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## AFFECTIVE GUIDANCE OF INTELLIGENT AGENTS: How Emotion Controls Cognition<sup>1</sup>

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### Abstract

Emotions and moods color cognition. In this article, we outline how emotions affect judgments and cognitive performance of human agents. We argue that affective influences are due, not to the affective reactions themselves, but to the information they carry about value, a potentially useful finding for creators of artificial agents. The kind of influence that occurs depends on the focus of the agent at the time. When making evaluative judgments, for example, agents may experience positive affect as a positive attitude toward a person or object. But when an agent focuses on a cognitive task, positive affect may act like performance feedback, with positive affect giving a green light to cognitive, relational processes. By contrast, negative affect tends to inhibit relational processing, resulting in a more perceptual, stimulus-specific processing. One result is that many textbook phenomena from cognitive psychology occur readily in happy moods, but are inhibited in sad moods.

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Few questions are more enduring than those concerned with the relations between cognition and emotion. From the ancient Greeks through the enlightenment philosophers to the present day, people's optimism or pessimism about the human condition has often turned on their beliefs about the possibility of rational thought unswayed by emotion. Gradually, however, cognitive scientists are coming to view cognition and emotion as complementary rather than antagonistic processes. Inability to use affective information as a result of brain-damage has profoundly negative consequences for judgment and decision-making (Damasio, 1994). Conversely, expertise at using affective information seems to be associated with effective personal and social functioning (Mayer, Salovey, & Caruso, 2004).

Thus, although one might imagine that being unencumbered by emotion could be an advantage of artificially intelligent systems, that may turn out not to be the case. At least in humans, emotions appear to play critical roles in good judgment and in the adaptive regulation of thought and other cognitive processes, including attention, memory, and motivation. We focus in this article on what research has taught us about how affect guides the judgments or regulates the thought of human agents. We describe what we have learned about these processes from behavioral research. Although, developers of artificial systems may implement emotion differently than biological evolution has, it may nevertheless be useful to have a description of the emotion-relevant processing in biological systems. Additionally, treating affect as information, as we do, may be a useful assumption also in designing artificial systems.

An obstacle to studying emotion is the belief that it is difficult to define. However, moods and emotions can be usefully defined simply as "affective states." In this designation, the term

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“affective” applies to anything evaluative. The term “affect” can also be used more restrictively to refer to an embodied reaction of pleasure or displeasure that references the goodness or badness of something and of arousal that references its urgency or importance. The “states” part of the designation of moods and emotions as affective states applies whenever multiple systems of an organism reflect the same condition at the same time. Thus, when angry, for example, one not only has angry thoughts and angry feelings, but may also express anger in the face and body and in gestures, inclinations, and actions. Not all of these systems have to be involved, but a state requires more than one system. Thus, a useful characterization of emotion is that: *Emotion is a multi-system registration of the goodness or badness and importance of something*. The various specific emotion types, then, are representations of the particular ways in which something can be good or bad.

Actually, there are two components of affective reactions, and each conveys different information. Valence, the pleasantness or unpleasantness of affect, conveys information about value; whereas arousal, the exciting-calm dimension, conveys information about urgency or importance. Thus, affective reactions provide often compelling information about importance as well as about value (Clore & Schnall, 2005).

One might ask in what sense we can be informed by our own emotional reactions, since they are assumed to be self-generated. One answer is that, like many important psychological processes, those governing the evaluation of objects and events are largely unconscious. In many ways, people are “strangers to themselves” (Wilson, 2003), so that being informed by one’s feelings whether something good or bad has been encountered and whether it is important or trivial can be highly useful. Indeed, just as people tend to believe their sensory experience above all else, so too they find the self-generated experiences of affect compelling.

Psychologists now believe that the process of decision-making takes place largely unconsciously (Wegner, 2002). As a result, deciding explicitly often involves entertaining alternatives until one is visited by a feeling that a decision has been made. When ordering food from a menu or selecting a video to watch, one may entertain alternatives until one of them feels right. Decisions are therefore difficult when none of the alternatives feels right or when more than one alternative elicits such feelings. Making important decisions in the absence of an experience of rightness may be stressful. For couples considering marriage, for example, saying yes without feeling anything would surely be anxiety-provoking.

