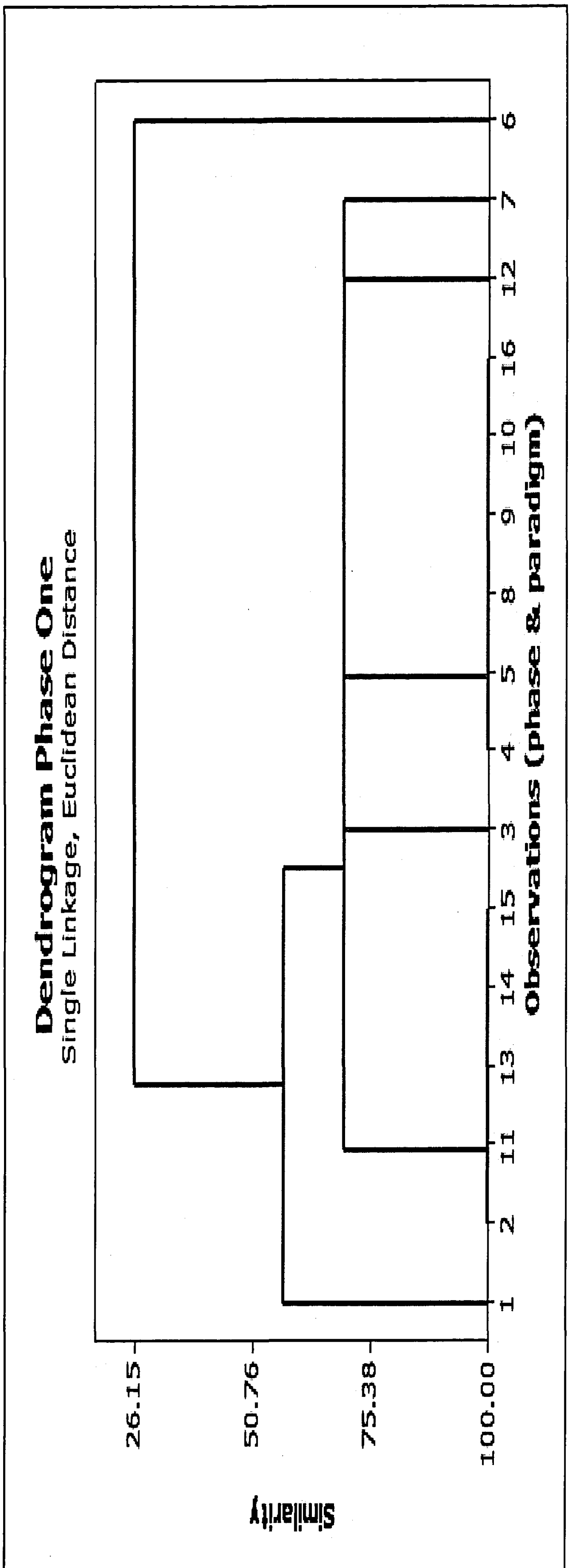
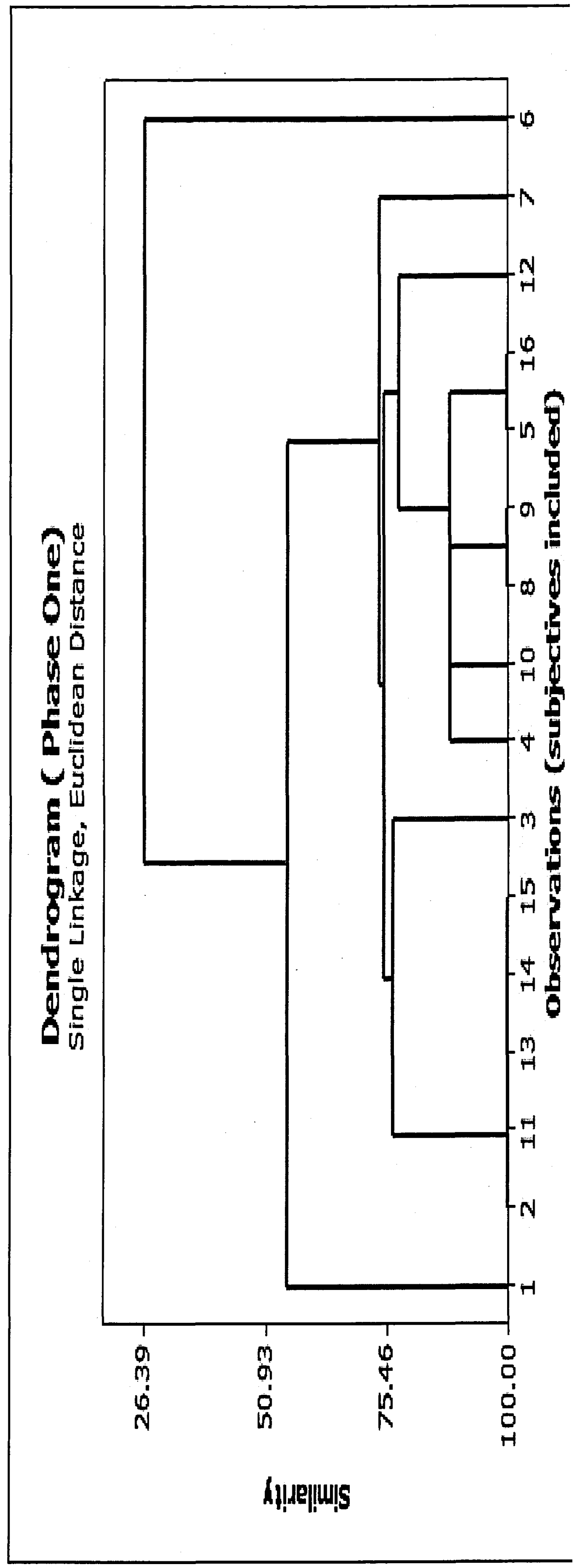
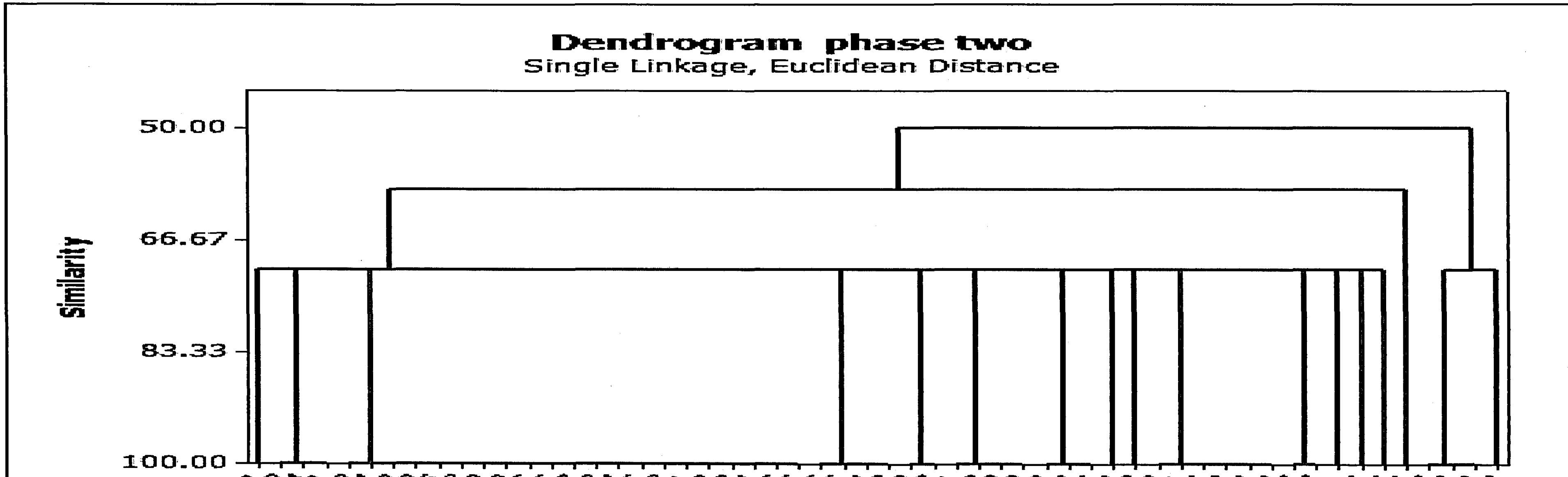
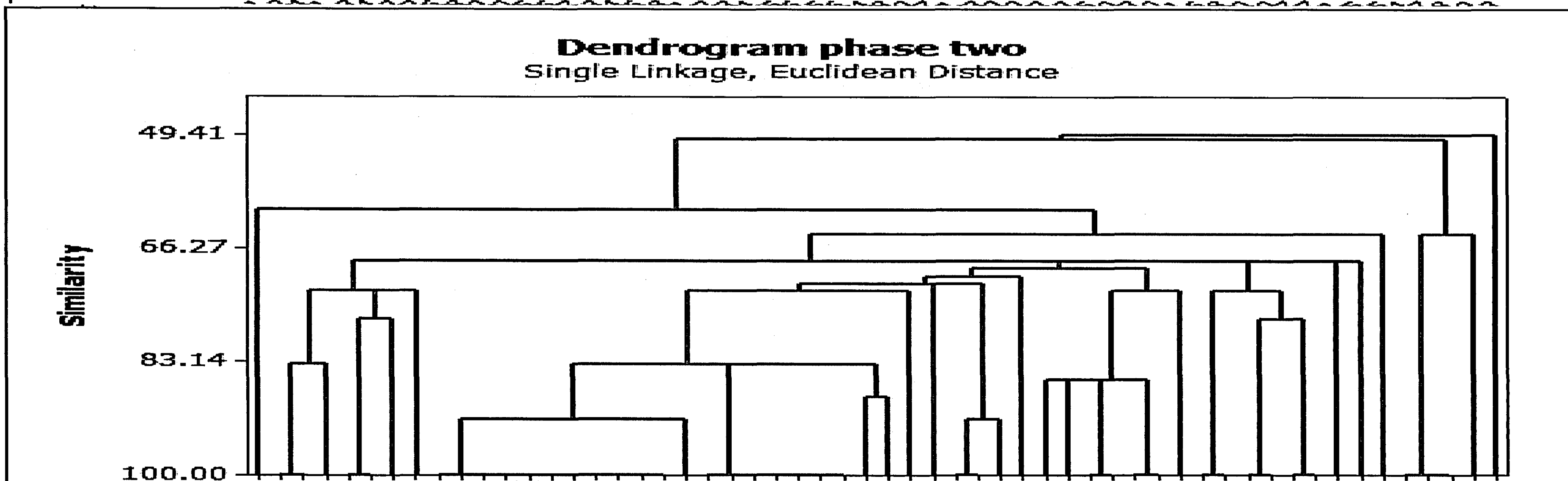

