Mood, Emotion and Action: a concern-realization model.

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1.INTRODUCTION

A promising starting point for attempts at a further understanding of the relations between affect and cognition are the effects of *moods* or *feeling states* on cognitive processes. From recent reviews of these effects (e.g Bower 1981; Clark & Isen 1982) it can be concluded that at least the following cognitive functions are influenced by feeling states:
memory; "Mood State Dependent Retention" (MSDR) refers to the observation that recall of information is facilitated if the mood states at the time of learning and of recall correspond, but is inhibited if these moods are different.
selection; the "Mood Congruity Effect" (MCE) refers to the increased saliency of mood-congruent materials; processing of information is facilitated, when the affective valence of this information is congruent with the mood of the subject.
production; it has been found that subjects in production tasks tend to generate responses that are congruent to their mood. E.g. in free association and in interpretive tasks angry subjects give more angry responses.

2.A NETWORK THEORY

Bower (1981) proposes an extension of general semantic network theories to explain these results. In his theory each distinct emotion is represented by a specific node in the memory network. All information specific to a particular emotional state is assumed to be linked to the node for this emotion and thus can generate activation towards this node. Moreover, episodic representations of events in which this emotion was experienced are also connected to the emotion node.
The explanation in this model for the MSDR phenomenon is that mood functions as a retrieval cue; the mood during learning will become linked to the episodic representation then formed. If the same mood is experienced at the time of recall, the emotion node will generate activation towards this episodic representation.
The selection and production effects are also explained by the principle that mood spreads activation to related information in memory. This principle could explain selective learning of mood-congruent materials in a number of ways. For instance, mood-congruent materials might become connected to more information in memory, or might be elaborated upon more.
The mood effects on production are implied by the assumption that increased activation of mood-related materials increases their availability.

A question unanswered sofar is how emotion nodes become activated. Bower

& Cohen (1982) present a model of emotional appraisal of events that addresses this question. They extend the network model by adding a *blackboard control structure*. This control structure facilitates interaction and integration of information from different knowledge sources by allowing all sources to put hypotheses on the blackboard. The contents of the blackboard are changed by a set of production rules. Each production has a left-hand side (LHS) that can be matched against the contents of the blackboard, and a right-hand side (RHS) that changes the plausibility values of the hypotheses on the board.
Emotional appraisal of events is the result of the application of *emotional-interpretation* (E-I) rules. In the LHS of E-I rules a cognitive interpretation of events is specified, the RHS specifies some adjustment of the activation level of emotion nodes. As an example of the use of E-I rules consider the event of "a big boy Sam hitting a smaller boy Johnny". This event could match an E-I rule with LHS "a bully hurts a weakling". This rule then assigns emotional interpretations to the components of the event, e.g. it associates anger with Sam and sympathy with John. As a result both the anger and the sympathy emotion nodes become more highly aroused.
Bower & Cohen assume the existence of large numbers of E-I rules that vary in generality and are hierarchically organized. Thus, many E-I rules may be applicable to any given situation, but the most specific E-I rules are favored. However, the selection of E-I rules is also dependent on their momentary priority ordering.
Interactions between emotional states and emotional interpretations of events -one reacts differently to a slight annoyance in a good or a bad mood- are accounted for by postulating *interaction rules*.

2.1. problems for network theories

The main problem with the network theory is that, even with the blackboard as extension, it is at best only half a theory of emotion. The question remains unanswered what the implications are of the emotional interpretation of an event for the observer. There is little explanatory power in postulating emotion nodes for each emotion. The model may predict that emotional states influence the processing of information that has a corresponding emotional quality; the model does not predict what information will have that quality.
The problem of pinpointing what information one can expect to be affected by a given mood manipulation is highlighted by some recent experimental results. Johnson & Tversky (1983) had subjects estimate the frequency of fatalities due to various causes. Before making estimates, experimental subjects read a story describing one fatal event in some detail. The striking results of these experiments were, that experimental subjects rated all risks considerably higher than control subjects, but did not overestimate risks related to the mood inducing story more than unrelated risks. As Johnson & Tversky (1983) conclude:

> The pervasive global effect of mood and the absence of a local effect pose a serious problem to memory-based models of this effect, such as spreading activation within a semantic network. In such models ... Risks that are closely linked to the story should be influenced more than unrelated risks, contrary to the present findings.