## Specific Emotions

In addition to feeling positively or negatively, however, people’s experience of affect is also modified by the nature of the situation in which such affective reactions occur. Specific emotions, like fear, anger, or embarrassment, are representations of particular kinds of negative affect (Barrett, 2006; Clore & Ortony, 2000). Thus, fear is negative affect in the face of threat, anger is negative affect in the face of insult or injustice, and embarrassment is negative affect occasioned by violating behavioral norms. Such specific emotions thus convey situational as well as affective information, which may further direct motivation and constrain action. For such reasons emotions and the ability to read emotions are critical ingredients in making agents believable and hence in eliciting natural responses from people interacting with or observing computer agents.

We describe research that examines two kinds of cognitive effects of emotion—effects on judgment and decision-making on the one hand and effects on information processing or styles of thinking on the other. We generally refer to these as “judgment effects” and “processing effects.” We examine judgment effects first.

## Affect in Judgment

There is a long history of scholarly and empirical study of judgment and decision-making. Traditionally, many judgment and decision theorists focused on how people combine information about objects of judgment (e.g., Anderson, 1971). It was assumed that judgments reflected evaluative beliefs about the attributes of objects. In a similar way, attitude theorists assumed that attitudes are based on a combination of the evaluative implications of beliefs about objects of judgment (e.g., Fishbein & Ajzen, 1975).

However, research emerged showing that such judgments could be affected by the mood that the judge happened to be in at the time (e.g., Bower, 1981; Clore, 1975). These studies raised the question of how such results might be assimilated into the traditional view that judgments necessarily reflect the attributes of objects of judgment. The initial answer was that mood might bias the sample of beliefs accessed to make the judgment. It was assumed on the basis of a spreading activation model of memory (e.g., Collins & Loftus, 1975) that moods might activate mood-congruent material in memory, resulting in judgments that reflect a biased sample of mood-congruent attributes from memory (Bower, Montiero, & Gilligan, 1978; Forgas, 1995; Isen, Shalke, Clark, & Karp, 1978).

### Affect-as-Information

Another explanation, which we prefer, is that instead of acting indirectly by first activating judgment-relevant attributes in memory, affect can serve directly as information to the judge about his or her evaluative reaction to the object of judgment (Schwarz & Clore, 1983). Research suggests that in many situations, people make evaluative judgments essentially by asking themselves, "How do I feel about it?" (Schwarz & Clore, 1988). Consider, for example, how people evaluate whether they like the food they are eating in a restaurant. When one finds oneself eating lasagna, for example, does the system look up the value of lasagna in memory to determine liking? Does the system essentially say, "I am eating lasagna, I know from memory that I like lasagna, therefore I like my dinner?" Robots might be designed to take such an approach, but humans and other embodied agents may be more likely to taste the food and use the subjective experience of pleasure or displeasure directly as the answer to the question. Of course, the experience of liking depends on attributes of the dish, including its ingredients and its execution. Moreover, noting that the lasagna looks fresh, tastes of basil, and is al dente may amplify one's enjoyment. However, ultimately the evaluation is in the eating, not in the knowing. This is the sort of process envisioned for all kinds of evaluative judgments by the "affect-as-information" approach (Clore, et al, 2001; Schwarz & Clore, 2007). The basic assertion is simply that one function of affective reactions is to serve as information about what one likes or dislikes or values positively or negatively. This explanation assumes that just as affective expressions inform us about others, our own affective feelings and subjective experiences inform us about ourselves.

A variety of experiments have been conducted by psychologists on the role of affect in judgment and decision-making. A standard technique to satisfy the requirements of good experimental design is to randomly assign participants to different groups and then to induce moods or emotional states in different groups to determine their influence. In this section, we describe three sample experiments from our lab that examine how affect influences different kinds of judgments.

