Research Report

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Psycognition:
An Exploration of the Strategic Behaviours Underlying Fighter Pilots' Decision Making in Critical Incidents.

Dr. Karmen Guevara

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An Exploration of the Strategic Behaviours Underlying Fighter Pilots' Decision Making in Critical Incidents

1. Abstract

This report presents the findings from preliminary research which explored the subconscious processes underlying the strategic behaviours and decision making of fighter pilots. A primary aim of the research was to explore whether Psycognition, a methodological approach which focuses on eliciting the subconscious processes which influence human behaviour, could contribute to our understanding of the cognitive requirements for adaptive aircrew systems.

The Psycognition methodology was applied to an investigation of how fighter pilots' subconscious processes influenced their strategic behaviours in handling certain critical incidents. The research focused on pilots' strategic behaviours in three kinds of critical incidents: those involving a breakdown in plan, a control breakdown and incidents involving information overload. The following is a summary of the key findings from the research:

- ◊ Despite the similarities in background, training, experience and the strength of the military culture, significant differences emerged in how the subjects responded to certain critical incidents.
- ◊ In these situations the subjects drew upon deeply rooted subconscious core beliefs to guide their decisions and actions, instead of conscious, rational cognition.
- ◊ The differences in strategic behaviours were evident in situations which involved a breakdown in plan or control, an overload of information or a compromise of principles and values.
- ◊ Psycognition provides us with a basis for predicting what these behaviours will be, the strategies that will be applied and the breakdown situations in which they will emerge.

◊ The identification of predictive subconscious behaviours at breakdown points can contribute to our understanding of the human requirements for future cognition adaptive systems.

2. Introduction

System related air disasters are usually attributable to a combination of factors. Rarely can one factor be singled out as the primary contributor to the disaster. However, a common theme emerges in almost all air disasters. It is the human element, particularly human error or misjudgements that allegedly contributed to the system related disaster. There are two types of human related errors: one in which the human element is combined with a technical error and the second is a human reaction error.

What becomes evident in considering the human element in these incidents is that the systems developed were based on a number of assumptions about human behaviour. For example, common assumptions made in system design are that pilots will act according to predictable behaviour, their decision making is rational and logical and that they interpret and process information through cognitive processes.

While in the majority of circumstances these assumptions are valid, what appears in system related disasters, is that when things go wrong it is usually because for whatever reason, one or more of these assumptions became invalid.

A good example is the US Vincennes incident in the Gulf War in which an Iranian civilian airliner was accidentally shot down while flying out of Iran. Although the circumstances surrounding this incident are controversial, it provides a good illustration of how the psychological state of the senior crew, particularly the Captain's, was an important contributing factor to the incident that occurred.

It has been reported that the tension preceding the incident had been building up on the Iran and Iraqi border. In the morning of the incident the Vincenne had been particularly harassed by Iranian gun boats, which lead to the extreme agitation and frustration of the Captain and his crew.

Reportedly, immediately following the harassment, an Iranian civilian airliner departed from a civilian airport. This was picked up on the Vincennes radar and the display correctly indicated that the plane was not hostile and in fact was ascending and not descending toward the ship. Therefore it did not represent any threat.

However, the Captain and the crew were conditioned to the hostile environment and felt particularly harassed by the morning and consequently misread the display. They interpreted it as an hostile plane and therefore shot it down. [Neumann, 1995]

In this example the people involved did not act according to rational behaviour, they did not necessarily make logical decisions and the evidence suggests they drew upon something other than conscious reasoning to process the information they received and the actions they took.

It is becoming increasingly clear that there is a need to broaden our understanding of human behaviour to include the seemingly irrational and illogical behaviours. This requires that the cognitive framework currently used to understand conscious rational behaviour is extended to include the subconscious processes that influence and shape behaviour, particularly those that appear irrational or unpredictable.

This example illustrates two important points. Firstly, it illustrates how behaviours often operating automatically and intuitively without 'conscious' control, can influence the interpretation of information.

Secondly, it illustrates the role that these automatic and intuitive behaviours can play in determining the actions taken in stressful and threatening environments.

In thinking about the functioning and role of emotional systems and requirements for advanced aircrew systems where cognitive compatibility will be necessary, it will be particularly important to consider both the conscious and subconscious processes which influence pilots' decision making and behaviours. Cognition adaptive systems are systems which know how humans perceive, think and act, with the possibility to also know about human desires and intentions.

This was the starting point for the research. The research studied the subconscious processes that influence fighter pilots' behaviour by applying Psycognition, a methodological approach which focuses on understanding the subconscious processes which influence human behaviour. This approach although different in focus, is complimentary to current approaches and extends existing cognitive frameworks.

This report is organised in two parts. Part 1 discusses the research objectives, methodology and theoretical background to the research. In Part 2, Sections 6 through 9 focus on a discussion of the research findings. The conclusions and implications for design are drawn in Sections 10 and 11. The research report concludes with highlighting areas for further research in Section 12.

3. Research Objectives

The research objectives were two fold. An overall objective of the research was to explore the potential benefits of applying the Psycognition methodology to knowledge and requirements elicitation for cognition adaptive aircrew systems.

A research objective was to determine whether the information obtained through applying a Psycognitive approach could contribute to our current understanding of the cognitive requirements for advanced aircrew systems.

A research objective was to explore whether the impact of fighter pilots' subconscious strategic behaviours on decision making in critical incidents concerning plan breakdown and failure, carried design implications for cognition adaptable systems.

3.1 Hypotheses

Our starting hypothesis was that despite the strength of the military system, similarities in training and experience, we would expect to find differences in the subjects' strategic behaviours in certain situations. It was hypothesised that these behavioural differences would be closely linked to the subjects' characterological orientation.

Drawing from the theoretical framework of Psycognition we hypothesised that:

- In normal circumstances the subjects' characterology would not significantly influence their strategic behaviours. However in certain situations, when a subjects' characterology is compromised or threatened, the subconscious processes underlying their characterology would emerge and direct their strategic behaviours. We hypothesised that the subjects' character strategies would be revealed at points of breakdown.
- The subjects' characterology will influence how they organise their experiences and the strategies they apply to achieve important goals and for dealing with situations in which a loss of control occurs.

3.2 Research questions

There were four primary questions that guided the research. These were:

- Do the subjects have significantly different characterological orientations?

- If so, how do these differences influence the way the subjects handle critical incidents involving a breakdown?

- At what breakdown points would the subjects' character strategy emerge?

- Does the information on the subconscious strategic behaviours of fighter pilots elicited with Psycognition, contribute to our understanding of the cognitive requirements for adaptive aircrew systems. If so, what are the design implications?

4. Methodology

The research methodology was based on Psycognition which focuses on the understanding of the subconscious processes which influence human behaviour. Core to the Psycognitive approach is characterology. The term characterology refers to a gestalt of belief structures consisting of emotional responses and behaviours that are semi-predictable and reside in the subconscious. A characterological framework was applied in the data analysis to examine how the subjects organised their experiences around subconscious core material in certain breakdown situations.