Dendrogram Phase One
Single Linkage, Euclidean Distance
Similarity
26.15
50.76
75.38
100.00
1
2
11
13
14
15
3
4
5
8
9
10
16
12
7
6
Observations (phase & paradigm)


Dendrogram (Phase One)
Single Linkage, Euclidean Distance
Similarity
26.39
50.93
75.46
100.00
1
2
11
13
14
15
3
4
10
8
9
5
16
12
7
6
Observations (subjectives included)

Phase One

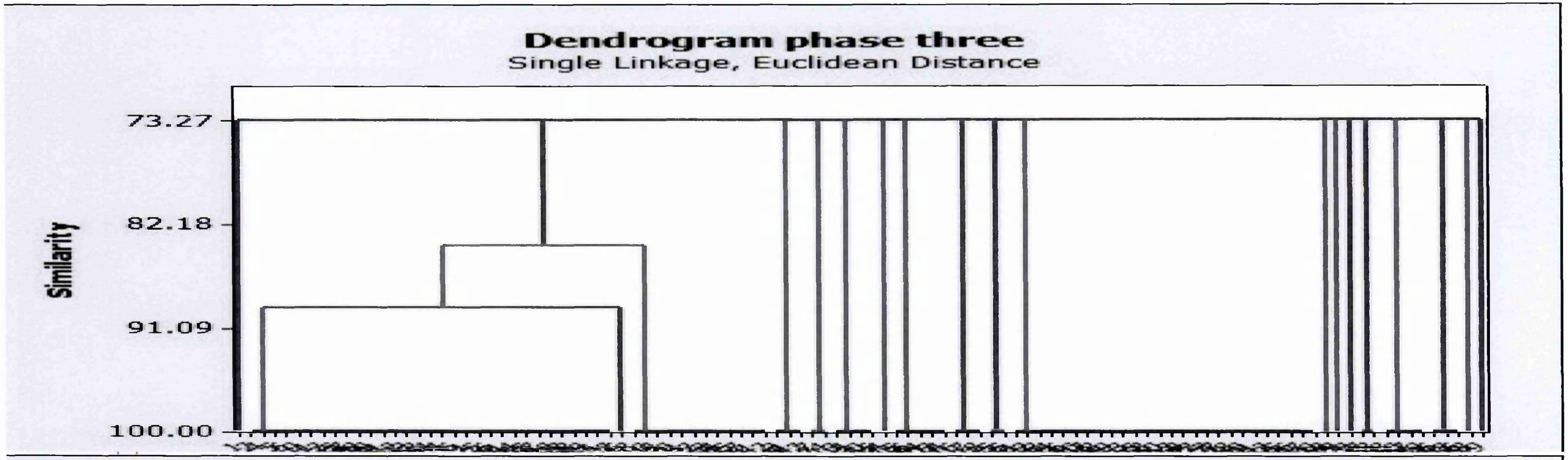
1	5W+H
2	Benchmarking
3	Browsing
4	Brutethink
5	Bug Listing
6	Cartoon Story Board
7	CATWOE
8	Causal-cognitive Mapping
9	cognitive mapping
10	Collective Notebook
11	Compare to others
12	Contradiction Analysis
13	Futurist
14	Monitor weak signals
15	Opportunity Searches
16	Scenario analysis

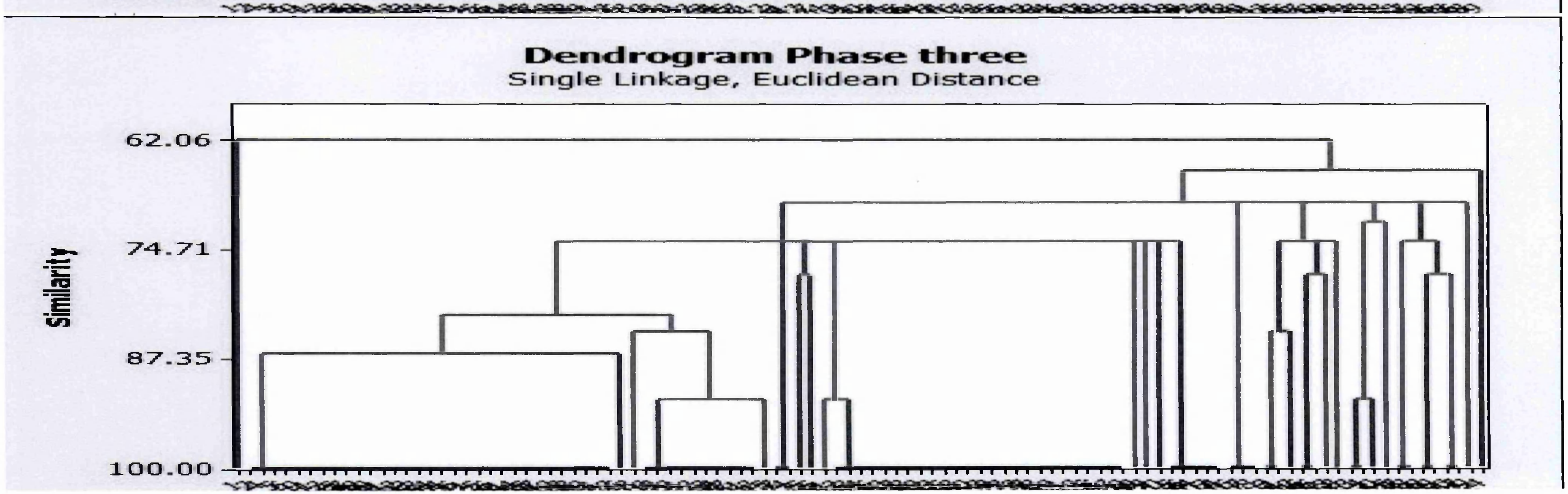

Dendrogram phase two
Single Linkage, Euclidean Distance
Similarity
50.00
66.67
83.33
100.00


Dendrogram phase two
Single Linkage, Euclidean Distance
Similarity
49.41
66.27
83.14
100.00

