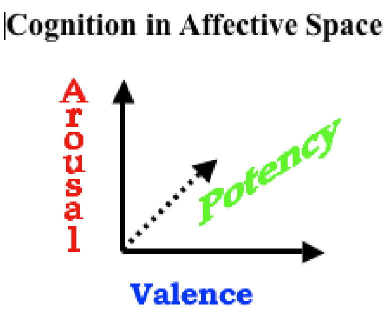
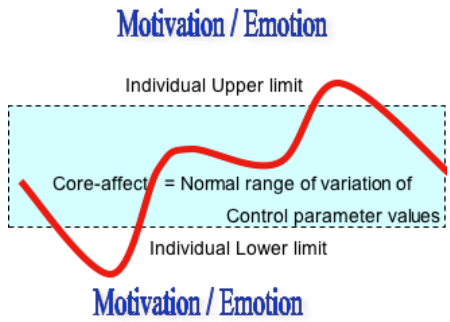
Unified Model of Cognition, Emotion and Action

The Second European Conference on Emotion, Université catholique de Louvain, May 18th, 19th & 30th, 2006

Branka Zei Pollermann
Geneva University Hospitals, Department of Psychiatry
Branka.Zei@hcuge.ch





Overview:

The unified model of cognition, emotion, and action suggests that cognitive processes that steer and organise adaptive behaviour evolve in what is commonly known as affective space. By combining insights from genetic epistemology (Piaget, 1950), the model explains how and why certain affective dimensions are inseparable from cognitions involved in adaptive interaction with environment. The functioning of adaptive action is approached within the framework of dynamic systems with self-organizing properties. Valence, arousal, and potency are considered as the system's control parameters, while the amplitude and speed of change in control parameter values are seen as generators of more or less stable states that are likely to be felt as emotional. Each state is defined as a point in a three dimensional space. Depending on their structure and stability over time, these states can be conceptualized as motivations, emotions, moods, or personality traits. The very raison d'être of these three control parameters is explained from the cybernetic point of view enriched with constructivist epistemology.

The model

Emotions are considered to be initiators, modulators, or terminators of actions. They appear to mediate adjustment to environmental conditions and improve the individual's chances of survival. Does this mean that emotions are dedicated adaptive systems and that one needs to be in an emotional state in order to engage in adaptive behavior?

We say *No* and support the view that affective aspects of cognitions are inherent to the functioning of dynamic systems where behaviour results from organisation through a limited number of interacting lower-order control parameters. Shifts in values and the interactions between control parameters produce different behavioural outputs.

Our model suggests that the system's control space be defined by three dimensions: valence, arousal, and potency. These have so far been considered as intrinsically affective (Mehrabian and Russel, 1974; Russell 2003). By contrast, we believe that attribution of valence, perception and estimation of arousal, and appraisal of the subjet's potency are part of cognitive processes involved in the organism's interaction with the environment. We believe that it is only under certain conditions that valence, arousal and potency come to be conceptualised as dimensions of emotions.

This is conceptually close to Lang's view of there being no clear demarcation between affective and nonaffective behavior (Lang, 1990). We take a stand against theories based on specific emotional mechanisms (Plutchik, 1980) and argue in favour of a general systems approach to emotion which includes the mechanisms that control behavior (Carver & Scheier, 1981; Mandler 1975). Based on Piaget's genetic epistemology, we propose a model which states that the subject's interaction with environment implies the construction and usage of schemata that necessarily involve *affective* aspects (Piaget, 1954). Our model concernes the functioning of interaction processes which apply to organisms described as open systems with dynamic teleology (Bertalanffy, 1972).

Piaget's general model of interaction comprises two types of interactions: Type I interaction produces the knowledge of the relation between the properties of the object and the properties of the subject's action. Type II interaction includes the properties of perceptual and sensorimotor schemata as elaborated in Type I interaction, to which are added inferential co-ordinations, consciousness, and retroactive regulation.

Most cybernetic models of self-organizing adaptive systems (Cellérier, 1968; Canamero, 2001, Orlando, et al. 2005;) agree that for a system to be adaptive, it should perform at least five tasks :

1. Sense the internal and external environment, interpret, and store the sensory input,
2. Use the perceptual inputs and memory to decide which action is most appropriate,
3. Regulate the internal resources for execution of action,
4. Transform the chosen action patterns to overt behavior including, communicative actions,
5. Evaluate the outcome.

Our model suggests that the control parameters steering the execution of the five tasks be: valence, activation, and potency.

Valence is inherent to tasks 1 and 5 in which the subject assimilates internal and/or external stimuli into the already existing knowledge structures (perceptual, sensori-motor and conceptual schemes). In this process, each piece of knowledge is tagged for its actual or potential hedonic valence. The function of valence tags is to regulate approach - avoidance behaviors (Cacioppo, Klein, Berntson, & Hatfield, 1993).

Potency tagging is inherent to task 2 of an adaptive system, which involves: action selection and arbitration, decision making and an estimate of the subject's coping potential. The latter aspect refers to the relation between available power and the power needed to cope with the situation.