The research sample consisted of four subjects, all of whom were fighter pilots, with similar backgrounds in terms of education, training, rank and flying hours. Psycognition methods were applied to elicit information on the subjects' strategic behaviours in certain critical incidents. The data was collected during two hour interview sessions with each subject. The sessions focused on the subjects' recollections of how they handled past critical incidents and also on the exploration of the subconscious processes underlying the strategies they applied in these incidents.

The data collection sessions focused on three types of critical incidents:

Information Overload Strategies

- The term information refers to all forms of input; written, verbal, auditory, sensory or displayed. The eight adjustment processes to information overload have been typified as: omissions, errors, filtering, abstracting, multiple channels, queuing, escape and chunking. [Miller, 1995]

Control Strategies

- Control strategies are attempts to maintain control when there is a perceived or actual breakdown of control in a situation.

Plan Breakdown Strategies

- A breakdown in plan occurs when an intended goal and strategy to achieve that goal does not happen according to plan. A breakdown in plan often results in a failure to achieve the desired outcome.

5. Background & Theoretical Framework

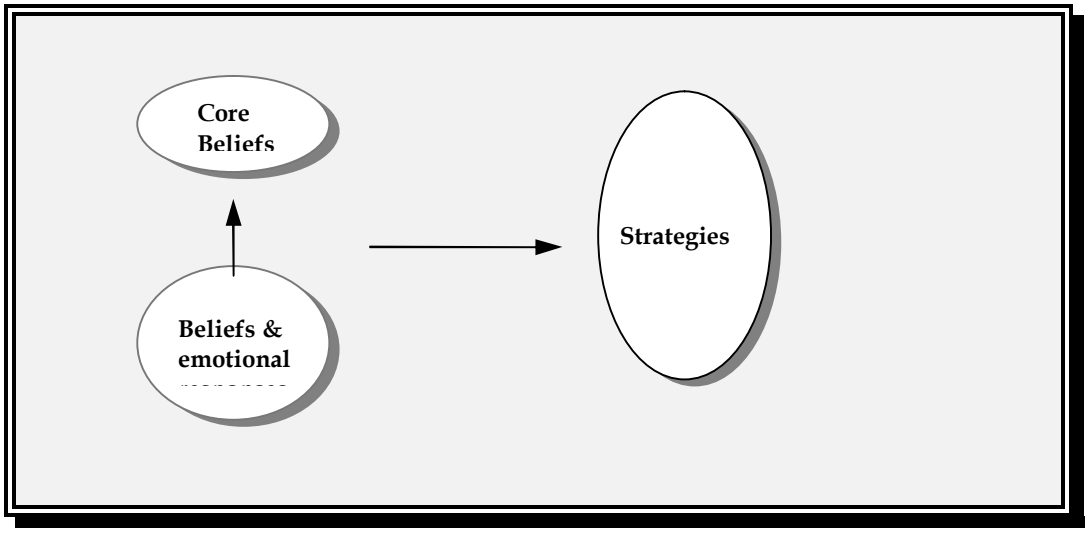
Psycognition is based on the theory that behavioural motives originate from the subconscious and therefore are significant because they directly influence individuals' perceptions and conscious behaviours. Psycognition seeks to understand these subconscious behaviours through characterology, which consists of the emotional responses and behaviours that are semi-predictable and reside in the subconscious.

The human psyche being an efficient organism, makes decisions about self and the world and self in the world. These decisions are based on answers to early developmental questions. For example, What can be trusted? Can I get what I need here? How can I have power here? How can I work with others? How am I valued?

If we had to keep addressing these questions about the world and ourselves in the world day after day we would never accomplish anything else, so once a decision is made about these questions, it resides in the subconscious mind. These decisions with their resulting beliefs, emotions and behaviours filter how an individual responds to life events.

For clarity's sake we discuss characterology in terms of core beliefs and strategies. Core beliefs consist of beliefs and emotional responses formed early in development and strategies are behaviours that are predicated on core beliefs.

A Model of Characterology



Character is present in everyone to a greater or lesser degree. The more self aware a person is of their core beliefs, the less they operate subconsciously and the more conscious control the individual will have. Nevertheless, even the most trained or self aware person will revert to their character or survival mode under extreme stress, in life threatening situations, or in situations in which their core beliefs are compromised.

Psycognition applies a framework of six characterologies as a basis for examining subconscious processes and behavioural strategies. (Kurtz, 1990) These are summarised in the table below.

An Overview of Characterological Themes

Character Position	*Behavioural Orientation*	*Core Belief*
Mr. Safety	• safety & trust.	• the world is dangerous.
Mr. Action	• performance & recognition.	• self worth stems from achievement.
Mr. Endurance	• subtle power & indirect control. • endurance .	• not good enough but important to do one's best.
Mr. Freedom	• freedom & direct control. • to be the best & to win.	• must be in charge, not safe to give up power & control.
Mr. Self-Reliant • going it alone.	• challenge.	• must take care of oneself, never rely on others.
Mr. Expressive	• attracting attention. • constant involvement. • avoid separation.	• not being interesting & listened to.

These characterologies are similar to other character typologies for example, those developed by Jung, Shapario and Erickson. However, these typologies are based on different dimensions, for example, Jung's extrovert and introvert or Shapario's focus, thinking, and actions, or Erickson's attention, distance, etc.

[Sharp,1987;Shapario;1965;Erickson,1976] The difference in the Psycognition framework from these typologies, lies in the focus on characterology, core beliefs and strategies.

This characterological framework enables us to understand character processes in terms of strategies. The purpose is not to classify individuals according to 'type', but instead to illuminate the individual patterns of behaviour. Characterology is intended as a starting point for developing hypotheses about individual strategic behaviours. These enable us to look for systems and consistencies in behaviour and thereby make predictions about the kinds of strategies individuals will draw upon in certain situations.

To a certain extent these characterologies are generalisable. For example, the 'Mr. Safetys' of the world will have an orientation around safety and trust reflecting a common core belief that 'the world is a dangerous place'. Because of the common core belief, similarities in the strategic behaviours of 'Mr. Safetys' will most likely exist in the strategies they operate around isolation when under stress. There is likely to be a common focus on detail and analysis and a similarity in the handling of information overload. We could also expect to find a common set of strategic behaviours among the other characterologies - 'Mr. Action, Mr. Endurance, Mr. Freedom', etc. For example, all 'Mr. Freedoms', will have a tendency to organise their experiences around the theme of freedom, control and winning. They will draw upon similar strategic behaviours to support this theme like being in charge, seeking excitement and adventure.