Phase two

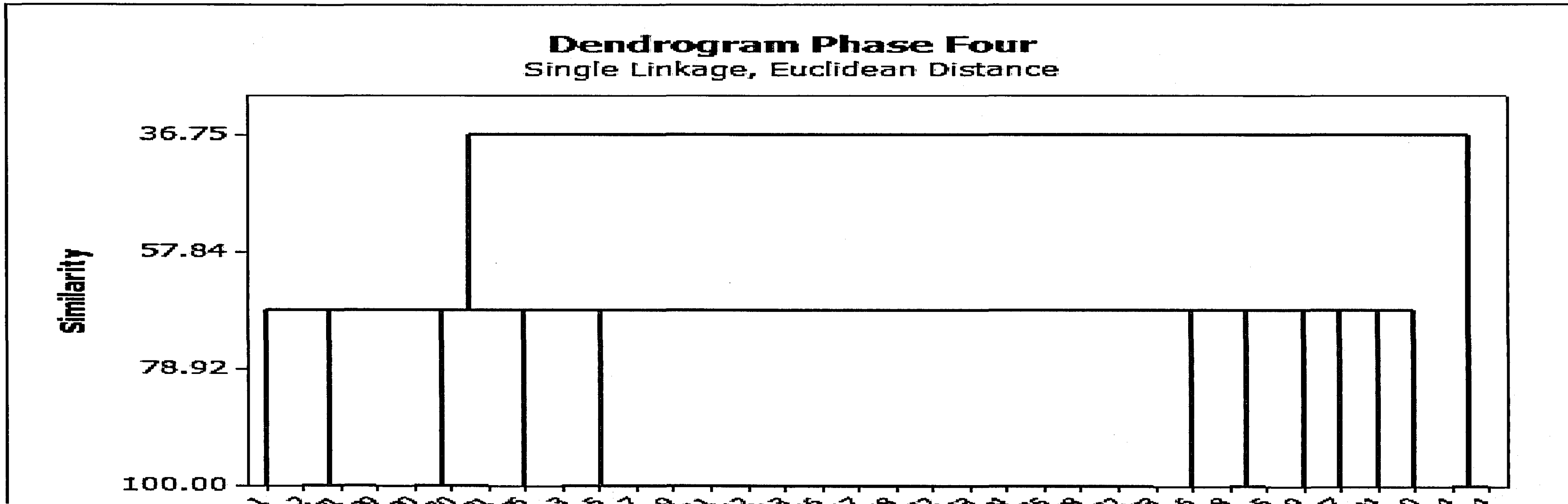
1	5W+H
2	Brutethink
3	Bug Listing
4	Cartoon Story Board
5	CATWOE
6	Causal-cognitive Mapping
7	cognitive mapping
8	Collective Notebook
9	Contradiction Analysis
10	Scenario analysis
11	Affinity Diagram
12	Bkwards Fwards Planning
13	Bounce it off someone else
14	Boundary exam'n (DeBono 82)
15	Boundary Relaxation
16	Brainstorming
17	Brainwriting
18	Brainwriting 6-3-5
19	Camelot
20	Card Story Boards
21	Checklist
22	Collage
23	Component Detailing
24	concensus building
25	Concept Fan
26	Consensus Mapping
27	Criteria for idea-finding potential
28	Dimensional Analysis
29	Draw a picture/Visual Thinking
30	Experience kit
31	Fishbone diagram
32	Force Field Analysis
33	False faces
34	Heuristic Ideation Technique
35	Hexagons
36	Inverse Brainstorming
37	King of the moubtain
38	Limericks and parodies
39	Listing Complaints
40	Metaphors
41	Mind Maps
42	Progressive Abstraction
43	Pugh Matrix
44	Redefining a problem/opportunity
45	Respond to someone else
46	Reversal
47	Rewrite objective many ways
48	Rich Pictures
49	Role playing
50	Rolestorming
51	Squeeze & Stretch
52	Suggestion techniqwues
53	What do you know
54	What patterns eist?


Dendrogram phase three
Single Linkage, Euclidean Distance
Similarity
73.27
82.18
91.09
100.00

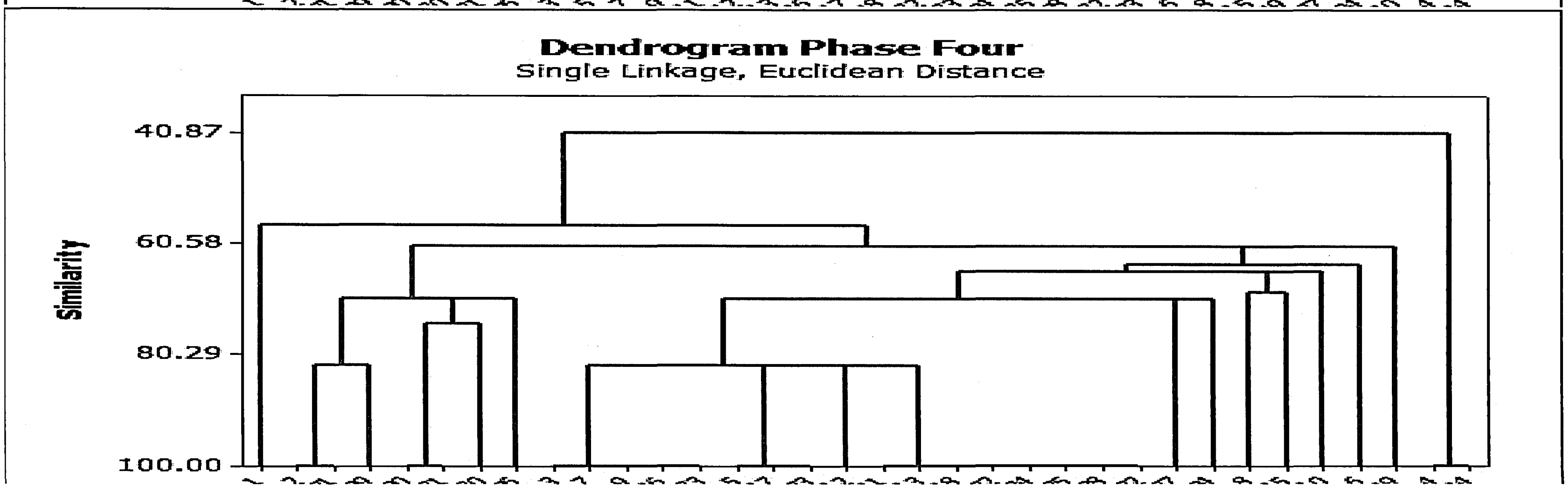

Dendrogram Phase three
Single Linkage, Euclidean Distance
Similarity
62.06
74.71
87.35
100.00

Phase three

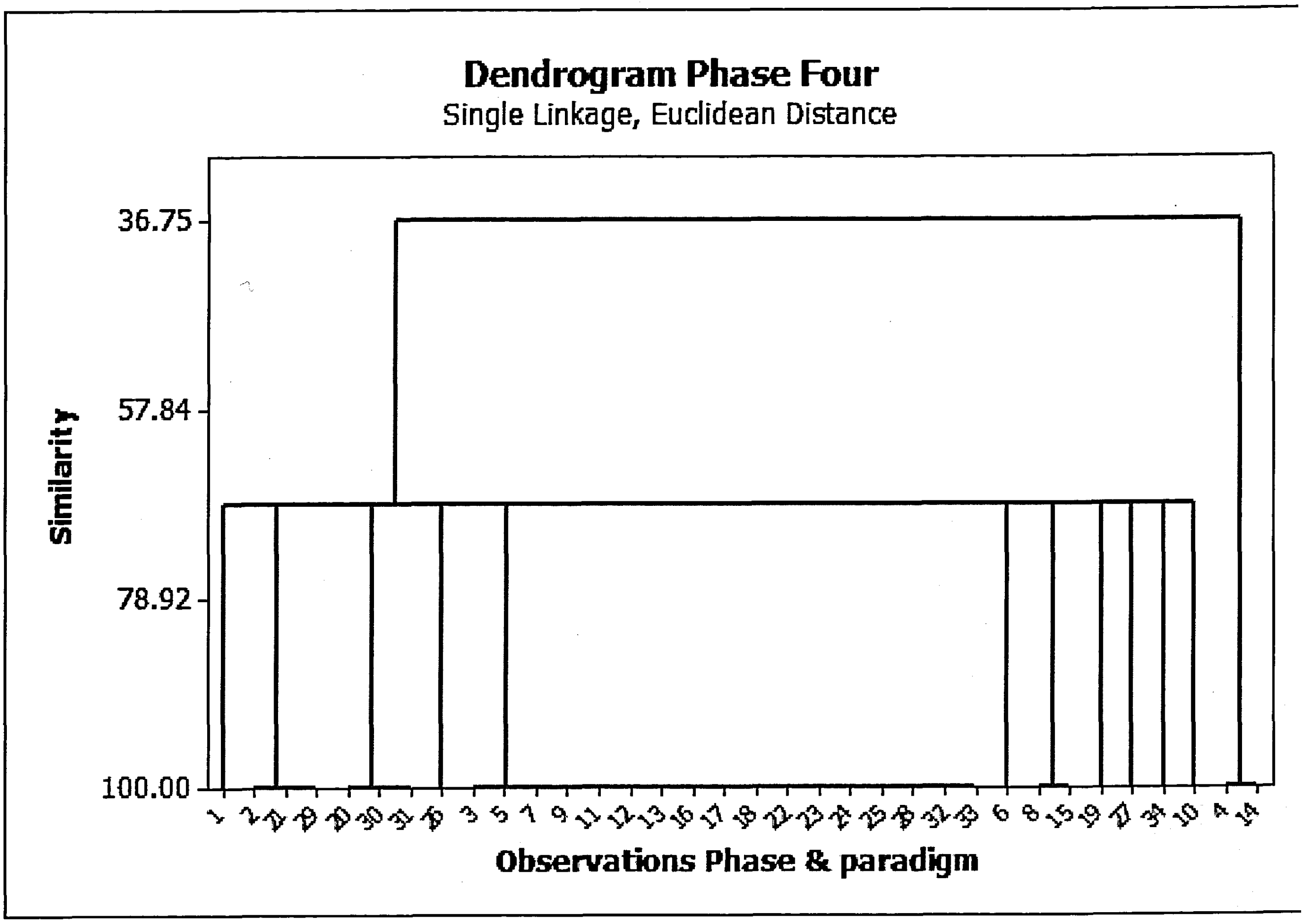
1	5W+H
2	CATWOE
3	Affinity Diagram
4	Boundary exam'n (DeBono 82)
5	Boundary Relaxation
6	Brainstorming
7	Brainwriting
8	Brainwriting 6-3-5
9	Collage
10	Component Detailing
11	Concept Fan
12	Consensus Mapping
13	False faces
14	Heuristic Ideation Technique
15	Hexagons
16	Listing Complaints
17	Metaphors
18	Mind Maps
19	Progressive Abstraction
20	Pugh Matrix
21	Reversal
22	Rich Pictures
23	Rolestorming
24	7x7 matrix
25	Analogies & Metaphors
26	Analysis of past solutions
27	Associations
28	Assumption Reversals
29	Assumption Surfacing
30	Attribute Association Chains
31	Attribute Listing
32	Back to the customer
33	Back to the Sun
34	Brainsketching
35	BrainWriting Constrained
36	BrainWriting constraint Varied
37	BrainWriting Game
38	BrainWriting Idea Card
39	BrainWriting Pool
40	Cherry Split
41	Circle of Opportunity
42	Crawford Slip Writing
43	Creative circles
44	Creative Imaging
45	Creative leap
46	Deadlines
47	Delphi
48	Direct Analogies
49	Establish Idea Sources
50	Examine it with the sences
51	Excursion technique
52	FCB Grid
53	Focussed Object
54	Fresh eye

