

# Chapter VIII

## On the Cognitive Processes of Human Perception with Emotions, Motivations, and Attitudes

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### ABSTRACT

An interactive motivation-attitude theory is developed based on the Layered Reference Model of the Brain (LRMB) and the object-attribute-relation (OAR) model. This paper presents a rigorous model of human perceptual processes such as emotions, motivations, and attitudes. A set of mathematical models and formal cognitive processes of perception is developed. Interactions and relationships between motivation and attitude are formally described in real-time process algebra (RTPA). Applications of the mathematical models of motivations and attitudes in software engineering are demonstrated. This work is a part of the formalization of LRMB, which provides a comprehensive model for explaining the fundamental cognitive processes of the brain and their interactions. This work demonstrates that the complicated human emotional and percep-

tual phenomena can be rigorously modeled and formally treated based on cognitive informatics theories and denotational mathematics.

### INTRODUCTION

A variety of life functions and cognitive processes has been identified in cognitive informatics (Wang, 2002a, 2003a, 2003b, 2007b) and cognitive psychology (Payne & Wenger, 1998; Pinel, 1997; Smith, 1993; Westen, 1999; Wilson & Keil, 1999). In order to formally and rigorously describe a comprehensive and coherent set of mental processes and their relationships, an LRMB has been developed (Wang & Wang, 2006; Wang, Wang, Patel, & Patel, 2006) that explains the functional mechanisms and cognitive processes of the brain and the natural intelligence. LRMB encompasses 39 cognitive processes at six layers known as the

sensation, memory, perception, action, meta and higher cognitive layers from the bottom up.

*Definition 1: Perception is a set of internal sensation cognitive processes of the brain at the subconscious cognitive function layer that detects, relates, interprets, and searches internal cognitive information in the mind.*

Perception may be considered as the sixth sense of human beings since almost all cognitive life functions rely on it. Perception is also an important cognitive function at the subconscious layers that determines personality. In other words, personality is a faculty of all subconscious life functions and experience cumulated via conscious life functions. It is recognized that a crucial component of the future generation computers known as the *cognitive computers* is the *perceptual engine* that mimic the natural intelligence (Wang, 2006a, 2007c).

The main cognitive processes at the perception layer of LRMB are *emotion, motivation, and attitude* (Wang et al., 2006). This article presents a formal treatment of the three perceptual processes, their interrelationships, and interactions. It demonstrates that complicated psychological and cognitive mental processes may be formally modeled and rigorously described. Mathematical models of the psychological and cognitive processes of emotions, motivations, and attitudes are developed in the following three sections. Then, interactions and relationships between emotions, motivations, and attitudes are analyzed. Based on the integrated models of the three perception processes, the formal description of the cognitive processes of motivations and attitudes will be presented using RTPA (Wang, 2002b, 2003c, 2006b, 2007a). Applications of the formal models of emotions, motivations, and attitudes will be demonstrated in a case study on maximizing strengths of individual motivations in software engineering.

## THE HIERARCHICAL MODEL OF EMOTIONS

Emotions are a set of states or results of perception that interprets the feelings of human beings on external stimuli or events in the binary categories of pleasant or unpleasant.

*Definition 2: An emotion is a personal feeling derived from one's current internal status, mood, circumstances, historical context, and external stimuli.*

Emotions are closely related to desires and willingness. A *desire* is a personal feeling or willingness to possess an object, to conduct an interaction with the external world, or to prepare for an event to happen. A *willingness* is the faculty of conscious, deliberate, and voluntary choice of actions.

According to the study by Fischer, Shaver, and Carnochan (1990) and Wilson and Keil (1999), the taxonomy of emotions can be described at three levels known as the sub-category, basic, and super levels as shown in Table 1.

It is interesting that human emotions at the perceptual layer may be classified into only two opposite categories: *pleasant* and *unpleasant*. Various emotions in the two categories can be classified at five levels according to its strengths of subjective feelings as shown in Table 2 (Wang, 2005), where each level encompasses a pair of positive/negative or pleasant/unpleasant emotions.

*Definition 3: The strength of emotion  $|E_m|$  is a normalized measure of how strong a person's emotion on a five-level scale identified from 0 through 4, that is:*

$$0 \leq |E_m| \leq 4 \quad (1)$$

where  $|E_m|$  represents the absolute strength of an emotion regardless whether it is positive (pleasant)

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