Drawing these generalisations however is not always straightforward because it is not uncommon for individuals to draw upon more than one characterology. In as much as individuals are diverse, creative and complex, we can find more than one character strategy within an individual. For example, it is possible for a 'Mr. Freedom', to draw upon the character strategies of 'Mr. Action' in certain circumstances.[Kurtz, 1990]

However, in cases where more than one characterology is drawn upon, it is typical for one characterology to be the dominant one and for the other/s to be less deeply ingrained. Because of this, these behavioural strategies seldom come to the forefront and instead are superimposed by the dominant characterology. In certain situations however, they can and do emerge.

Understanding behaviour in terms of characterology provides a logical explanation for what often appears to be irrational or unpredictable behaviour but in Psycognition, is completely rational and understandable. Thus, our contention is that information on how character strategy operates in individuals is valuable in extending our understanding of the cognitive requirements for advanced aircrew systems.

5.1 Emotional Responses & The Rational Brain

The importance of subconscious behaviour and the prominence it has in rational decision making is becoming recognised outside of the psychoanalytical domain. For example, recent brain and behavioural research has led to important discoveries about the emotional architecture of the brain.

At the heart of these discoveries is the identification of the key role the amygdala, which is part of the limbic system, plays in determining emotions and the extent to which they override the rational. Le Doux's revolutionary research revealed the interplay between the amygdala and the neocortex in which the amygdala has what he describes as a "privileged position as a psychological sentinel, in which it is able to hijack the brain."[Le Doux, 1986,1992]

This is a radical departure from conventional neuroscience theory which is based on the dominance of the neocortex (the thinking brain) in formulating emotional reactions. Le Doux's research revealed that quite the contrary happens. He discovered additional pathways in the brain, like a "neural back alley" by which the amygdala is able to receive direct sensory input before it is registered by the neocortex. Therefore emotional responses are already in the

process of being formulated by the time the rational brain has the chance to formulate its response. [Le Doux, 1992]

The newly discovered role of the amygdala is most important in understanding irrational and impulsive behaviour which overrides the rational. In the brain's architecture the amygdalas role is one of watching for danger signals. Goleman describes this as, ". . . challenging every situation, every perception, with but one kind of question in mind, the most primitive: "Is this something I hate? That hurts me? Something I fear?" If the answers are positive, the amygdala sends instant messages of crisis to all parts of the brain."[Goleman, 1996]

This research confirms the importance of extending the existing cognitive frameworks for understanding human behaviour to include the subconscious.

6. Discussion of Results

There were a small number of similarities among the subjects. For example, the level of training, the number of flying hours, field experience and length of military service. The subjects were also similar in age and rank. There was a strong similarity in the motivating factors which lead to their piloting career, for example, each subject developed a strong desire to fly from a very early age and pursued that desire with dedication and without questioning. The subjects shared a strong passion for flying.

Three themes emerged from the research findings.

- The first theme related to the differences in the strategies the subjects applied in certain situations. Each subject drew upon a particular behavioural strategy in situations that involved an overload of information, a breakdown in a plan of action and control breakdown.

- The second theme concerned the subjects' characterological orientation and how this became the dominant force in influencing their behavioural strategies and decision making in these breakdown situations.

- The third theme highlighted breakdown situations in which the subjects' character strategy dominated their decision making and gained precedence over the military system. Under normal circumstances however, the strength of the military system for example, training, ethos and field experience counteracted the subjects' characterological behaviours.

The following sections present the research findings on the subjects' strategic behaviours in the three breakdown situations. The subjects' behaviours are described in terms of the strategies that emerged from the data analysis.

6.1 Information Overload Strategies

An analysis of the data revealed significant differences between the subjects' adjustment processes in information overload situations. The data highlighted four types of strategies which the subjects consistently applied to situations involving an overload of information.

Results From the Data:
The Subjects' Information Overload Strategies

Strategy	*Adjustment Process*	*Cognitive & Behavioural Response*
A	• filter, chunk, escape	• goes for a lot of information in attempt to control overload. • quantity is important - he determines the quality. • core belief around not trusting dominates behaviour. • withdrawal from the situation.
B	• to speed up	• speeds up & goes faster. • goes for a lot of detail. • core belief around, "what more do I need to do here?"
C	• queue & delay	• slows things down. • timing is important for receiving information & for response. • core belief around, doing his best & waiting for the outcome.

As we can see each individual's information overload is different from one another. For example, Strategy A is based on escape and an attempt to control the overload situation through obtaining as much information as possible, and then chunking it into manageable bits and filtering it for the quality. While Strategy D is based on deflecting the situation through abstraction and drawing

There were significant differences in the strategies the subjects' applied in information overload situations. For example with Strategy A, the subject's adjustment process is based on escape, chunking and filtering. The subject attempts to control the overload situation through obtaining as much information as possible and then chunking it into manageable bits and filtering it for quality. Only when this process is complete, can the subject trust the information and feel safe with it. If however, a lack of safety persists, the subject with 'escape' either through over analysis (escapes into his head) or will withdraw from the situation altogether.
In contrast, another subject applied Strategy D which is based on deflecting the situation through abstraction and drawing upon multiple channels of information, instead of relying only on one. In this strategy the subject is attempting to maintain control through manipulation of the information.

There is also a marked contrast between the subjects' adjustment processes in Strategies B and C. The subject who applied Strategy C responded to situations of information overload by slowing things down. This strategy is based on queuing information, until the subject has had time to consider it and delaying further input until he is ready for more. In contrast, the subject who applied Strategy B, followed a process based on speeding everything up in order to obtain more detail. This process is based on speed and obtaining additional information as fast as possible.

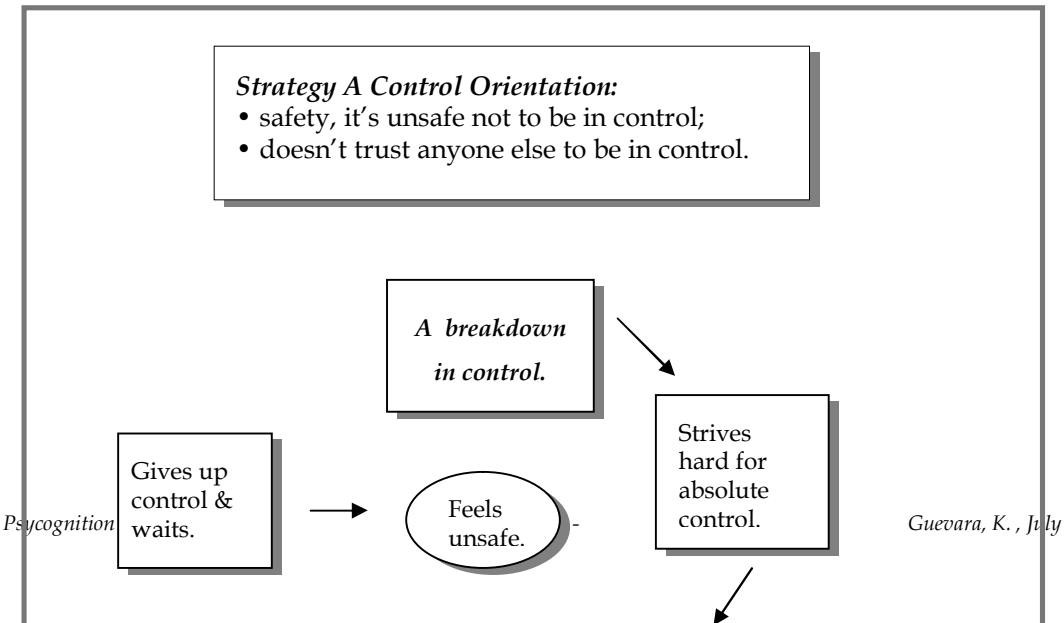
The data analysis identified a close interconnection between the adjustment process of each subject in their information overload strategy and the core belief underlying the behavioural response. For example, Strategy A is organised around the core belief of mistrust. Therefore, the strategy is based on a mistrust of the information and on obtaining as much information as possible and carefully filtering it for quality.