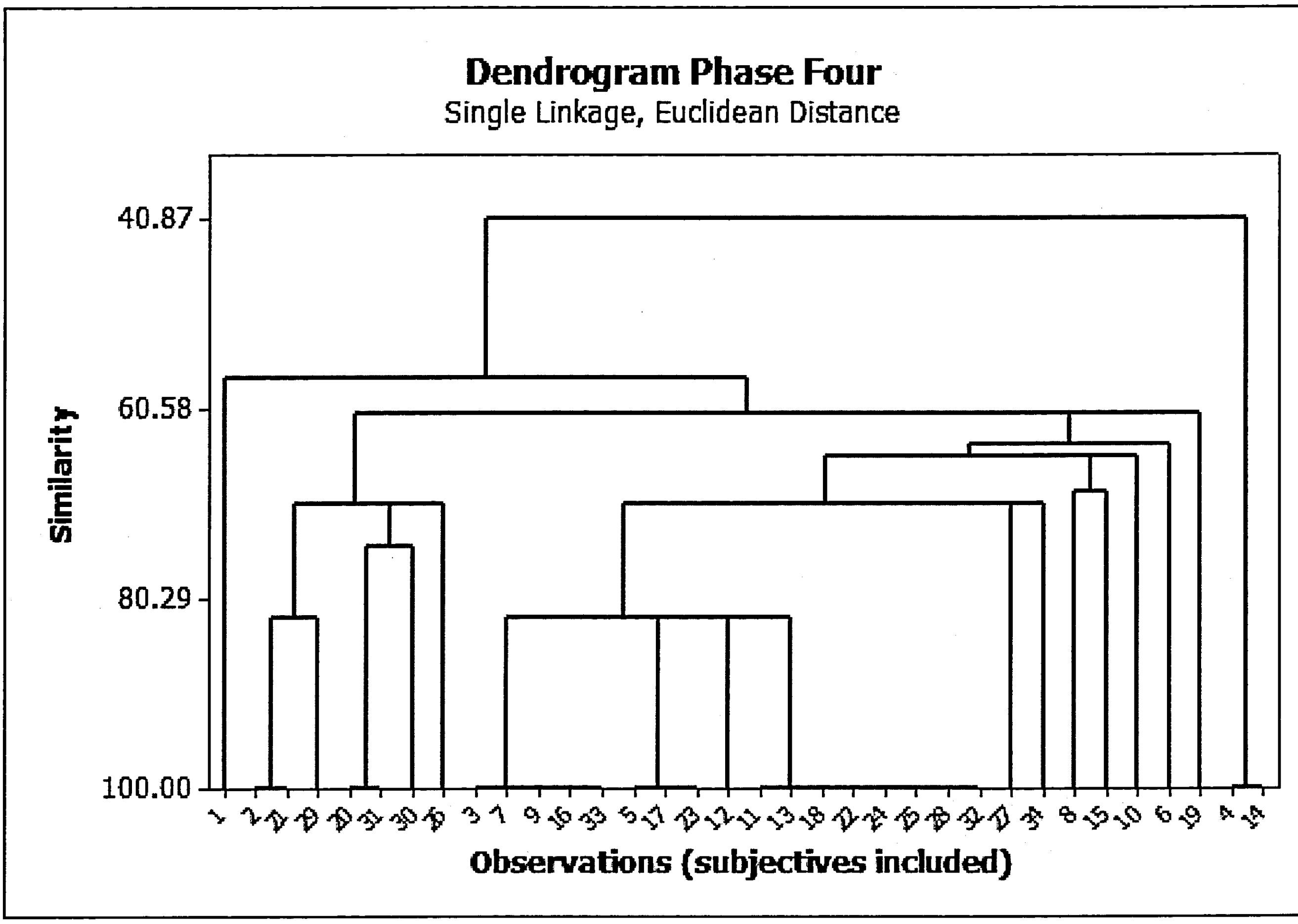


Dendrogram Phase Four
Single Linkage, Euclidean Distance
Similarity
36.75
57.84
78.92
100.00



Dendrogram Phase Four
Single Linkage, Euclidean Distance
Similarity
40.87
60.58
80.29
100.00


Dendrogram Phase Four
Single Linkage, Euclidean Distance
Similarity
36.75
57.84
78.92
100.00
Observations Phase & paradigm


Dendrogram Phase Four
Single Linkage, Euclidean Distance
Similarity
40.87
60.58
80.29
100.00
Observations (subjectives included)

Phase four

1	5W+H
2	Affinity Diagram
3	False faces
4	Hexagons
5	Mind Maps
6	Progressive Abstraction
7	Pugh Matrix
8	Reversal
9	Contradiction Analysis
10	Checklist
11	Dimensional Analysis
12	Force Field Analysis
13	Browsing
14	AIDA
15	Anonymous Voting
16	Be a Warrior
17	BulletProofing
18	Comparison tables
19	Control charts
20	Critical Path Diagrams
21	Design of experiments
22	Dialectical Approaches
23	Dot voting
24	Estimate-Discuss-Estimate
25	Flow diagram
26	Histogram
27	How-How Diagram
28	Matrix data analysis
29	Measles chart
30	Nominal Group Evaluation
31	Pareto diagram
32	Run chart
33	Screening Matrix of ideas
34	Sticky Dots

Phase One	Thinking Required Activist – **Pragmatist** – Reflector Accommodators Divergers	Receptives	Keep	Either	Benchmarking
					Browsing
					Brutethink
					Bug Listing
					CATWOE
					Causal-cognitive Mapping
					cognitive mapping
					Collective Notebook
					Compare to others
					Contradiction Analysis
					EitherFuturist
					Monitor weak signals
					Opportunity Searches
					Scenario analysis
		Rec-Perct	Stretc-	Either	5W+H
		Perc	Break	Either	Cartoon Story Board

Phase Two	Thinking Required Activist – **Pragmatist** – Reflector Accommodators Divergers	Receptives	Keep	Either	Bkwards Fwards Planning
					Bounce it off someone else
					Boundary exam'n (DeBono 82)
					Boundary Relaxation
					Brutethink
					Bug Listing
					Camelot
					CATWOE
					Causal-cognitive Mapping
					Checklist
					cognitive mapping
					Collective Notebook
					concensus building
					Consensus Mapping
					Contradiction Analysis
					Criteria for idea-finding potential
					Dimensional Analysis
					Draw a picture/Visual Thinking
					Experience kit
					Fishbone diagram
					Inverse Brainstorming
					King of the moubtain
					Limericks and parodies
					Listing Complaints
					Redefining a problem/opportunity
					Respond to someone else
					Rewrite objective many ways
					Role playing
					Scenario analysis
					Squeeze & Stretch
					Suggestion techniqwues
					What do you know
					What patterns eist?
					Why-why diagram
					Workout/retreats