### Emotion and Well-being

The operating heuristic when using affect to make evaluative judgments is that, "If it feels good, it is good." A defining experiment for this idea was done some years ago (Schwarz & Clore, 1983). It involved telephoning respondents living in the American Midwest either on

the first warm and sunny days of early Spring or on one of the cold and rainy days that followed. Other research had shown that unseasonably sunny days tend to elevate people's moods, whereas people tend to find unseasonably cold and rainy days a bit depressing. The weather thus served as a source of affective cues that might not always be correctly attributed to their true source. Indeed, it was hypothesized that without a salient source, affective cues tend to be linked to whatever is in mind at the time. Consistent with this reasoning, respondents both reported being in better moods and also being more satisfied with their life as a whole on sunny days than on rainy ones. Moreover, when some people were first asked directly about the weather, thus linking their feelings to their true cause, the effects of weather on judgment of life satisfaction disappeared.

This last procedure provided critical evidence for the affect-as-information position. Judgments were found to reflect mood only when such background feelings were associated with deliberations about life satisfaction. The effect went away when weather was made salient as the true cause of the feelings. This implicit attribution of feelings to the weather did not change the feelings themselves, but their diagnostic value for determining how respondents felt about their life as a whole. The results thus suggest that we are informed by our affect, even though we produce it ourselves. Moreover, rather than being reflex-like, these affective influences depend on their apparent meaning, which can sometimes be altered by simple cognitive manipulations, such as that involved in directing attention to the weather. Thus, affective influences are due, not to the affect itself, but to its information value.

Is this process unique to judgments of such amorphous things as life satisfaction or does it operate also on evaluations about which people have more fixed ideas? For example, what about something like moral judgments?

### Disgust and Moral Judgment

In a series of experiments (Schnall, Haidt, & Clore, in press), we examined people's judgments about the morality of various behaviors as described in standard moral vignettes. To determine the role of emotional factors in such moral reasoning, we induced the emotion of disgust (which had been hypothesized to have a special relationship to moral judgment). One of these experiments was conducted in a room arranged in a manner designed to induce disgust. For example, participants sat at a table that was sticky with dried, spilled food, next to a trash can overflowing with old pizza boxes and other garbage, and they were given a chewed up pencil to make their ratings. The experimenter apologized that due to space limitations, they had been assigned to use such a work place. This comment helped ensure that the emotion induced was only disgust and not also anger or negative affect toward the experimenter. Participants in a control condition worked at the same table with a clean table cloth in the same room after it had been cleaned.

An example of the moral vignettes (Greene, Sommerville, Nystrom, Darley, & Cohen, 2001) is as follows:

You are at the wheel of a runaway trolley quickly approaching a fork in the tracks. On the tracks extending to the left is a group of five railway workmen. On the tracks extending to the right is a single railway workman. If you do nothing the trolley will proceed to the left, causing the deaths of the five workmen. The only way to avoid the deaths of these workmen is to hit a switch on your dashboard that will cause the trolley to proceed to the right, causing the death of the single workman. How wrong is it for you to hit the switch in order to avoid the deaths of the five workmen?

The point of these elaborate preparations was to induce feelings of disgust that might be experienced as reactions to the various morally ambiguous behaviors that participants were asked to consider. To ensure that whatever effects occurred really reflected the experience of

disgust rather than simply the idea of disgust, we used a standard personality measure (of body consciousness) to assess the degree to which participants habitually paid attention to their own bodily responses. We found that the individuals in the disgusting room condition, who also tended to pay attention to their own bodily responses, perceived the actions described in the vignettes to be more immoral than those experiencing the clean room and those reporting that they tended not to focus on their own bodily responses. We assume that the effect was due to respondents who implicitly attributed or associated their visceral reaction of disgust as reactions to the prospect of engaging in the morally ambiguous actions. In this and related experiments it was apparent that participants used their own momentary feelings to make moral judgments. The results are thus consistent with the famous proposal of the philosopher David Hume in 1777 in which he said that, "Morality is more properly felt than judged" and that, "Reason is, and ought to be, the slave of the Passions." The idea more recently proposed by Haidt (2001) is that moral reactions are a matter of intuition and emotion, and that moral reasoning may come after a moral judgment has already been made on the basis of intuition and emotion.