We claim that two assumptions are needed to explain these results. A first assumption is that mood selects information not on the basis of some affective quality, but on the relevance of information to planning. Specifically, we propose:
in positive moods the processing of knowledge concerning the success of goal-based action is facilitated, while in negative moods information relating

to failure is more readily processed.
Thus, in a depressed mood all we know about unattainable goals, unsuitable instruments, incompetent actors and bad outcomes comes easily to mind. In an elated mood, on the other hand, we are experts on success.
However, there is a problem associated to this proposal: it seems very hard to envisage an associative memory model wherein information relating to success of certain plans can be activated independently of information relating to failure of those same plans. A solution to this problem is to assume that it is not the *data-base* but the *logic-engine* that is the source of mood effects.
We propose that:
the main locus of mood effects in cognitive processing lays not in the activation patterns in the general semantic network, but in the 'tuning' of certain inferential procedures that operate on the network.
We will briefly outline a general theory of emotion, to show how these two assumptions could be incorporated in a model of mood effects.

3.A CONCERN-REALIZATION MODEL OF EMOTION

Emotions can be regarded as changes in action readiness elicited by significant events (Frijda 1984; i.p.). Action readiness can change in three ways: change in *activation*, the general readiness for action; change in *inhibition*, the blocking of action readiness; and changes in the readiness for specific kinds of actions. Such a specific readiness or "impulse" is called *action tendency*.
Action tendencies can be conceived of as the highest level of planning (i.e. *meta-plans*, Wilensky 1981). They differ from plans in that they are steered by the goal of changing the current situation, rather than by that of achieving an anticipated state. For example, the action tendency *attack* is controlled by the goal of changing the mode-of-existence of the object of the attack in the present situation, not by the goal of decreasing the well-being of that object to some specifiable degree.
The significance of events is determined by *concerns*. A concern can be defined generally as a disposition to prefer certain states of the world over others. In the computational context of a blackboard control structure, a concern is represented by a *Concern-Realization Rule* (C-R rule). A C-R rule consists of a LHS and a RHS part:
the LHS contains a description of a preferred state, the concern proper. The preferred state is matched against the interpretations of situations posted on the blackboard. This matching process can signal three types of event relevance: the event can be *congruent* to the concern, resulting in positive emotions, or *discordant* with the concern, for negative emotions, or *relevant*, without being evidently congruent or discordant; the latter is the condition for attention and interest.
The RHS of a C-R rule increments or decrements specific action tendencies, general activation, or inhibition.

The concern-realization model further assumes the existence of a general planning mechanism that transforms action tendencies into plans and puts these to action. Following Wilensky (1981) we distinguish three classes of rules in the planning mechanism:
Proposer Rules take in action tendencies and propose plans to effectuate them;
Projector Rules take in plans and test the feasibility of these plans. Projector rules may produce scenarios of potential failures of the plan.
Revisor Rules attempt to revise plans so as to overcome difficulties projector rules have come up with.

The crucial difference between the present proposals and the Bower & Cohen (1982) model is that the concern-realization model is action oriented. C-R rules map events into specific, object-related, action tendencies. We suggest that this feature enables one to account for the emotional appraisal of events with a far more coherent and comprehensive set of rules. Some appreciation of this point may come from a further reflection on the earlier example of "bully Sam hitting little Johnny".

Imagine that the mothers of both Sam and Johnny happen to be watching this event. In the network model Johnny's mothers appraisal of this event will, for any likely set of E-I rules, lead to a strong activation of both the "anger" and the "sympathy" nodes, originating from anger with Sam and sympathy with Johnny. It is possible, if perhaps unlikely, that some set of E-I rules would lead to the same degree of activation of these nodes for Sam's mother, but with Sam as the single source of this activation. (E.g. Sam's mother is angry for Sam staining his clothes, she is sympathetic to his show of strength and she doesn't care about Johnny.)