Phase Two	Thinking Required Pragmatist – **Reflector** – Analyst Divergers Assimmilators	Receptive **Perceptive**	Stretch	Either	5W+H
					Affinity Diagram
					Concept Fan
					Force Field Analysis
					Hexagons
					Progressive Abstraction
				Group	Brainstorming
					Brainwriting
					Brainwriting 6-3-5
					Card Story Boards
		Perceptive	Break	Either	Component Detailing
					False faces
					Heuristic Ideation Technique
					Metaphors
					Pugh Matrix
					Reversal
					Cartoon Story Board
					Collage
					Rolestorming
					Rich Pictures
				Individual	Mind Maps

Phase Three	Thinking Required Reflector – **Analyst** – Activists Divergers Assimmilators Convergers	Receptive	Keep	Either	Assumption Surfacing
					Attribute Listing
					Boundary exam'n (DeBono 82)
					Boundary Relaxation
					BrainWriting Constrained
					BrainWriting constraint Varied
					BrainWriting Game
					BrainWriting Idea Card
					BrainWriting Pool
					CATWOE
					Consensus Mapping
					In the realm of the sences
					Kepner-Trego
					LARC
					Listing Complaints
					Circle of Opportunity
				Individual	7x7 matrix
					Analogies & Metaphors
					Analysis of past solutions
					Associations
					Attribute Association Chains
					Back to the customer
					Back to the Sun
					Deadlines
					Direct Analogies
					Establish Idea Sources
					Examine it with the sences
					FCB Grid
					Focussed Object
					Fresh eye
					Idea bits and racking
					Idea notebook
					Listening to music
					Lotus Blossom
					Name possible uses
					Organised Random Search
					Personal Analogies
					Product improvement checklist
					Related Words
					Relatedness
					Reversal — dereversal
					Rolling in the grass for ideas
					Sleeping/dreaming on it
					The Napoleon technique
					The two-words technique
					Visualization
					What if?

Phase Three	Thinking Required Reflector – **Analyst** – Activists Divergers Assimmilators Convergers	Receptive	Keep	Group	Crawford Slip Writing
					Creative circles
					Creative Imaging
					Creative leap
					Delphi
					Excursion technique
					Gallery Method
					Gordon Little
					Group decision support systems
					Idea board
					Idea triggers
					Innovation committee
					Inter -companyInnovation groups
					Lion's den
					Mitsubishi Method
					NHK method
					Nominal group technique
					Phillips 66
					Photo ecursion
					Pin Card Technique
					Scenario writing
					SIL method (combining)
					Storyboarding
					Synectics
					Take five
					TKJ
		Receptive Perceptive	Stretch	Either	5W+H
					Affinity Diagram
					Cherry Split
					Concept Fan
					Force-Fit Game
					Hexagons
					Progressive Abstraction
					Word Diamond
				Individual	Input-output
				Group	Brainstorming
					Brainwriting
					Brainwriting 6-3-5
					Morphological Analysis

Phase Three	Thinking Required Reflector – **Analyst** – Activists Divergers Assimilators Convergers	Perceptive	Break	Either	Assumption Reversals
					Component Detailing
					False faces
					Free Association
					Heuristic Ideation Technique
					Metaphors
					Object Stimulation
					Pugh Matrix
					Reversal
					Rolestorming
				Individual	Mind Maps
					Picture Stimulation
				Group	Brainsketching
					Collage
					Imagining
					Rich Pictures
					Star Cruising
					Wildest Ideas
					Wishful Thinking

Phase Four	Thinking Required Analyst – Activists - Pragmatist Assimmilators Convergers Accommodators	Receptive	Keep	Individual & Group	AIDA
					Be a Warrior
					Browsing
					BulletProofing
					Checklist
					Comparison tables
					Contradiction Analysis
					Control charts
					Critical Path Diagrams
					Design of experiments
					Dimensional Analysis
					Dot voting
					Estimate-Discuss-Estimate
					Flow diagram
					Histogram
					How-How Diagram
					Matrix data analysis
					Measles chart
					Pareto diagram
					Run chart
					Screening Matrix of ideas
				Group	Anonymous Voting
					Dialectical Approaches
		Perceptive - Receptive	Stretch	Individual & Group	5W+H
					Affinity Diagram
					Force Field Analysis
					Hexagons
					Progressive Abstraction
					Sticky Dots
		Perceptive	Break	Individual & Group	False faces
					Nominal Group Evaluation
					Pugh Matrix
					Reversal
				Individual	Mind Maps

Appendix 9 Public Acceptance Survey

Thank you for your time viewing the presentation.

Please take a couple of minutes to answer the following short questions.

By tailoring problem solving tools to both the problem and abilities of the user, where do you see such a strategy being useful?

How strongly do you believe such a strategy will help users:

Look for quick local solutions available within their speciality? (1-5)

Look for solutions outside their speciality but available within their industry (1-5)

Look for solutions, outside the same speciality and industry (1-5)

Look for assistance from consultants and alike, should a ready made solution not be available (1-5)

Raise awareness that a brand new solution is about to unfold and is worth looking at (1-5)

To help the analysis of the above data.

What Industry sector do you work in? ________________

Which best describes your company? Service Provider Product Provider.

Which best describes your day to day role:

Decision-making, Specialist practicioner, Consultative?

Which best describes *your prime role* within your industy?

Design & Make Products, Process Information, Deal with People?

Finally, please examine the table on the next page.
Please put a tick where you see the best fit strategy in the film, helping industry.
(You can answer as many or as few as you feel necessary)

Thank you for your contribution to the research.
Please return your response to stevemoran@btintertnet.com

Real Business Issues

Intangible Areas

CSF	Current and Future Markets	Products and Services	People	Innovation and Change	Strategy, Planning and Execution	Finance and Investment	Risk, Reward and Uncertainty
Relationships	Strength of channels and ability to access chosen markets	Working with others to develop customer solutions	Excellence in networking teamwork and collaboration	Development of sensors and early warning systems	Negotiating strength within the value chain	Ability to build and convey an attractive 'value proposition'	Considering scenarios helps us to live with uncertainty
Knowledge	Accuracy and relevance of our market research and intelligence	Relative attractiveness of features and benefits	Getting the right mix of wisdom and experience to succeed	Development of proprietary solutions and valuable Intellectual Property Rights (IPR)	Strength of management track record to date	Pricing and budgeting strategies are evidence based	We have metrics which accurately keep track of all our CSFs
Leadership and Communication	Pragmatic and sustainable direction and focus	Prioritisation of market research and product development	Efforts aligned towards a shared aim and purpose	Effective trade off between current and future needs	We set realistic objectives for each of our key activities	Determination to succeed despite obstacles and difficulties	Routines and frameworks for delegation and control
Culture and Values	Negotiating power and influence with suppliers & collaborators	Customer loyalty based on quality of experiences	Motivating by rewarding productive behaviours	Listening to and sharing ideas with others to build solutions	Changes which we implement create value for stakeholders	We take a pragmatic view in terms of sharing rewards	We work with our stakeholders to limit areas of dissatisfaction
Reputation and Trust	Delivering our promises on time and to specification	Our solutions set the standard for value and performance	Understanding implications and consequences of ways of working	Sensitivity in dealing with problems and concerns	We are viewed as a safe pair of hands by those we work with	Open and honest dialogue with financiers and partners	Retaining the support needed to survive temporary setbacks
Skills and Competencies	Understanding of factors which drive market attractiveness	Effective use of design covering the whole of each product's life	Training development and learning opportunities	Ability to see problems and opportunities in true context	We prioritise actions based on both importance and urgency	Ability of the business to grow and to generate profits	Speed with which we learn from mistakes and act to correct them
Processes and Systems	Focus on need for continual improvement in all we do	Fit between production capabilities and market needs	Staff appraisal is linked to critical success factors	Effective processes for making best use of good ideas	We understand interconnections & dependencies between actions	Control of all operations but particularly cash flow	Ability to understand risks and operations for managing them

DTI (2007)