Activation tagging is inherent to tasks 3 and 4 of the cybernetic model. It denotes the afferent-feedback-based online percept of internal body tone as well as an estimate of the required task-relevant activation of resources. The online percept can be defined as a cognitive composite of feedback information from cardiovascular targets, gut, lungs, muscles, and electro cortical arousal. The activation-tag carries the information about the amount of energy mobilization involved in autonomic, motor, physiological and computational ongoing changes as well as those estimated as required to handle the stimulus and/or its consequences.

Emotions as specific configurations of the control space

When the amplitude and/or the speed of change in control-parameter values fall outside an individually determined normal range of variation, such configurations become cognitively dominant and lend themselves to be subjectively known as motivational or emotional states. The detection of deviations in control parameters is rooted in the fundamental physiological principle of set-point detection. We share Watt's view that " When internal physiological states are outside a desirable range, both visceral sensations and action dispositions (thirst and pursuit of fluids) are activated. But phenomenal states of rage, separation distress, fear must have similar mechanisms, that these are 'not OK' departures from ideal organismic baselines, activating defensive responses, while play and affection, sexual stimuli etc., must encode or activate the opposite, setting in motion basic appetitive mechanisms. These are central and not peripheral aspects of affect." (Watt, 2001 p. 306). The deviation from a set-point is implicit in Russel's dimensional model of emotion, where the center of the circumplex represents a neutral point on both bipolar dimensions, and "each emotion label can be thought of as a vector originating from center of the circle with its length representing intensity (extremity or saturation)" (Russel, 1989).

Piaget's theory of knowledge suggests that knowledge is constructed by means of assimilation of the object of cognition into the subject's own schemata (from perceptual and sensory motor to conceptual ones) which are also continuously accommodated to new situations. Assimilation itself involves thematization - a process whereby different components of the object are selected, conceptualized, categorized, hierarchically stored, translated into semiotic entities (e.g. given names), and placed into a relational network of other concepts. Richard Lane's model of emotional consciousness is particularly interesting in this regard because it links levels of emotional consciousness to the levels of representational schemata complexity (R. Lane, 2001).

References:

Bertalanffy, L. v. (1972). *General system theory : foundations, development, applications*. London.

Cacioppo, J. T., Klein, D. J., Bentson, G. G., & Hatfield, E. (1993). The psychophysiology of emotions. In M. L. a. J. M. Haviland (Ed.), *Handbook of Emotions* (pp. 119-142). New York Guildford.

Canamero, L. (2001). Emotions and adaptation in autonomous agents: a design perspective. . *Cybernetics and systems an international journal, 32*, 507-529.

Carver, C. S., & Scheier, M. F. (1981). *Attention and self-regulation: A control-theory approach to human behavior*. New York: Springer-Verlag.

Cellérier, G. (1968). Modèles cybernétiques et adaptation. In J. Piaget (Ed.), *Etudes d'épistémologie génétique* (Vol. XXII, pp. 6-90). Paris: Presses universitaitres de France.

Lane, R. (2001). Hierarchical organisation of emotional experience ans its neural substrates. In A. Kazniak (Ed.), *Emotions qualia and consciousness* (Vol. 10, pp. 247-270). London: World Scientific Publishing.

Lang, P. J. (1990). Cognition in emotion: concept and action. In C. Izard, J. Kagan & R. Zajonc (Eds.), *Emotions, cognition and behaviour.* (pp. 192-226).

Mandler, G. (1975). *Mind and emotion*. New York: Wiley.

Mehrabian, A. & J. Russel (1974). *An approach to environmental psychology*. Cambridge: MIT Press.

Orlando A. G., Canamero, L., te Boekhorst R. (2005). Analyzing the Performance of "Winner-Take-All" and "Voting-Based" Action Selection Policies within the Two-Resource Problem. Proceedings of AISB 05, Agents that want and like. Hatfield Herts, UK.[a]

Piaget, J. (1950). *Introduction à l'épistémologie génétique. 3 La pensée biologique, la pensée psychologique et la pensée sociale* (1 ed. Vol. 3). Paris: Presses universitaires de France.

Piaget, J. (1954). *Les relations entre l'affectivité et l'intelligence dans le développement mental de l'enfant*. Paris,: Centre de documentation universitaire.

Plutchik, R. (1980). *Emotion, a psychoevolutionary synthesis*. New York: Harper & Row.

Russel, J. (1989). Measures of emotion. In R. Plutchik & H. Kellerman (Eds.), *The Measurement of emotions* (pp. 83-111). San Diego: Academic Press.

Russell, J. A. (2003). Core affect and the psychological construction of emotion. Psychological Review, Vol. 110, No. 1, 145-172.

Watt, D. F. (2001). Affective neuroscience and extended reticular thalamic activating system (ERTAS) theories of consciousness. In A. Kazniak (Ed.), *Emotions qualia and consciousness* (Vol. 10). London: World Scientific Publishing.