If *"A person's current emotional state may be described as the activation level of a set of N emotions like fear, anger ..."* (Bower & Cohen 1982) then this would seem to imply that both mothers are in the same emotional state. Intuitively, this does not seem right. It should make some difference whether the objects of anger and sympathy are different or the same. In the concern-realization model the reactions of both mothers can be described in terms of two action tendencies, *attack* and *support*, roughly corresponding to anger and sympathy respectively. For Johnny's mother, these two action tendencies are in this situation virtually identical (i.e. they share the same goal of changing Sam's presence in the situation). For Sam's mother however the action tendencies "attack Sam" and "support Sam" clearly conflict.

The general point should be clear. It is one of the essential features of nodes in an associative semantic network that they can accumulate activation, but do not represent where that activation came from. Thus, any model that represents emotion in terms of the activation of emotion nodes will have a problem in representing the distinction between true emotional ambivalence (which is always based on the presence of conflicting action tendencies) and *emotional complementarity*, that results from an action tendency implying different orientations towards different objects. Solution to this problem will be entirely ad hoc unless an action component is added to the model.

4.MOOD RECONSIDERED

There exists considerable confusion over the meaning of the concepts "mood" and "emotion". Sometimes no distinction appears to be made at all (e.g. Bower 1981), sometimes the distinction is only a matter of degree (e.g. Clark & Isen 1982). We risk to add to this confusion in arguing that mood in fact is not a feeling state at all. Feeling states refer to the experience of concern relevance and of action readiness, including interoception of activation and inhibition. Mood, we suggest, refers not to action readiness and concern relevance, but to the *tuning of the concern-realization system*. We have mentioned in passing that the application of E-I rules is dependent on a momentary priority ordening. The same holds for planner- and C-R rules. The tuning of the system then, is the momentary priority ordering of the rules that make up the system.

Our earlier hypothesis on the relation between mood and knowledge about success or failure can thus be further understood. We have assumed that the planning mechanism entails Proposer and Projector rules. A Proposer is by nature an optimist, it generates plans that might succeed. A Projector,

however, is a pessimist: its task is to demonstrate how plans may fail. We propose then, that elated and depressed moods correspond to high priority assignments to Proposer and Projector rules, respectively. This proposal finds some support in a study by Isen & Nowicki (1981). These authors found that subjects in a creative problem solving task generated more ideas and more often reached a solution after seeing a funny movie.

REFERENCES

Bower, G. H. Mood and Memory. *American Psychologist*, 1981, 36, 129-148.

Bower, G. H. & Cohen, P. R. Emotional Influences in Memory and Thinking: Data and Theory. in: M. S. Clark & S. T. Fiske (eds.): *Affect and Cognition*, New Jersey: LEA 1982

Clark, M. S. & Isen, A. M. Toward understanding the relationship between feeling states and social behavior. In: A. Hastorf & A.M. Isen (eds.): *Cognitive Social Psychology.* Amsterdam: Elsevier 1982.

Frijda, N. H. Towards a Model of Emotion. In: C.E.Spielberger,J.Sarason & P.E.Detares (eds.): *Stress & Anxiety* Vol 1, N.Y. Hemisphere 1984 (in press)

Frijda, N. H. *The Emotions* New York: Cambridge U.P. (in preparation).

Isen, A. M. & Nowicki, G. P. Positive affect and creative problem solving. Paper presented at the annual meeting of the Cognitive Science Society, Berkeley, 1981.

Johnson, E. J. & Tversky, A. Affect, Generalization, and the Perception of Risk. *Journal of Personality and Social Psychology* 1983, Vol.45, 20-31.

Wilensky, R. Meta-Planning. *Cognitive Science* 1981, 5, 197-233.