Public Appraisal Data

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	>>	C14	C15	C16	C17	C18
				Belief					Intangible							Real		
1	2	2	3	5	5	5	1	1	0	4	0	0	0	7	0	2	1	1
2	1	1	3	3	4	3	4	5	3	4	6	3	6	6	5	5	5	7
3	2	1	3	3	4	3	4	5	3	4	6	3	6	6	5	5	5	7
4	1	2	3	3	4	5	2	2	3	3	3	1	1	6	2	3	2	3
5	1	1	3	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
6	1	2	3	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
7	1	3	3	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
8	2	1	3	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
9	2	1	3	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
10	2	2	3	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
11	2	1	3	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
12	2	2	3	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
13	2	3	3	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
14	1	2	2	3	4	4	5	5	5	2	2	3	4	4	5	4	3	6
15	1	1	2	3	4	3	4	5	3	4	6	3	6	6	5	5	5	7
16	2	1	2	3	4	3	4	5	3	4	6	3	6	6	5	5	5	7
17	1	1	2	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
18	1	2	2	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
19	1	3	2	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
20	2	1	2	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
21	2	1	2	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
22	2	1	2	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
23	2	2	2	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
24	2	3	2	4	3	3	4	5	4	3	4	3	4	6	4	4	5	5
25	2	3	1	5	5	5	3	5	1	2	2	3	1	3	4	3	0	6
26	2	2	1	3	4	5	5	4	4	1	1	1	4	5	2	2	3	4

03/08/2011 23:36:48

```
Welcome to Minitab, press F1 for help.
Executing from file: C:\Program Files\Minitab 15\English\Macros\Startup.mac

 This Software was purchased for academic use only.
 Commercial use of the Software is prohibited.
```

ALL

One-way ANOVA: Belief, C5, C6, C7, C8

Source	DF	SS	MS	F	P
Factor	4	29.738	7.435	13.05	0.000
Error	125	71.192	0.570		
Total	129	100.931			

```
S = 0.7547   R-Sq = 29.46%   R-Sq(adj) = 27.21%


                                 Individual 95% CIs For Mean Based on
                                 Pooled StDev
Level    N    Mean   StDev   ---------+---------+---------+---------+
Belief  26  3.8077  0.5670            (-----*-----)
C5      26  3.4231  0.6433     (----*-----)
C6      26  3.3462  0.7452   (-----*-----)
C7      26  3.8462  0.7845             (-----*-----)
C8      26  4.6923  0.9703                              (-----*-----)
                             ---------+---------+---------+---------+
                                    3.50      4.00      4.50      5.00

Pooled StDev = 0.7547
```

One-way ANOVA: Intangible, C10, C11, C12, C13, C14, C15

Source	DF	SS	MS	F	P
Factor	6	151.37	25.23	22.72	0.000
Error	175	194.35	1.11		
Total	181	345.72			

```
S = 1.054   R-Sq = 43.79%   R-Sq(adj) = 41.86%


                                 Individual 95% CIs For Mean Based on
                                 Pooled StDev
Level        N   Mean  StDev  -------+---------+---------+---------+--
Intangible  26  3.577  1.027           (---*---)
C10         26  3.038  0.662      (---*---)
C11         26  3.846  1.405             (---*----)
C12         26  2.731  0.778  (---*---)
C13         26  3.923  1.412              (---*---)
C14         26  5.808  0.749                                 (---*---)
C15         26  3.885  1.071              (---*---)
                              -------+---------+---------+---------+--
                                   3.0       4.0       5.0       6.0

Pooled StDev = 1.054
```

One-way ANOVA: Real, C17, C18, C19, C20, C21, C22

Source	DF	SS	MS	F	P
Factor	6	126.29	21.05	12.04	0.000
Error	175	306.00	1.75		
Total	181	432.29			

S = 1.322   R-Sq = 29.21%   R-Sq(adj) = 26.79%

```
                                  Individual 95% CIs For Mean Based on
                                  Pooled StDev
Level    N   Mean  StDev  ------+---------+---------+---------+---
Real    26  3.923  0.744            (----*----)
C17     26  4.385  1.388                 (----*----)
C18     26  5.115  1.243                        (----*----)
C19     26  3.077  1.695    (----*----)
C20     26  2.962  0.662  (-----*----)
C21     26  4.654  1.958                   (-----*----)
C22     26  2.885  1.033  (----*----)
                          ------+---------+---------+---------+---
                              3.0       4.0       5.0       6.0

Pooled StDev = 1.322
```

Service

Results for: Worksheet 5

One-way ANOVA: Belief, C5, C6, C7, C8

Source	DF	SS	MS	F	P
Factor	4	12.680	3.170	6.51	0.000
Error	45	21.900	0.487		
Total	49	34.580			

S = 0.6976   R-Sq = 36.67%   R-Sq(adj) = 31.04%

```
                                Individual 95% CIs For Mean Based on
                                Pooled StDev
Level    N    Mean   StDev  --+---------+---------+---------+-------
Belief  10  3.6000  0.5164       (------*------)
C5      10  3.4000  0.5164   (-------*------)
C6      10  3.3000  0.6749  (------*------)
C7      10  3.9000  0.7379            (------*------)
C8      10  4.7000  0.9487                         (------*-------)
                            --+---------+---------+---------+-------
                            3.00      3.60      4.20      4.80

Pooled StDev = 0.6976
```

One-way ANOVA: Intangible, C10, C11, C12, C13, C14, C15

```
Source  DF       SS     MS      F      P
Factor   6   55.543  9.257  11.57  0.000
Error   63   50.400  0.800
Total   69  105.943

S = 0.8944   R-Sq = 52.43%   R-Sq(adj) = 47.90%


                                Individual 95% CIs For Mean Based on
                                Pooled StDev
Level        N    Mean   StDev  -+---------+---------+---------+--------
Intangible  10  3.8000  0.6325           (----*---)
C10         10  3.1000  0.5676     (----*----)
C11         10  4.1000  1.1972             (----*----)
C12         10  2.8000  0.6325   (---*----)
C13         10  4.1000  1.3703             (----*----)
C14         10  5.8000  0.6325                            (---*----)
C15         10  4.1000  0.8756             (----*----)
                                -+---------+---------+---------+--------
                                2.4       3.6       4.8       6.0

Pooled StDev = 0.8944
```

One-way ANOVA: Real, C17, C18, C19, C20, C21, C22

```
Source  DF      SS    MS     F      P
Factor   6   38.49  6.41  3.66  0.004
Error   63  110.50  1.75
Total   69  148.99

S = 1.324   R-Sq = 25.83%   R-Sq(adj) = 18.77%


                         Individual 95% CIs For Mean Based on
                         Pooled StDev
Level    N   Mean  StDev  --------+---------+---------+---------+-
Real    10  4.100  0.568             (-------*-------)
C17     10  4.500  1.080                 (-------*-------)
C18     10  5.300  1.160                         (-------*-------)
C19     10  3.500  1.958       (-------*-------)
C20     10  3.000  0.816  (-------*-------)
C21     10  4.400  2.171                (-------*-------)
C22     10  3.300  0.483     (-------*-------)
                          --------+---------+---------+---------+-
                                3.0       4.0       5.0       6.0

Pooled StDev = 1.324
```

==

Product

One-way ANOVA: Belief, C5, C6, C7, C8

Source	DF	SS	MS	F	P
Factor	4	17.700	4.425	6.84	0.000
Error	75	48.500	0.647		
Total	79	66.200			

S = 0.8042   R-Sq = 26.74%   R-Sq(adj) = 22.83%

```
                                  Individual 95% CIs For Mean Based on Pooled StDev
Level    N    Mean   StDev   +---------+---------+---------+---------
Belief  16  3.9375  0.5737            (------*-----)
C5      16  3.4375  0.7274    (-----*------)
C6      16  3.3750  0.8062   (-----*------)
C7      16  3.8125  0.8342         (------*-----)
C8      16  4.6875  1.0145                      (------*------)
                             +---------+---------+---------+---------
                           3.00      3.60      4.20      4.80
```

Pooled StDev = 0.8042

One-way ANOVA: Intangible, C10, C11, C12, C13, C14, C15

Source	DF	SS	MS	F	P
Factor	6	96.80	16.13	12.04	0.000
Error	105	140.69	1.34		
Total	111	237.49			

S = 1.158   R-Sq = 40.76%   R-Sq(adj) = 37.38%

```
                                 Individual 95% CIs For Mean Based on
                                 Pooled StDev
Level        N   Mean  StDev  --+---------+---------+---------+-------
Intangible  16  3.438  1.209        (----*---)
C10         16  3.000  0.730    (----*----)
C11         16  3.688  1.537          (----*----)
C12         16  2.688  0.873  (---*----)
C13         16  3.813  1.471           (----*----)
C14         16  5.813  0.834                             (---*----)
C15         16  3.750  1.183          (----*----)
                              --+---------+---------+---------+-------
                              2.4       3.6       4.8       6.0
```