We can see how the core belief around, "what more do I need to do", influences Strategy B which involves a process of speeding up and "doing" as much as possible. Similarly, Strategy C and D are high influenced by the subjects' core beliefs. Strategy C is influenced by a core belief around "waiting", hence a queuing and delaying adjustment process and Strategy D, a "I can handle this" core belief, which leads to a control and manipulation process.

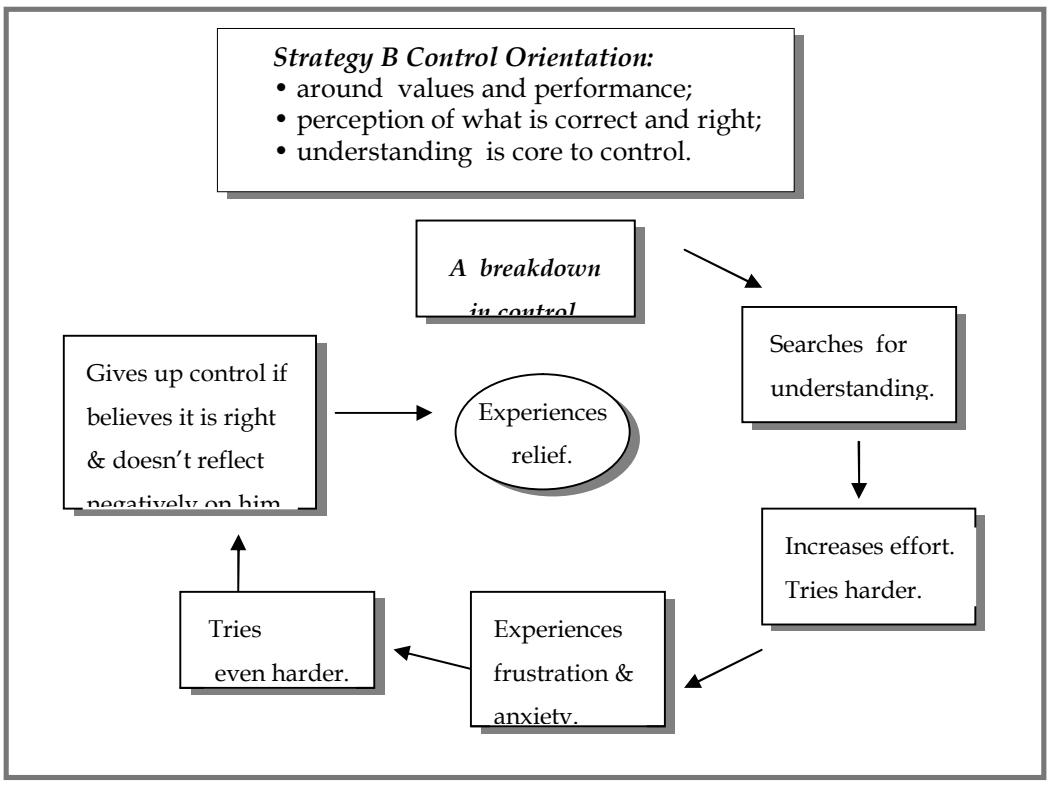
6.2 Strategic Control Behaviours

An analysis of the data highlighted significant differences in the subjects' strategic behaviours in handling situations involving a perceived or actual breakdown in control. The following four examples illustrate the control breakdown strategy applied by each subject. As we can see in the following examples, each subject had a particular way of responding to control breakdown situations.