### Emotion and Perception of Physical Space

Of course, there are no correct answers to questions about one's well being or about morality. Would affect influence judgments of objective physical reality in the same way? A series of recent studies provides a surprising answer (e.g., Riener, Stefanucci, Proffitt, & Clore, 2003). In these studies, people were asked to stand at the bottom of a hill on the University of Virginia campus and to judge how steep the hill was. To examine the influence of affective factors, we asked them to make their judgments while listening on headphones to music chosen to be either cheerful and upbeat or slow and sad. We had previously determined that the music tended to alter people's momentary moods. As a result they experienced either positive or negative affect as they made their judgments of the hill.

Participants made their judgments either verbally, visually using a kind of protractor, or haptically using a palm board, which they adjusted (without looking at the board) to whatever angle seemed to match the incline. The results showed that the individuals feeling sad when they made their estimates saw the incline as steeper than those who felt happy or who were feeling nothing in particular. Overestimation of the incline was, moreover, about the same as shown in an earlier experiment when people judged the hill wearing a backpack loaded to equal twenty per cent of their body weight (Bhalla & Proffitt, 1999). People thus seem to have experienced their sadness as a burden, which tended to make mountains out of molehills.

The larger context of this research is work by Proffitt (2006) in which the perception of distance and slant reflect available physical resources. Our results are similar to those from individuals exhausted by exercise and from elderly individuals. All tend to show the same kinds of overestimates as shown by the participants in sad moods. Although the induced sad mood was not valid information about the hill, the results of this particular study may not have involved misattribution. Feeling sad for whatever reason could be thoroughly valid information about one's resources for coping with the steepness of the hill. Relative to a person feeling fit and energetic, a person feeling sad and depressed probably should indeed find the hill challenging.

It is important to note that the effect of resources on estimates of slant emerge on the verbal and visual measures, but not on the haptic or palm board measure. Proffitt (2006) sees the verbal and visual measures as tapping a different aspect of the perceptual system than the haptic measure. The verbal and visual measures are believed to reflect activity in the visual pathway sometimes called the "What" stream (Goodale & Milner, 2004), which might govern such decisions as whether or not to climb a hill. But the haptic measure is believed to tap a part of the system sometimes called the "how" stream, which might, for example, govern actions such as how big a step to take when climbing the hill.

This research was pursued further by asking what would happen if the hill were estimated from the top by Stefanucci (e.g., Stefanucci, Proffitt, & Clore, 2005). Instead of inducing sad moods, she induced low levels of fear by having the participants at the top of the hill stand on a skateboard. Control participants stood on a stable platform, which was the same height as the skateboard. She found that fear also increased estimates of the incline of the hill. Again, perception of incline measured verbally and visually showed the effects of emotion, but perception tapped by the haptic measure remained accurate. It was speculated that it might be adaptive to use cues of danger and limited resources when deciding whether to descend or ascend a hill, but that the control of actual motor movements should probably be as accurately calibrated as possible. Summary. In this section, we discussed the nature of moods and emotions and argued that they play important and largely adaptive roles when they influence the judgments of intelligent agents. They do so, we suggested, not necessarily by influencing what information is retrieved from memory, but by serving themselves as a source of embodied information about value. Specifically, *pleasant feelings signify positive attributes and events, and unpleasant feelings are taken to signify negative attributes and events.* We also reviewed several experiments in which we found (1) that feeling happy in the moment led to judgments of greater life satisfaction, (2) that feeling disgust led to judgments that certain behaviors were more immoral, (3) that feeling sad made people see hills as steeper when judged from the bottom, and (4) that feeling fear made the hills seem steeper when viewed from the top.

