

Psycognition: Cognitive Architectures for Augmented Cognition Systems

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Abstract. This paper describes Psycognition, a concept and methodological approach for eliciting the subconscious processes which influence human behavior. An examination of the Psycognition methodology is drawn from research that explored the subconscious processes underlying the tactical behaviors and decision making of a sample of RAF fighter pilots. This example application illustrates how the approach can be applied to apparently random behavior in critical situations. A primary aim of the research was to explore whether the Psycognition approach could contribute to our understanding of the requirements for future cognitive adaptive aircrew systems.

Keywords: Characterologies, core beliefs, strategic behaviors, subconscious processes, fighter pilot research, cognitive architectures, predictable emotional responses, diagnostic, predictive analytic tool.

1 Introduction

The objective of this paper is to introduce Psycognition, a novel concept, and methodological approach for eliciting the subconscious processes which influence human behavior. It has become increasingly clear that there is a need to broaden our understanding of human behavior to include the seemingly irrational and illogical forms. This requires that those cognitive frameworks used to understand conscious rational behavior be extended to include the subconscious processes that influence and shape behavior, particularly those that appear irrational or unpredictable.

System design draws heavily upon the assumption that individuals act according to conscious, rational, and predictable behaviors. However, evidence from studies of system disasters indicates that a major contributing factor is human error. [1] Furthermore, studies have identified a theme in which human error relates to a breakdown in rational behavior. The importance of subconscious behavior and the prominence it has in decision making is recognized outside the psychoanalytical domain. Recent neurological research has led to important discoveries about the emotional architecture of the brain. [2]

An examination of the Psycognition methodology is drawn from research that explored the subconscious processes underlying the tactical behaviors and decision making of a sample of RAF fighter pilots from the UK. A primary aim of the research was to explore whether the Psycognition approach could contribute to our understanding of the requirements for building a new generation of cognitive adaptive aircrew systems, a key component for future combat aircraft.

2 Psycognition

Psycognition is based on the theory that behavioral motives originate from the subconscious and therefore are significant because they directly influence an individual's perceptions and conscious behaviors. [3] Psycognition seeks to understand the subconscious processes associated with the semi-predictable emotional responses and behaviors that reside in the subconscious.

The human psyche being an efficient organism for survival makes decisions about self, the world, and self in the world. Examples of the key questions are: 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?

Once a decision is made about these questions, this decision resides deeply rooted in the subconscious mind. These decisions filter how an individual responds to each real life event. 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 behaviors that are predicated on those core beliefs [4]. Psycognition applies a framework of six characterologies as a basis for examining subconscious processes and associated behavioral strategies. For ease of comprehension colloquial terms are used instead of clinical ones. These characterologies are universal even though there are variations in the terms used [5] [6].

Table 1. Overview of Characterological Themes

Character Position	Behavioral 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 It's important to do one's best
Mr. Freedom	Freedom & direct control To be the best & to win	Must be in charge power & control It's not safe to give up
Mr. Self-Reliant	Challenge Going it alone	Must always take care of oneself Never rely on others
Mr. Attention	Attracting attention Constant involvement	Not being interesting & listened to

This characterological model enables us to understand character processes in terms of strategies. Characterology is intended as a starting point for developing hypotheses about individual strategic behaviors. These enable us to look for patterns and inconsistencies in behavior and thereby make predictions about the kinds of strategies individuals will draw upon in certain situations.

3 The Research – A Case Study

The Psycognition methodology was applied to an investigation of how RAF fighter pilots' subconscious processes influenced the strategies they chose in handling certain

critical incidents. The research focused on the pilots' tactical behaviors in three kinds of critical incidents: a breakdown in plan; a control breakdown; and information overload. The key research findings can be summarised as [7]:

- 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 tactical behaviors were evident in situations that involved a breakdown in plan or control, an overload of information or a compromise of principles and values.
- The evidence suggested that there is a logical explanation for human behaviors that are seemingly irrational and unpredictable.
- A conclusion drawn from the research was that Psychognition provides us with a basis for predicting what these behaviors will be, the strategies that will be applied, and the breakdown situations in which they will be triggered.

4 Application of Psychognition

Augmented cognition technologies monitor and assess the state of the user through behavioral, psychophysiological, and neurophysiological data acquired in real time. The resulting Psychognitive models of characterological and predictive behaviors add an important dimension to this composite picture of the user. This information can then feed into an algorithm that characterises an individual and predicts potential behavioral outcomes and strategic choices. By tapping into this human dimension, Psychognition has the potential to contribute to the ability of augmented cognition systems to adapt to the cognitive state of users.

Figure 1 provides an overall architecture in which a system collects continuous real-time information about a user through various sources, and draws from the RAF fighter pilot research to provide a simple illustration of how this might apply.