Pooled StDev = 1.158

One-way ANOVA: Real, C17, C18, C19, C20, C21, C22

```
Source   DF      SS     MS     F      P
Factor    6   93.05  15.51  8.69  0.000
Error   105  187.44   1.79
Total   111  280.49

S = 1.336   R-Sq = 33.18%   R-Sq(adj) = 29.36%


                         Individual 95% CIs For Mean Based on Pooled StDev
Level   N   Mean  StDev  +---------+---------+---------+---------
Real   16  3.813  0.834              (-----*------)
C17    16  4.312  1.580                   (-----*------)
C18    16  5.000  1.317                         (------*------)
C19    16  2.812  1.515     (-----*------)
C20    16  2.938  0.574      (-----*------)
C21    16  4.812  1.870                        (-----*------)
C22    16  2.625  1.204   (-----*------)
                         +---------+---------+---------+---------
                        2.0       3.0       4.0       5.0

Pooled StDev = 1.336
```

Decision Makers

One-way ANOVA: Belief, C5, C6, C7, C8

```
Source  DF       SS      MS      F      P
Factor   4  28.2667  7.0667  72.88  0.000
Error   55   5.3333  0.0970
Total   59  33.6000

S = 0.3114   R-Sq = 84.13%   R-Sq(adj) = 82.97%


                               Individual 95% CIs For Mean Based on
                               Pooled StDev
Level    N    Mean   StDev   ---+---------+---------+---------+------
Belief  12  3.6667  0.4924             (--*--)
C5      12  3.3333  0.4924        (--*--)
C6      12  3.0000  0.0000   (--*--)
C7      12  4.0000  0.0000                   (--*--)
C8      12  5.0000  0.0000                                  (--*--)
                             ---+---------+---------+---------+------
                               3.00      3.60      4.20      4.80

Pooled StDev = 0.3114
```

One-way ANOVA: Intangible, C10, C11, C12, C13, C14, C15

```
Source  DF       SS      MS      F      P
Factor   6   73.905  12.317  32.33  0.000
Error   77   29.333   0.381
Total   83  103.238

S = 0.6172   R-Sq = 71.59%   R-Sq(adj) = 69.37%


                                   Individual 95% CIs For Mean Based on
                                   Pooled StDev
Level         N   Mean   StDev  ----+---------+---------+---------+-----
```

```
Intangible  12  3.6667  0.4924          (---*--)
C10         12  3.3333  0.4924       (--*---)
C11         12  4.6667  0.9847                    (---*--)
C12         12  3.0000  0.0000  (---*---)
C13         12  4.6667  0.9847                    (---*--)
C14         12  6.0000  0.0000                                 (---*---)
C15         12  4.3333  0.4924                 (--*---)
                                ----+---------+---------+---------+-----
                                  3.0       4.0       5.0       6.0

Pooled StDev = 0.6172
```

One-way ANOVA: Real, C17, C18, C19, C20, C21, C22

```
Source  DF      SS     MS      F      P
Factor   6   67.81  11.30  10.20  0.000
Error   77   85.33   1.11
Total   83  153.14

S = 1.053   R-Sq = 44.28%   R-Sq(adj) = 39.94%


                         Individual 95% CIs For Mean Based on
                         Pooled StDev
Level   N   Mean  StDev  ---+---------+---------+---------+------
Real   12  4.333  0.492           (-----*-----)
C17    12  5.000  0.000                 (-----*-----)
C18    12  5.667  0.985                       (-----*-----)
C19    12  3.333  1.969  (-----*-----)
C20    12  3.333  0.492  (-----*-----)
C21    12  5.000  1.477                 (-----*-----)
C22    12  3.333  0.492  (-----*-----)
                         ---+---------+---------+---------+------
                          3.0       4.0       5.0       6.0

Pooled StDev = 1.053
```

===

Practicioner

One-way ANOVA: Belief, C5, C6, C7, C8

```
Source  DF     SS    MS     F      P
Factor   4   1.56  0.39  0.32  0.861
Error   40  48.22  1.21
Total   44  49.78

S = 1.098   R-Sq = 3.13%   R-Sq(adj) = 0.00%


                         Individual 95% CIs For Mean Based on
                         Pooled StDev
Level   N   Mean  StDev  ---+---------+---------+---------+------
Belief  9  3.778  0.667     (-----------*-----------)
C5      9  3.556  0.726  (-----------*------------)
C6      9  3.778  0.972     (-----------*-----------)
C7      9  3.667  1.323   (-----------*-----------)
C8      9  4.111  1.537        (------------*-----------)
                         ---+---------+---------+---------+------
                          3.00      3.60      4.20      4.80
```

```
Pooled StDev = 1.098
```

One-way ANOVA: Intangible, C10, C11, C12, C13, C14, C15

```
Source  DF      SS     MS     F      P
Factor   6   69.97  11.66  6.74  0.000
Error   56   96.89   1.73
Total   62  166.86

S = 1.315   R-Sq = 41.93%   R-Sq(adj) = 35.71%


                                 Individual 95% CIs For Mean Based on
                                 Pooled StDev
Level        N   Mean  StDev  -+---------+---------+---------+--------
Intangible   9  3.556  1.424          (-----*-----)
C10          9  2.778  0.833      (-----*----)
C11          9  2.889  1.537      (-----*-----)
C12          9  2.222  1.202  (-----*-----)
C13          9  3.222  1.563        (----*-----)
C14          9  5.778  0.833                         (-----*----)
C15          9  3.222  1.563        (----*-----)
                              -+---------+---------+---------+--------
                              1.5       3.0       4.5       6.0

Pooled StDev = 1.315
```

One-way ANOVA: Real, C17, C18, C19, C20, C21, C22

```
Source  DF      SS    MS     F      P
Factor   6   25.97  4.33  1.88  0.101
Error   56  129.11  2.31
Total   62  155.08

S = 1.518   R-Sq = 16.75%   R-Sq(adj) = 7.82%


                            Individual 95% CIs For Mean Based on
                            Pooled StDev
Level  N   Mean  StDev  -----+---------+---------+---------+----
Real   9  3.444  0.882           (---------*----------)
C17    9  3.778  1.563               (---------*---------)
C18    9  4.333  1.500                    (---------*---------)
C19    9  3.111  1.691        (---------*---------)
C20    9  2.556  0.726  (----------*---------)
C21    9  4.000  2.398                 (---------*---------)
C22    9  2.556  1.236  (----------*---------)
                        -----+---------+---------+---------+----
                           2.0       3.0       4.0       5.0

Pooled StDev = 1.518
```

Consultantive/Advisory

One-way ANOVA: Belief, C5, C6, C7, C8

Source	DF	SS	MS	F	P
Factor	4	8.960	2.240	5.60	0.003
Error	20	8.000	0.400		
Total	24	16.960			

S = 0.6325   R-Sq = 52.83%   R-Sq(adj) = 43.40%

```
                                 Individual 95% CIs For Mean Based on Pooled StDev
Level   N    Mean   StDev    +---------+---------+---------+---------
Belief  5  4.2000  0.4472              (-------*-------)
C5      5  3.4000  0.8944    (--------*-------)
C6      5  3.4000  0.8944    (--------*-------)
C7      5  3.8000  0.4472          (-------*--------)
C8      5  5.0000  0.0000                            (-------*--------)
                             +---------+---------+---------+---------
                           2.80      3.50      4.20      4.90
```

Pooled StDev = 0.6325

One-way ANOVA: Intangible, C10, C11, C12, C13, C14, C15

Source	DF	SS	MS	F	P
Factor	6	22.286	3.714	4.06	0.005
Error	28	25.600	0.914		
Total	34	47.886			

S = 0.9562   R-Sq = 46.54%   R-Sq(adj) = 35.08%

```
                                      Individual 95% CIs For Mean Based on
                                      Pooled StDev
Level        N    Mean   StDev   ----+---------+---------+---------+-----
Intangible   5  3.4000  1.3416        (------*-------)
C10          5  2.8000  0.4472   (------*-------)
C11          5  3.6000  0.8944          (------*------)
C12          5  3.0000  0.0000     (------*------)
C13          5  3.4000  1.3416        (------*-------)
C14          5  5.4000  1.3416                         (------*------)
C15          5  4.0000  0.0000             (------*-------)
                                 ----+---------+---------+---------+-----
                                   2.4       3.6       4.8       6.0
```

Pooled StDev = 0.9562

One-way ANOVA: Real, C17, C18, C19, C20, C21, C22

Source	DF	SS	MS	F	P
Factor	6	41.09	6.85	3.63	0.009
Error	28	52.80	1.89		

```
Total    34  93.89

S = 1.373   R-Sq = 43.76%   R-Sq(adj) = 31.71%


                            Individual 95% CIs For Mean Based on
                            Pooled StDev
Level   N   Mean   StDev   --+---------+---------+---------+-------
Real    5  3.800   0.447            (-------*--------)
C17     5  4.000   2.236             (--------*-------)
C18     5  5.200   0.447                     (--------*-------)
C19     5  2.400   0.894   (-------*-------)
C20     5  2.800   0.447     (--------*-------)
C21     5  5.000   2.236                   (-------*--------)
C22     5  2.400   1.342   (-------*-------)
                           --+---------+---------+---------+-------
                           1.5       3.0       4.5       6.0

Pooled StDev = 1.373
```