## Affective Montage

We have stressed that the pervasive effects of emotion on judgment are not obligatory, but that they reflect the evaluative information people derive from them. As a result, the impact of emotion depends on how people parse their own subjective experience. The *Affective Montage Principle* (Clore et al, 2001) reflects the fact that affect tends to be experienced as a reaction to whatever is currently in mind. This fact was appreciated years ago by a filmmaker named Kuleshov in revolutionary Russia. He did an interesting experiment which gave rise to the Soviet montage film theory of the 1920's. In his experiment, viewers saw the relatively expressionless face of a well known Russian actor followed by images either of a bowl of soup, a child with a teddy bear, or a woman in a coffin. Kuleshov found that what viewers saw in the actor's face depended on the context provided by the images that followed it. The actor appeared hungry when followed by an image of a bowl of soup, but as filled with joy when followed by the image of a child with a teddy bear, and as sorrowful when followed by the image of a woman in a coffin (for a related modern experiment, see Wallbott, 1988). He concluded that editing rather than performance is the basis of the emotional impact of film on audiences.

For the events in our own movie theater of the mind, we ourselves are the audience. But just as with other audiences, our emotions depend largely on the editing of the events we experience, and that is also the point of the affect-as-information hypothesis (e.g., Clore, et al, 2001).

Returning to our research on affective influences, we can see the montage principle at work. When forming evaluative judgments, we may experience our affect as a reaction to the object of judgment. But the same feelings can have very different effects when experienced in the context of a performance goal as opposed to a judgment goal. We turn next to research on the consequences of emotion in such performance situations. This transition illustrates a principle that should be important in the design of emotionally believable agents; namely, that *emotions and their effects are situated and contingent on the focus of attention and goals of the agent involved.*

## Affect and Cognitive Processing

We have suggested that the information value of affect depends on the focus of attention at the time that it is experienced. Thus, positive feelings that might be experienced as feelings of liking when one is focused on a person, might be experienced as feelings of efficacy when one is focused on a task. In this section, we review the role of affect in regulating cognitive performance. In general, we find that with a task focus, happy mood leads to a global focus and top-down processing, whereas sad mood leads to a local focus and bottom-up processing. The idea is that positive affect confers value on one's current thoughts and inclinations and people tend to focus globally rather than locally (a phenomenon known as the "global superiority effect"). By contrast negative affect may inhibit this tendency if experienced as task difficulty or as negative feedback about the adequacy of current expectations and inclinations. This hypothesis was tested by examining the role of affect in a number of standard cognitive psychological phenomena. One of these was schema-guided memory.

### Schema-guided Memory

In 1932, a Cambridge University psychologist named Bartlett (1932) published a book entitled *Remembering* in which he proposed a theory of constructive memory. He claimed that memory was not like a recording or a photograph that can be replayed or retrieved at a later time, but rather that memories are constructed at the time of remembering. He studied the process using a method resembling the childhood game of Gossip, in which initial information becomes unwittingly modified as it is passed along in a group. Using this "method of successive reproduction," Bartlett showed a drawing of an African shield, which bore the title "Portrait of a man." He asked some students to study the drawing and then draw it from memory. That reproduction was then shown to others who studied it and drew it from memory. Their reproductions were studied and recalled by a third group, and so on. After half a dozen successive reproductions, the drawing looked nothing like the original, but very much like a portrait of a man. He concluded that the schema of a man's face, which had been suggested by the title, had been used to reconstruct what had been seen. He reasoned that this process is typical of how we remember anything; namely, by constructing rather than retrieving what we have experienced.

In a repetition of this experiment, moods were induced by having participants write at length about a happy or sad experience in their recent past (Gasper & Clore, 2002). The results showed that individuals in happy moods, but not those in sad moods, showed the same effects as Bartlett's undergraduates in 1932. That is, the successive reproductions of the drawing of an African shield by those who had written about a happy event developed into drawings of a face of a man. The reproductions by those who had written about a sad event were significantly less likely to resemble a face, as judged by independent raters blind to condition. These results suggest that positive affective cues validated and negative cues inhibited people's tendencies to use accessible concepts to guide their memory reconstructions.