In this example the cognitive adaptive system 'knows' the cognitive architecture of the pilot (A Mr. Safety). It has a map of his behavioral strategies for handling a breakdown in the clarity function. The system will track his difficulties in processing information and will attempt to manage the process through interventions to reduce the insight barrier and to restore the clarity function. The system aims to slow things down for Mr. Safety so that he can understand the meaning of the information he is receiving. It attempts to break things into smaller, more manageable steps. It will also try to keep the pilot in contact with the situation to prevent him from withdrawing into confusion or over analysis (which is a strategy of Mr. Safety's) The system does this by tracking signs of the strategy not working, which will be reflected in increased confusion and fragmentation.

One can imagine that the cognitive architectures upon which Psychognition are based can be equally powerful in the design of augmented cognition systems in numerous other application areas. Obvious ones are those where ineffective strategies

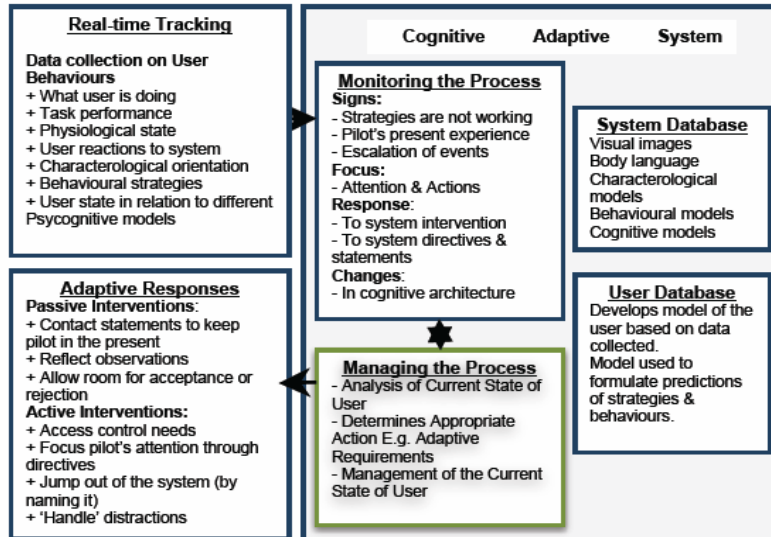


Fig. 1. A Model for Cognitive Adaptive System Support of Strategic Behaviors

can lead to accidents and fatalities. Among these are the military, NASA, air traffic control, ambulance control and hospital emergency rooms. Although not life threatening, stock market trading floors are an excellent example of high stress environments in which strategic breakdowns often result in significant financial losses¹.

As education, training and career re-skilling become increasingly distant, interactive and technology based, it will be essential for these systems to 'understand' the characterological make up of students to enable individual tailoring and equally important, to track students cognitive state for continuous adaptation. This will underpin the quality of education and the learning experience. This is also true of the area of telehealth as the technologies become highly interactive and extend beyond non-clinical usages. Here lies the application to medical avatars as they are envisioned now, but also as the focus expands beyond the physiological to encompass the mental health of individuals as well. [8] In the future Psycognitive models of individual characterology with the monitoring of behavioral and psychophysiological data potentially could detect the mental imbalances that lead to psychological disorders and illness. [9]

An important socio-economic and political trend is the movement towards individuals accepting increasingly more responsibility for the welfare of themselves and their families in all areas of their lives. As public sectors continue to shrink, the level of personal responsibilities will continue to rise. In combination with the other rapid changes occurring in the world, such as disruptive climate changes, oil prices, food shortages, terrorism, etc. individuals will need to develop a new form of

¹ An investigation of the application of Psycognition to the London Stock Exchange was carried out in 1997.

resilience. One can imagine personal avatars as guide and coach rolled into one, playing this role. New coping mechanisms and survival strategies can be created as ones' personal avatar navigates them through uncharted waters and stirs them away from self-defeating strategies predicated on core beliefs and characterological orientation.

5 Conclusion - A Powerful Diagnostic and Predictive Analytical Tool

In consequence, the methodological framework and models upon which Psycognition is based makes it a powerful diagnostic and predictive analytical tool. By focusing information gathering on the dimension of human behavior where core beliefs lie embedded in the subconscious, Psycognition provides an instrument for formulating hypotheses of individual characterological orientation. This creates a platform for a predictive analysis of the manifestation of character under certain circumstances. It is critical for designing rapid response in life threatening situations because individual character is triggered by certain stimuli and therefore emerges in particular situations, especially under stress or in danger. Beyond life threatening situations, Psycognition is also a powerful predictive analytical tool that potentially can be applied in numerous other application areas. This is because all human beings have character, core beliefs, emotional responses, and various subconscious and conscious strategies predicated on these.

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