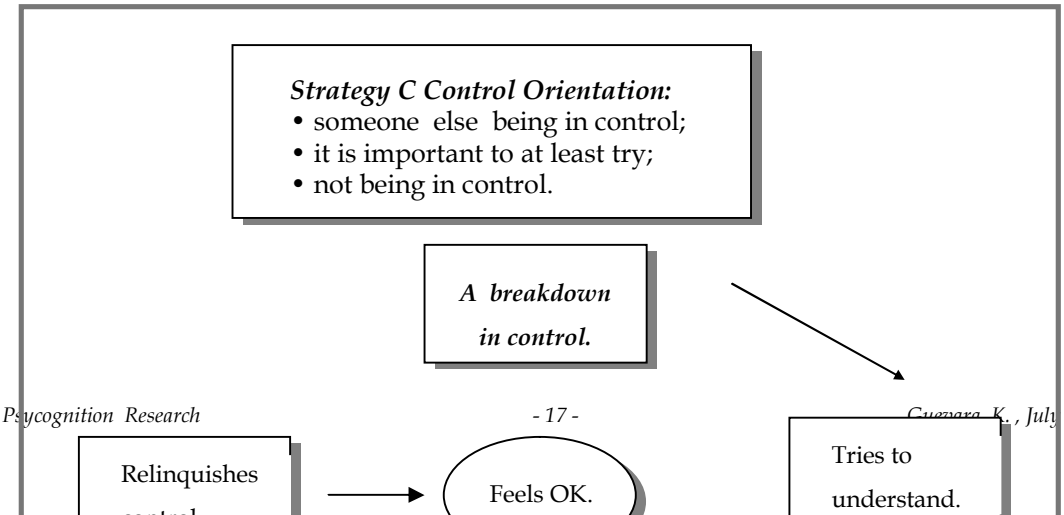
Control Breakdown Strategy A



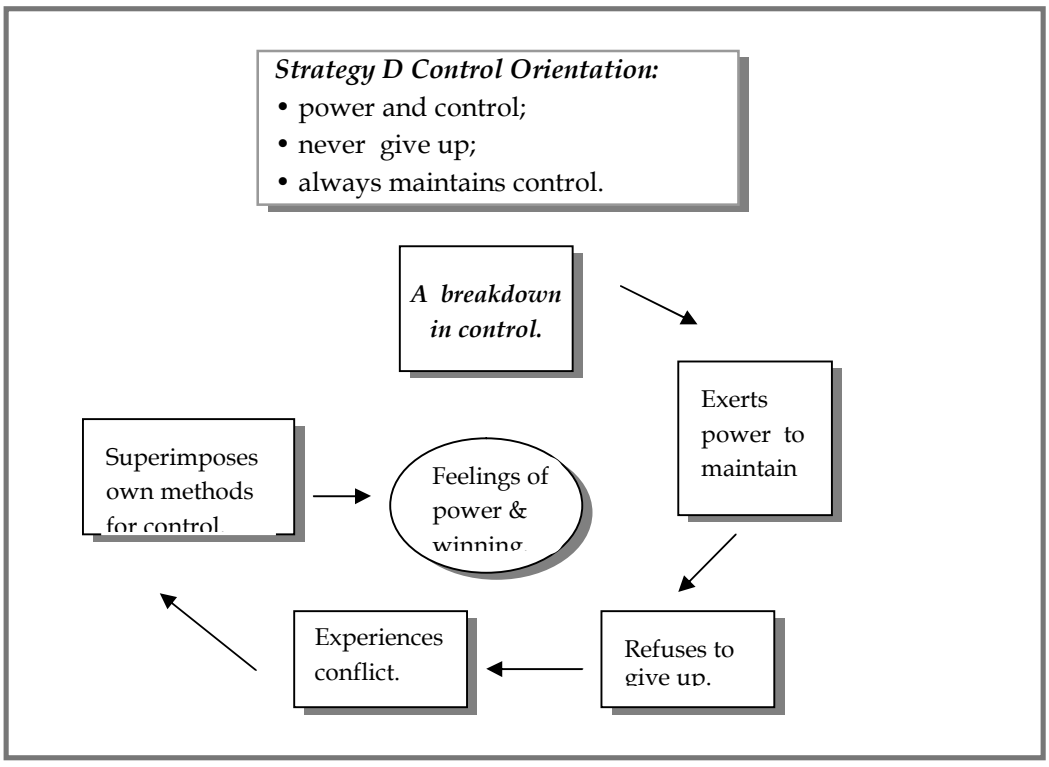
Control Breakdown Strategy B



Control Breakdown Strategy C



Control Breakdown Strategy D



These examples highlight a number of significant differences in the subjects' strategic behaviours in control breakdown situations. For example, control Strategy B is orientated around values and performance. The subject who applied this strategy, relinquished control only after he made a significant

effort to understand the breakdown and when he was certain that his values and performance were not compromised.

This contrasts with Strategy D which has an orientation around power and control. With this strategy, control is not relinquished, instead, the subject will superimpose whatever is necessary for him to maintain control over the situation.

The data analysis also revealed differences in how the subjects' experienced the loss or recovery of a breakdown in control situations. In control Strategy B, the subject initially experiences frustration and anxiety, but experiences relief when he eventually has to give up control. This is very different from control Strategy A, where the subject experiences a lack of safety and therefore prepares for the worse. It is also a marked contrast to Strategy D, where the subject experiences feelings of power and winning when he refuses to relinquish control and finds a way to maintain control over the situation.

6.3 Plan Breakdown Strategies

Similar to the strategic behaviours demonstrated in information overload and control breakdown situations, the data highlighted clear differences in how the subjects' handled breakdowns in plans. The subjects' different behavioural strategies in plan breakdown situations are presented in the following table.

The Subjects' Plan Breakdown Strategies

Plan Breakdown Strategy A

***Primary motivator*:**	• high performance.
***Motivating goal*:**	• to get his own way.
***Driving force*:**	• achievement.
***Strategic tactics*:**	• strong focus on goal.
	• manipulates situations to achieve goal.
	• doesn't stop, doesn't let anything get in the way.
***Breakdown factor*:**	• violation of - inconsistency with core values
***Response*:**	• withdraws.

Plan Breakdown Strategy B

***Primary motivator*:**	• values and principles.
***Motivating goal*:**	• to achieve what he believes is right.
***Driving force*:**	• achieving and being right.
***Strategic tactics*:**	• focus on what he beliefs is right.
	• perseveres until he gets what he wants.
***Breakdown factor*:**	• compromise of values and principles.
***Response*:**	• changes strategic plan to meet goal.
	• battles and 'bashes' against the 'system'.
	• seeks to understand failure situation.
	• gathers facts and information.
	• accepts situations if can rationally understand it.

Plan Breakdown Strategy C

***Primary motivator*:**	• to try his best.
***Motivating goal*:**	• to achieve desired goal.
***Driving force*:**	• to influence the outcome of goal.
***Strategic tactics*:**	• provides input to situation.
	• attempts to influence outcome.
	• tries to be ahead of events.
	• attempts to steer things in goal direction.
***Breakdown factor*:**	• adopts strategy for plan breakdown.
	• waits for the outcome.
Response:	• compromise.

Plan Breakdown Strategy D

***Primary motivator*:**	• achieving success and winning.
***Motivating goal*:**	• to achieve goal in his own way.
***Driving force*:**	• achieving what he wants.
***Strategic tactics*:**	• focus on desired outcome .
	• based only on achievement.
	• impulse over-rides rational thinking & judgement.
***Breakdown factor*:**	• none - success driven.
***Response*:**	• changes strategic plan to meet goal.
	• refuses to accept failed situation.

The significant differences in how the subjects navigated a breakdown in plans lie in the subjects' final response to not achieving their desired goals. The data highlighted a range of responses from a complete withdrawal from the situation, to a refusal to accept the situation, to creating a rationale for acceptance of the situation, through to compromise. These final responses reflect the subjects' attempts to come to terms with being unable to achieve their goals.

The data also revealed similarities in the strategic tactics the subjects' employed to achieve their goal once a breakdown in a plan emerged. For example in plan breakdown Strategy A, where achievement is the driving force for the subject, the tactics included a strong goal focus, a manipulation of the situation and a refusal of any interference. This is similar to plan breakdown Strategy B, where the subject's driving force is also achievement and his tactics focus on achieving the desired outcome.

The differences emerge in the breakdown factor. In Strategy A, the breakdown factor is a violation of the subject's values. In Strategy B, the breakdown factor does not occur because the subject reverts to a tactic of changing the plan in order to meet the goal. This is not unlike Strategy C, where the subject's tactics include changing the plan in order to meet the goal. However, the difference emerges in the subject's final response to the breakdown. In Strategy B, the subject's response is a refusal to accept a failure, where in Strategy C, the subject accepts a failed situation if he can create a rationale for doing so.

7. Themes and Patterns in The Subjects' Strategic Behaviours

Certain themes and patterns in the individual behavioural strategies emerged from the data analysis. There are close parallels between the strategies the subjects applied to information overload, control breakdown and plan breakdown situations. These are outlined in the table below.