### Global-Local Perception

The previous results imply that positive affect promotes a focus on the forest and negative affect a focus on the trees. A second experiment (Gasper & Clore, 2002) tested this hypothesis by examining mood effects on a test of global-local perception. In the test (Kimchi & Palmer, 1982), participants view triangular or square geometric shapes made of smaller triangles and squares. For a given target figure, respondents indicate which of two comparison figures is most similar. For example, three squares in an overall triangular arrangement, could be viewed either globally as a triangular shape or locally as a collection of squares. A series of such choices constitute a measure of a person's inclination to adopt a global or a local perceptual focus.

Participants responded to the perception task after writing for ten minutes about a happy or sad event in their recent past. The results showed that individuals in happy moods made more global choices than those in sad moods, confirming the hypothesis that positive affect promotes a big picture view and negative affect a more detailed view.

## Explanations

What explains this influence of happy and sad affective cues on global-local perception? Is the connection between positive affect and global focus a direct one, perhaps reflecting a common neurological address for the two processes? Many of the effects of mood on cognitive processing would be compatible with such an idea. However, we suspect that it is a psychological rather than an anatomical relationship. Affect appears to act as a sort of mental traffic light, in which flashes of happy affect give a green light to current cognitive content and inclinations, whereas flashes of sad affect tend to inhibit reliance on self-generated responses, leaving a more conservative, stimulus-bound responding (Clore & Huntsinger, in press). If so, then, positive affect might promote global attention because it is a default strategy (the “global superiority effect” referred to previously).

Many of the cognitive influences of positive affect can be seen as the promotion or maintenance of already dominant response tendencies. For example, positive affect has been shown to promote, and negative affect to inhibit, many kinds of category-level responses, such as the reliance on schema and category-guided memory (Bless, Clore, Golisano, Rabel, & Schwarz, 1996; Storbeck & Clore, 2005). Another example is a tendency for positive affect to facilitate the use of accessible stereotypes when people form impressions of others (e.g., Bodenhausen, Sheppard, & Kramer, 1994; Isbell, 2004). Do such findings indicate that affective cues dictate a specific processing agenda, such as global versus local attention? Alternatively, does the affective tuning of cognition that we observe operate at a more general level, such as by promoting or inhibiting whatever responses happen to be dominant in a particular situation or for a particular person? Two sets of experiments have recently been done to address this issue.

One of the experiments focused on the relation between mood and stereotype use and the other focused on the relation between mood and global-local responding. In the first (Huntsinger, Sinclair, Dunn, & Clore, 2007), individuals were selected who were unusual in their tendency to respond to outgroups in an egalitarian manner, individuals known in the literature as “chronic egalitarians.” Contrary to the usual effect, happy moods decreased and sad moods tended to increase the use of stereotypes in these highly egalitarian individuals. Instead of leading to global processing and stereotype use, happy mood appeared to give a green light to whatever response was already dominant, which in the case of chronic egalitarians, involved individuated rather than category-level responding.

A second experiment (Clore & Bar-Anan, 2007) also focused on this general question. In it, participants in happy or sad moods took a test of global-local perception (Navon, 1977). However, before the test proper, these individuals were exposed to a series of priming trials designed to make either global or local responses dominant. Under those conditions, rather than always leading to global responses, positive affect tended to increase, and negative affect tended to decrease, whatever response had been made dominant by the priming procedure. Again, it appeared that the proper model for understanding the influence of affect on cognitive processing might be one in which *positive affective information provides a green light and negative affective information provides a red light for currently activated thoughts and inclinations.*

Before proceeding, we should note that anger turns out to have the same effects as happy mood (e.g., Bodenhausen, et al 1994), which would seem to qualify the above generalization. However, from an affect-as-information perspective, the critical factor is not the affect, but its



information value. Although anger is usually considered a negative emotion, it can produce relational processing, because, like happiness, it confers positive value on one's own perspective. That is, anger makes one confident in one's correctness.