==

Designers

One-way ANOVA: Belief, C5, C6, C7, C8

```
Source  DF    SS    MS     F      P
Factor   4  1.40  0.35  0.35  0.835
Error    5  5.00  1.00
Total    9  6.40

S = 1   R-Sq = 21.88%   R-Sq(adj) = 0.00%


                            Individual 95% CIs For Mean Based on
                            Pooled StDev
Level   N   Mean   StDev    --+---------+---------+---------+-------
Belief  2  4.000   1.414    (--------------*--------------)
C5      2  4.500   0.707        (---------------*--------------)
C6      2  5.000   0.000             (--------------*--------------)
C7      2  4.000   1.414    (--------------*--------------)
C8      2  4.500   0.707        (---------------*--------------)
                            --+---------+---------+---------+-------
                            2.4       3.6       4.8       6.0

Pooled StDev = 1.000
```

One-way ANOVA: Intangible, C10, C11, C12, C13, C14, C15

```
Source  DF     SS    MS     F      P
Factor   6   9.43  1.57  0.69  0.668
Error    7  16.00  2.29
Total   13  25.43

S = 1.512   R-Sq = 37.08%   R-Sq(adj) = 0.00%


                                Individual 95% CIs For Mean Based on
                                Pooled StDev
Level        N   Mean   StDev   -----+---------+---------+---------+----
Intangible   2  2.500   2.121        (------------*-----------)
C10          2  1.500   0.707   (------------*-----------)
C11          2  1.500   0.707   (------------*-----------)
```

```
C12        2  2.000  1.414   (------------*------------)
C13        2  2.500  2.121      (------------*-----------)
C14        2  4.000  1.414             (------------*------------)
C15        2  3.000  1.414        (------------*------------)
                            -----+---------+---------+---------+----
                               0.0       2.0       4.0       6.0

Pooled StDev = 1.512
```

One-way ANOVA: Real, C17, C18, C19, C20, C21, C22

```
Source  DF     SS    MS     F      P
Factor   6  37.43  6.24  5.46  0.021
Error    7   8.00  1.14
Total   13  45.43

S = 1.069   R-Sq = 82.39%   R-Sq(adj) = 67.30%


                        Individual 95% CIs For Mean Based on
                        Pooled StDev
Level  N   Mean  StDev  -------+---------+---------+---------+--
Real   2  2.500  0.707            (------*------)
C17    2  1.500  2.121        (------*------)
C18    2  5.000  1.414                      (------*------)
C19    2  4.500  0.707                    (------*------)
C20    2  2.000  0.000          (------*------)
C21    2  1.500  0.707        (------*------)
C22    2  0.000  0.000  (------*------)
                        -------+---------+---------+---------+--
                              0.0       2.5       5.0       7.5

Pooled StDev = 1.069
```

Information Processing

One-way ANOVA: Belief, C5, C6, C7, C8

```
Source  DF      SS     MS      F      P
Factor   4  25.345  6.336  51.25  0.000
Error   50   6.182  0.124
Total   54  31.527

S = 0.3516   R-Sq = 80.39%   R-Sq(adj) = 78.82%


                              Individual 95% CIs For Mean Based on
                              Pooled StDev
Level    N    Mean   StDev    --+---------+---------+---------+-------
Belief  11  3.7273  0.4671               (--*---)
C5      11  3.2727  0.4671        (---*--)
C6      11  3.0909  0.3015    (---*--)
C7      11  4.0909  0.3015                     (--*---)
C8      11  5.0000  0.0000                                    (--*---)
                              --+---------+---------+---------+-------
                              3.00      3.60      4.20      4.80

Pooled StDev = 0.3516
```

One-way ANOVA: Intangible, C10, C11, C12, C13, C14, C15

```
Source  DF      SS     MS      F      P
Factor   6  58.545  9.758  22.91  0.000
Error   70  29.818  0.426
Total   76  88.364

S = 0.6527   R-Sq = 66.26%   R-Sq(adj) = 63.36%


                                Individual 95% CIs For Mean Based on
                                Pooled StDev
Level        N    Mean   StDev  ----+---------+---------+---------+-----
Intangible  11  3.9091  0.5394           (---*---)
C10         11  3.0909  0.5394   (---*---)
C11         11  4.1818  1.0787              (---*---)
C12         11  3.0000  0.0000  (---*---)
C13         11  4.3636  0.8090                (---*---)
C14         11  5.8182  0.6030                              (---*---)
C15         11  4.2727  0.4671               (---*---)
                                ----+---------+---------+---------+-----
                                  3.0       4.0       5.0       6.0

Pooled StDev = 0.6527
```

One-way ANOVA: Real, C17, C18, C19, C20, C21, C22

```
Source  DF      SS     MS     F      P
Factor   6   64.52  10.75  9.16  0.000
Error   70   82.18   1.17
Total   76  146.70

S = 1.084   R-Sq = 43.98%   R-Sq(adj) = 39.18%


                           Individual 95% CIs For Mean Based on
                           Pooled StDev
Level   N   Mean  StDev  ------+---------+---------+---------+---
Real   11  4.182  0.405            (------*-----)
C17    11  4.818  0.603                   (-----*------)
C18    11  5.455  0.820                         (------*-----)
C19    11  3.091  1.868  (------*-----)
C20    11  3.182  0.405   (------*-----)
C21    11  5.000  1.789                    (------*------)
C22    11  3.182  0.405   (------*-----)
                         ------+---------+---------+---------+---
                             3.0       4.0       5.0       6.0

Pooled StDev = 1.084
```

==

People

One-way ANOVA: Belief, C5, C6, C7, C8

Source	DF	SS	MS	F	P
Factor	4	11.169	2.792	3.50	0.012
Error	60	47.846	0.797		
Total	64	59.015			

S = 0.8930   R-Sq = 18.93%   R-Sq(adj) = 13.52%

```
                                   Individual 95% CIs For Mean Based on
                                   Pooled StDev
Level    N    Mean   StDev  ---+---------+---------+---------+------
Belief  13  3.8462  0.5547           (-------*-------)
C5      13  3.3846  0.6504   (-------*--------)
C6      13  3.3077  0.7511  (-------*-------)
C7      13  3.6154  0.9608       (-------*--------)
C8      13  4.4615  1.3301                     (-------*--------)
                            ---+---------+---------+---------+------
                             3.00      3.60      4.20      4.80
```

Pooled StDev = 0.8930

One-way ANOVA: Intangible, C10, C11, C12, C13, C14, C15

Source	DF	SS	MS	F	P
Factor	6	91.65	15.27	11.93	0.000
Error	84	107.54	1.28		
Total	90	199.19			

S = 1.131   R-Sq = 46.01%   R-Sq(adj) = 42.15%

```
                                 Individual 95% CIs For Mean Based on
                                 Pooled StDev
Level        N   Mean  StDev  ---+---------+---------+---------+------
Intangible  13  3.462  1.127         (----*----)
C10         13  3.231  0.439       (----*----)
C11         13  3.923  1.441            (-----*----)
C12         13  2.615  0.961  (----*----)
C13         13  3.769  1.641           (----*-----)
C14         13  6.077  0.277                               (-----*----)
C15         13  3.692  1.316           (----*----)
                              ---+---------+---------+---------+------
                               2.4       3.6       4.8       6.0
```

Pooled StDev = 1.131

One-way ANOVA: Real, C17, C18, C19, C20, C21, C22

Source	DF	SS	MS	F	P
Factor	6	62.77	10.46	6.14	0.000
Error	84	143.08	1.70		
Total	90	205.85			

S = 1.305   R-Sq = 30.49%   R-Sq(adj) = 25.53%

```
                           Individual 95% CIs For Mean Based on
```

```
                                    Pooled StDev
Level     N    Mean   StDev   ---------+---------+---------+---------+
Real     13   3.923   0.760           (------*------)
C17      13   4.462   1.330                (-------*------)
C18      13   4.846   1.519                    (------*-------)
C19      13   2.846   1.625   (------*-------)
C20      13   2.923   0.760    (------*------)
C21      13   4.846   1.864                    (------*-------)
C22      13   3.077   0.760      (------*------)
                              ---------+---------+---------+---------+
                                     3.0       4.0       5.0       6.0

Pooled StDev = 1.305
```

Comments made by respondants from industry:

Ensuring you have the right balance of skills within a team to manage the full range of scenareos you are likely to face.
Where management needs to put together a team to solve,say, a manufacturing problem which is holding up development.
Team focussed tasxzks where multi-discipline members colaborate effective time lines and scoping of projects impact assessments, and costs vs tonefit planning spot and train skills to form balanced teams.
Development of new and innovative products.
Increasing rapport, trust and collaboration among staff in advancing a companiesability to develop and introduce new products or systems.

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