Themes & Patterns in The Subjects' Strategic Behaviours

Strategy	Information Overload	Control Breakdown	Plan Breakdown
A	Not trusting information. Seeks quantity in order to control overload.	Unsafe not to be in control. Feels unsafe when gives up control.	Focus on manipulating situation to achieve goal. Refusal to give up. Withdraws goal if core values are compromised.
B	Speeds up-faster. Goes for detail.	Increases effort-tries harder. Gives up if doesn't reflect negatively on him.	Focus on what is believed to be right. Perseveres & changes strategic plan. Accepts breakdown if rationally understood.
C	Slows/delays things. Does best & waits.	Attempts to understand. Relinquishes control.	Focus on doing his 'best'. Adapts to breakdown. Compromises if necessary.
D	Deflects situation through abstraction. Manipulates to maintain control.	Exerts power to control. Superimposes own methods for control.	Focus on achieving what he wants, in his own way. Impulse over-rides rational thinking/judgement. Refuses to accept failed situation.

The strategic themes that emerged from the data suggest that each subject draws upon a core strategy with which to handle breakdown situations. There were close parallels in the strategies the subjects applied to the three breakdown situations. The parallels were most visible in the subjects' information overload and control breakdown strategies. For example, the theme of trust and safety in Strategy A emerges in both information overload and control breakdown situations. The theme of speed and effort in Strategy B is also evident in these two breakdown situations. In Strategy C, the theme of slowness, delay and doing one's best is evident in information overload and plan breakdown situations.

Parallels in all three breakdown situations only emerged with Strategy D, where the theme of control and manipulation is evident in each of the three situations.

These parallels suggest that the subjects organise their experiences and behavioural responses around certain underlying core beliefs. The following core beliefs emerged from the data:

- Strategy A: safety and trust.
- Strategy B: values and performance.
- Strategy C: doing one's best and compromise.
- Strategy D: control and manipulation.

8. The Subjects' Strategic Behaviours in Terms of Characterology

When the subjects' behaviours are examined in terms of the characterology framework, explanations for the differences in the strategic behaviours begin to emerge. Although the table below provides an overview of the six characterologies discussed in earlier in Section 5, only four of these characterologies were found in the data. This will be discussed later. This overview has been extended to include the strategic behaviours and the barriers typically associated with each characterology. Barriers are habitual behaviours which block the process of taking appropriate actions and

decisions. Barriers are essentially defences against failure which reverses the appropriate behaviour that needs to occur. [Kurtz, 1990]

An Overview of Characterological Types

Character Orientation	Strategic Behaviours	Barriers
Mr. Safety **Orientation:** Safety & trust. **Core Belief:** The world is dangerous.	Overly focused on detail & analysis. Creates own world. Excludes external factors. **Information overload:** Escape, chunk, filter.	**Withdrawal:** Confusion leads to fear & withdrawal.
Mr. Action **Orientation**: Performance & recognition. **Core Belief:** Self worth stems from achievement.	Orientated around action & perfection. Focus on the logical & rational. **Information overload:** speed up.	**Action:** Lack of satisfaction leads to frustration & more action.
Mr. Endurance **Orientation:** Indirect control & endurance. **Core Belief:** Not good enough, but important to do one's best.	Subtle influence & control. Bearing up; delaying; resisting others & waiting. **Information overload:** Queuing & delaying.	**Resistance:** Negativity leads to feeling pushed, which leads to resistance.
Mr. Freedom **Orientation:** Freedom & control. To be the best & to win. **Core Belief:** Must be in charge. Not safe to give up power & control.	Ensures own choices & decisions. Seeks adventure & excitement. Being in charge. **Information overload:** Abstraction, multiple channels, manipulation.	**'Deceive':** denies feelings, invests in image which leads to deception.

Mr. Self-Reliant **Orientation:** Challenge. Going it alone. **Core Belief:** Take care of oneself. Never rely on others.	Mobilising self-support. Proving self-reliance. Personal challenge. **Information overload:** Multiple channels.	**Collapse:** inability to take in real support leads to weakness & collapse.

Character Orientation	Strategic Behaviours	Barriers
Mr. Expressive **Orientation:** Getting attention & involvement. **Core Belief:** Not being interesting & listened to.	Dramatises events & feelings to get attention & avoid separation. Delays separation of all kinds. **Information overload:** Speeds up.	**'Reaction':** Frustration leads to reaction.

A number of close parallels exist between the characterologies illustrated above and the strategic behaviours exhibited in the data by the subjects. For example, the subject's strategic behaviours in Strategy A, closely corresponds to the description of 'Mr. Safety' in the table. The theme of safety and trust is visible in the subject's strategies in two of the breakdown situations.

Similar links are visible in Strategy B, which is based on the subject's core beliefs around performance and action and 'Mr. Action'. There is also a close similarity between 'Mr. Endurance' and the subject who applies Strategy C for doing his best, influencing events and waiting for outcomes. In Strategy D, the subject's behaviours closely relate to those of 'Mr. Freedom'. In the data Strategy D reflected the subject's core themes of power, control and the need to exercise freedom in the choice of how things are done.

Links Between The Subjects' Strategic Behaviours & Characterology

Strategy A	*Safety - Trust* ----------►	**'Mr. Safety'**
Strategy B	*Performance - Action* ----------►	**'Mr. Action'**
Strategy C	*Influence - Endurance* ----------►	**'Mr. Endurance'**
Strategy D	*Power - Freedom* ----------►	**'Mr. Freedom'**

The research findings suggest that the subjects' character strategy emerges at points of breakdown - information, control and plan breakdown points. It is at these points, that subconscious behaviours begin to determine the strategy the subjects will apply. It is for this reason that we see one subject handling an information overload situation by seeking large quantities of information through a lack of trust, another speeding up the rate at which information is received and yet another slowing down and delaying the amount of information received.

Character strategy also provides an explanation for the differences that emerged in the subjects' handling of control breakdown situations. For example, we see a significant variation in how the subjects responded to a breakdown in control, at one end of the spectrum feeling unsafe when control is lacking, to giving up control only if values and performance are not compromised, to relinquishing control only if a rationale can be understood, to the opposite end of the spectrum, a firm refusal to relinquish control.

The analysis of the subjects' behaviour in the data identified four of the six characterological types outlined in the table above. This was fortuitous. Each of the four subjects' strategic behaviours in the three situations corresponded to a different characterological type - 'Mr. Safety, Mr. Action, Mr. Endurance, Mr. Freedom'. The limited size of the sample did not provide the scope for the two remaining characterologies to emerge. However, we can draw some speculations about the behavioural strategies that might have emerged from these two characterologies if the sample size had been larger.