### **Affect and the Cognitive Revolution**

The cognitive revolution of the 1960's and 70's was based on the realization that participants in experiments typically go "beyond the information given" by experimenters (Bruner, 1957). That is, people relate incoming information to what they already know, responding to stimuli as interpreted through activated knowledge structures. Perception and cognition exist in a cycle (Neisser, 1976) such that in addition to perceptual information informing cognition (bottom up processing), cognition also selects and interprets perceptual information (top down processing). Everyday functioning is a seamless interplay of such assimilation and accommodation (Piaget, 1954).

Our research suggests that affect is one factor governing the tipping point between these two processes. Affect thus serves a regulatory or *cognitive tuning* function (Clore, et al, 2001; Schwarz & Clore, 2007). A rough heuristic is that such affective feedback acts like a switch between cognition and perception. Positive affective cues promote cognitive, relational processing in which incoming information is related to existing knowledge, whereas negative affect leads to a more perceptual, stimulus-bound focus.

In the previous section, we characterized positive affect as giving a green light to whatever response was dominant. We then noted that the message of the cognitive revolution was that people's dominant response is to engage in cognitive, relational processing. Hence, the empirical generalization that happy processing is cognitive and sad processing is perceptual (Clore & Storbeck, 2006) is compatible with the interpretation of affective cues as conferring value on accessible cognitions and inclinations (Clore et al, 2001).

There is now a substantial literature on the influence of affect on cognitive processing (see Schwarz & Clore, 2007 for a review). Some of these studies have examined affective influences on classic phenomena from the history of cognitive psychology. These studies show that cognitive phenomena are generally promoted by positive affect and disappear or are reduced when people are sad (Bless, 2001). These include semantic priming (Storbeck & Clore, in press), schema-based memory (Bless, et al, 1996), stereotyping (Bodenhausen et al, 1994), false memory effects (Storbeck & Clore, 2005), and the global superiority effect (Gasper & Clore, 2002), among others. The phenomena appear to depend on being happy, or at least not being sad. The ironic conclusion is that many of the textbook phenomena that defined cognitive psychology appear to depend on affect. That is, they occur when people are feeling happy, but not when they are feelings sad. Since most people, even in their resting state, report being at least slightly happy (Diener & Diener, 1996), these phenomena are easily obtained. But one might speculate that, in a sense, the cognitive revolution had an affective trigger. Indeed, these findings led one questioner to ask, only partly in jest, whether the cognitive revolution, which occurred during the happy 1960's, would ever have happened if the same experiments had been conducted in the depression of the 1930's.

### **Potential for Application**

Affective influences depend on the information conveyed by affect in a particular situation. As a result, any compelling affective cue should have similar effects regardless of whether a mood or emotion is experienced. For example, rapid unconscious exposure to smiling or frowning faces can have the same effects as happy and sad mood (Clore & Colcombe, 2003). Similarly, such effects have also been found for incidental smiles in comparison with neutral and angry expressions by individuals shown on computer monitors as part of a task (Ottati,

Terkildsen, & Hubbard, 1997). This fact might conceivably be useful in the design of tutorial programs, for example, in which one might have an avatar smile or display other positive affective cues for the purpose of eliciting relational processing in students. Individuals exposed to such positive affective cues might then enjoy the benefits of the processing styles fostered by positive affect. These might include enhanced tendencies to take a big picture perspective, to access prior knowledge, and to entertain creative ideas.

Ultimately the range of cognitive consequences of affective cues depends on the specific information derived from them. That, in turn, depends on how such information is constrained. Examples of two important kinds of constraints on the applicability of the information from affect can be seen in Table 1. It shows four kinds of affective conditions -- emotions, moods, attitudes, and temperaments. According to the table, these affective conditions can be differentiated with respect to the constraints on their applicability imposed by temporal and object characteristics. That is, affect sometimes has a salient object and sometimes it does not, and some affective conditions exist only when activated, whereas some can also exist as latent dispositions to react. For example, emotions and moods are both states, meaning that they exist only in the present, whereas attitudes and temperaments are dispositions rather than states, meaning that they are not constrained by time. Thus, one can have an attitude toward a political candidate regardless of whether one is currently thinking about the candidate or not, whereas one may experience an emotion of anger only as long as one is currently focused on the angering action. Similarly, moods are temporary, whereas temperament continues to exist across time. However, neither moods nor temperaments have salient objects, and being unconstrained by being about something specific, they can both have wide applicability. Most of the research we have discussed employed mood manipulations as a source of affective cues unconstrained by a specific object, which had the advantage for research purposes that they could easily be misattributed to sources other than their true cause.