As we can see from the illustrations in the table, 'Mr. Self-Reliants' have core beliefs around mobilising self-support, relying on oneself and seeking challenges. Therefore we could expect to find behavioural themes of challenge and going it alone. We can hypothesise that the dominant behavioural theme which would influence a 'Mr. Self-Reliant's' strategy, would be the need to prove self-reliance and not seeking help from anyone.

These themes provide us with a basis for drawing hypotheses about the strategies that individuals with a dominant 'Mr. Self-Reliant' characterology would apply at certain breakdown points. For example, in situations of information overload, we can hypothesise that individuals would apply a strategy of using multiple channels for eliciting information. They would not rely on the information, but instead would rely upon their own analysis and conclusions drawn from the various channels. We could speculate that the control strategies of 'Mr. Self-Reliants' would focus initially on taking up the challenge and proving that a breakdown in control has not occurred, to work

hard at maintaining self-control and eventually to give up if not successful. We would expect a similar strategy in situations of plan breakdown.

We believe it is unlikely that we would find the characterology of 'Mr Expressive' in the fighter pilot domain. The core beliefs underlying this characterology have to do with obtaining attention, being listened to and feeling closely involved. The dominant theme in the strategic behaviours we would expect to emerge would be one of dramatising events and feelings to attract attention and to keep others involved. Strategies around creating drama and excitement would be aimed at avoiding separation.

At points of breakdown, where character is most likely to emerge, we could predict 'Mr. Expressives' would demonstrate strategic behaviours around drama and excitement. For example, in information overload situations, we would expect an attempt to speed up the information flow partly out of excitement, but also out of an attempt to remain connected. We hypothesise that it would be difficult for a Mr. Expressive to analyse or draw conclusions on their own from the information channel, particularly in overload situations. The lack of connectedness would heighten the tendency towards excitement and drama which would make it difficult for a Mr. Expressive to have the clarity with which to assimilate the information.

At other points of breakdown like control and plan, we could expect 'Mr. Expressive' to demonstrate strategies around creating excitement and drama in order to elicit the help of others and to closely involve others in achieving the goal or to maintain the control in the situation. In these situations we would expect that the goal itself or the possible loss of control would not be the focus. Instead, we speculate that in these situations 'Mr. Expressive' would focus on keeping others involved in resolving the problem and on the avoidance of being separated and alone.

9. Characterology As a Dominant Behavioural Force

A new research question emerged when the data revealed the differences in the subjects' characterologies and the counteraction of normal characterological tendencies by the strength of the military system. Under normal circumstances the military system for example, culture, ethos and regulations, provides for automatic behaviour. When this system is the dominant force, individual thinking and behaviours will become automatic and individuals will spontaneously draw upon this system for their responses.

The data was examined to determine whether there was evidence of the subjects' characterology becoming stronger than the military system and therefore becoming the dominant force in determining their behaviour and the strategies they operated. There were a number of specific incidents in the data where the subject's characterology emerged as a dominant force and superseded the military system. For reasons of confidentiality, these specific incidents cannot be described. However, the generic behaviours that emerged in the data which led to a superimposition of characterological influenced behaviours over the military system are illustrated in the table below.

Subject's Strategic Behaviours - The Dominance of Characterology

Strategy	*Cognitive Interference/ Character Compromise*	*Strategic Behaviour*	*Result - Military 'System' in Background*
A	• safety & trust.	• strives for understanding through detail & analysis.	• will not rely on system for safety. • has own rules for safety.
B	• performance & recognition.	• proving self worth. • over achievement. • strives for perfection.	• bypasses the system if necessary to maintain character integrity. • will not allow the system to undermine his performance.
C	• influence & ability. • to try to do ones' best.	• influences events. outcomes. • to do his best.	• bypasses the system if necessary • subtlety in controlling to influence events to own advantage.
D	• power, control, freedom &	• not being limited by the 'system'	• dangerous situations; overrides rules. • a disregard for procedures

10. Conclusions

The study provides evidence of the sensitivity of the characterological framework and of its' diagnostic and predictive power. We can draw a number of conclusions from the findings from this preliminary research. The overall conclusion is that Psycognition provides a useful framework for examining fighter pilots' subconscious strategic behaviours in certain breakdown situations. The nature of the findings, in particular the differences in pilot behaviours, indicate that a study of pilot subconscious behaviours can lead to an extended understanding of the strategies fighter pilots apply in decision making.

The following conclusions can be drawn from the data:

- The common assumption in system design that individuals draw upon conscious and rational behaviour is not valid in all circumstances.
- There are certain situations when the subjects will draw instead upon deeply rooted core beliefs which lie within the subconscious, to guide their decisions and actions.
- There are close parallels between the subject's strategic behaviours and their characterological orientation.
- In situations where the subjects are faced with an actual or perceived threat to survival, when they experience a breakdown in plan or control, an overload of information or there is a compromise of character, the subjects will revert to subconscious behaviour drawn from their characterology.
- Despite the similarities in the subjects' background, training, experience and the strength of the military culture, there were significant differences in how the subjects responded to breakdown situations.
- The differences in the strategies the subjects applied in breakdown situations can be understood through examining how they organise their experiences around the subconscious core beliefs rooted in their characterological orientation.

- The identification of dominant character orientation provides us with a basis for developing hypotheses about the subconscious strategic behaviours that will emerge in certain breakdown situations.

11. Implications for the Design of Cognition Adaptable Systems

Current system design draws heavily upon the assumption that individuals act according to conscious, rational and predictable behaviours. However, the evidence from studies of system disasters indicates that a major contributing factor to system disaster is often human error. Furthermore, studies have identified a theme in which human error often relates to a breakdown in rational and predictable behaviour.

The evidence from this preliminary research suggests there is a logical explanation for the seemingly irrational and unpredictable human behaviours that often occur in system disasters. Psycognition provides us with a basis for predicting what these behaviours will be, the strategies that will be applied and the breakdown situations in which they will be triggered. The identification of predictive subconscious behaviours at breakdown points can contribute to our understanding of the behavioural requirements for futuregnition adaptive systems.

The research findings have highlighted a number of potential implications for the design of cognition adaptive systems.

11.1 The handling of breakdown situations

Plan Breakdown

There are important differences in what motivates the subjects to achieve the goals in a particular plan. These motivators are closely linked to their core

beliefs and characterological orientation. Important differences emerge at the point of plan breakdown, when the subjects' are unable to continue with their strategy. It is at these points that the psychological and behavioural barriers linked to character orientation emerge, and influence how the subjects respond to a plan failure.

The diversity in the subjects' barriers and subsequent behaviour in breakdown situations suggest that they have different requirements for moving through these barrier points. For example, in the research, one subject withdraws at the point when values and performance are compromised, a second subject moves through the barrier point only when a rationale is created and another subject breaks through the barrier by controlling and manipulating the goals and plan.

This variation in requirements has certain design implications. For example, a system that supported a strategy based on creating rationales, would not necessarily meet a requirement for control and manipulation or a consistency with values or a requirement for delaying and consideration.

The research suggests that individuals' requirements to navigate, manipulate, alter and to create meaning in breakdown situations, vary and are closely related to the psychological goals that motivate them and the barriers that emerge at breakdown. The evidence suggests that systems that do not enable individuals the freedom to negotiate breakdowns in ways that are compatible with their characterological orientation, would lead to frustration and therefore result in individuals reaching their psychological barrier points.

Control Breakdown

This also applies to control breakdown situations. In the research, recovery from breakdown was highlighted as particularly important for subjects. The evidence suggests that it is at the point at which recovery of control appears impossible, that the strength of characterology emerges and is mostly likely to

supersede everything else. The evidence for this was strongest in situations in which the loss of control had implications for the compromise of character.

The differences in the subjects' recovery requirements have important design implications because the research suggests that if recovery is perceived as impossible, the subjects will bypass the system altogether when possible. The data indicated this applied to computer based systems as well as to the military system.

The variation in the subjects' recovery behaviours suggests that a recovery from breakdown requires a certain level of compatibility between the subjects and the systems they use. The research suggests that an individual's system requirements are at the levels of trust and safety, performance and recognition, the ability to influence and to have control and freedom. These themes suggest requirements for the support and facilitation of strategy based behaviours which are orientated around these requirements.

Information Overload

The themes of trust, timing, control and manipulation were highlighted in the research as important to how the subjects handled information overload situations. The differences in how the subjects oriented their strategic behaviours around these themes raise implications for system design because they imply important differences in individual requirements for the handling of information.

For example, a subject's requirement to trust information is met through a process of a careful elicitation of large quantities of information and a rigorous analysis of that information. The requirements of trust, quantity and analysis suggest that an 'analytical' support environment would provide a compatible context in which this process of selection and analysis could be facilitated and supported.

However, the differences in the subjects' strategic behaviours that emerged from the research, raises the question of the compatibility of an analytical support

environment for an individual whose strategic behaviours were orientated around very different themes. For example, individuals whose information overload strategies are based on increasing the speed of information elicitation (not necessarily the quantity) and a focus on detail, instead of analysis. A support environment for this strategic process would be more focused on the speed by which information is elicited and the rapid filtering of detail.

These variations do not necessarily imply a requirement for two different kinds of support environments. Despite the variation in these two strategic behaviours, overall both are analytical in nature. This raises the question whether these variations could be factored into the design of an analytical support environment.

For individuals with strategic behaviours of a completely different nature, however another kind of support environment would be more appropriate. For example, a 'naturalistic' support environment could provide a more compatible level of support for those individuals whose information overload strategies are based on the slowing down, the deflection and abstraction of information. In the case where timing is important and the need is for queuing and delaying, this becomes an important requirement in handling information breakdowns. For other individuals, abstraction is important and the requirement is to manipulate the information through a multiple of different channels. For both individuals, the overall requirement is for a support environment which permits them to navigate the breakdown in their own way, at their own pace.

12. Further Research

The preliminary Psycognition research has extended our understanding of fighter pilot strategic behaviours**.** The evidence from this research has highlighted important differences in how the subjects handled situations involving breakdowns in control, plans and information overload.

A characterological analysis of the subconscious behaviours, underlying the strategies the subjects drew upon in these situations, provided an explanation for the differences in strategic behaviours that emerged from the data. The results from this analysis highlighted close parallels between the core beliefs, character orientation and barrier points found in the characterological model and the core beliefs and strategic behaviours of the subjects. The analysis indicated the four subjects each had a different characterological orientation.

The characterological themes that emerged from the research were around safety and trust, performance and recognition, power and control, indirect control and endurance. The research findings indicated a link exists between the core beliefs the subjects had around these themes and the strategies they applied in breakdown and overload situations.

The research findings have identified a number of the subconscious behaviours that influenced the strategies the subjects draw upon in breakdown and overload situations. It has also provided a framework for understanding and providing explanations for the significant differences in the subjects' strategic behaviours.

The research has also highlighted the need for further research, in particular to validate the findings. A number of questions have also emerged from the findings which should be explored further to determine how applicable the findings are to the design of future cognition adaptive aircrew systems.

Areas for Further Research

The characterological orientation of fighter pilots

- The research identified four of the six generic characterological types. In the data analysis it appeared that the subjects drew upon one character orientation and did not significantly draw upon others. The data indicated that the subjects' drew primarily from their own character type for their behavioural strategies in certain breakdown situations.

- Further research needs to be carried out based on a larger sample size to determine whether a) the other two characterological types will emerge and b) whether fighter pilots draw upon more than one character type for their strategic behaviours and if so, under what breakdown situations.
- Research with a larger sample size would also investigate the question whether there is a common set of characterologies which govern fighter pilots' subconscious strategic behaviours.

Psycognition

- In this preliminary research, Psycognition has applied characterology as a framework for understanding the subconscious behaviours underlying the strategies the subjects applied in breakdown situations. Further research would extend this framework to include additional Psycognitive methods which would enable us to identify other subconscious strategic behaviours.
- The data in this preliminary research was based on the collection of verbal information from the subjects. The data collection sessions focused on the subjects' recollections of how they handled particular breakdown and information overload situations. The data collected was drawn from the subjects' personal and professional experiences.

  In order to explore the implications for the design of cognition adaptive systems, further research needs to expand the investigation to include other areas, particularly those related to how subjects handle breakdown situations involving system usage. The data that did emerge from these situations indicated that a focus on this area would prove worthwhile.

- Further research is also necessary to validate the characterological orientation of the subjects. Validation would require additional methods to be used to elicit subjects' subconscious strategic behaviours. For instance, in addition to verbal protocols, this might include observations, simulation or experimentation through scenarios.

Research Questions

The findings from this preliminary research raises five important questions:

- How important are the differences in the fighter pilots' subconscious strategic behaviours in breakdown situations to the design of cognition adaptive aircrew systems?
- Which of the characterological behaviours carry significant design implications for the cognition compatibility of aircrew systems? For instance, do significant implications lie at the core belief, the strategy or barrier levels or possibly at all three?
- To what extent should these significant behaviours be considered as cognitive requirements and therefore be factored into the design of systems?
- What kinds of requirements develop from a consideration of the subconscious strategic behaviours? For instance, compatibility does not necessarily imply adaptability, it could mean compensatory or perhaps a reversal or transition of behaviours. In some instances, it may be appropriate to ignore the behaviour altogether. This raises the question of how to address these behaviours in design to achieve the highest level of cognitive compatibility.
- What are the implications of factoring subconscious strategic behaviours into the design of cognition adaptable systems? What kinds of problems could arise from this approach? For instance, if a particular behaviour is supported through adaptability, what is the likely impact on other behaviours and what would be the effects on the strategic process, particularly at breakdown and barrier points?

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