As implied in Table 1, affect can be powerful in two different ways, including by being constrained by an object, as in an emotion, or by not being constrained by an object, as in a mood. The difference is illustrated in psychotherapy, where a common goal is to turn moods into emotions. For example, when an individual reports a general mood of depression, a therapist might attempt to learn what the depression is in response to. If the therapist is successful in uncovering the object of the depression, doing so will have changed it from a diffuse mood state to a specific emotion, with the result that the client can begin to engage in problem-focused coping, rather than simply trying to suppress the feelings, a common technique for engaging in emotion-focused coping.

In a similar vein, it is often the case that victims of trauma benefit greatly from talking to other people about their experience, rather than bottling it up. One reason that such communication may be beneficial is that the process of telling the story often has the effect of situating the affect to be relevant only to a particular time and place. As the emotions of trauma become constrained by time and place, their applicability to other stimuli becomes correspondingly more limited. If so, it can again be seen that the consequences of emotion depend on how its meaning is constrained by time and object.

A similar process can be seen in the Buddhist treatment for pain. A common practice is to have the individual focus directly on the pain and to describe both where and how it hurts in great detail. The result is that although the pain itself is not lessened, it becomes less likely to cause the same general distress as it otherwise might, because the process of localizing it constrains its relevance.

Other procedures for altering the constraints on affective experience are evident in the practice of meditation. In some forms of meditation one might begin by focusing on a flower or a candle

or some other object of beauty, for example. Although the process begins with a specific focus, the goal is often to become detached from such worldly objects so that one can meditate on beauty or truth or love itself, unconstrained by any particular form. The goal is thus the opposite of that involved in the therapy for pain. Rather than limiting the affect to be about one very specific time and location, during meditation, one seeks to transcend such limitations in order to participate in unconstrained beauty, truth, love, or some other virtue. Since God is often characterized by consisting of absolute truth, beauty, and love, the meditation can therefore be seen as having religious or spiritual significance.

In these examples, we have attempted to illustrate that the power of affect and emotion depends on how it is constrained with respect to time and object. From these examples, it appears that people and other believable intelligent agents may tend to act in order to constrain the information from whatever negative affect they experience, but act to get rid of constraints on the information from their positive affect.

## Summary

This article reviewed behavioral research from the affect-as-information perspective on how affect influences judgment and cognitive processing in biologically intelligent agents. Mood and emotional influences occur, we argued, because affective cues carry information about value. If so, artificially intelligent agents might benefit from some of the advantages of emotion without a similar biological basis. We argued that in contrast to traditional theories of judgment and decision-making, many evaluative judgments are made simply by asking oneself, "How do I feel about it?" Research examines such effects by inducing temporary mood states, for example through music or film segments. Whether such inductions have an influence depends on whether individuals implicitly attribute their affective reaction to the object of judgment, indicating that it is the information conveyed by the affect about the value of the object rather than the affect itself that is responsible.

In addition to influencing a variety of kinds of judgments, such induced moods and emotions also serve to regulate cognitive processing. When an agent is focused on a cognitive task, affect may influence the apparent value of one's current orientation to the task. Thus, positive affective cues essentially give a green light to accessible thoughts and dominant cognitive responses, whereas negative affect tends to inhibit such responses. In various cognitive and perceptual tasks, happy moods were found to promote a global focus and sad mood to lead to a more local focus. Such patterns were found in research on memory, perception, and stereotyping tasks. Subsequent studies suggested that, rather than a direct connection between affect and level of focus, positive affect empowers any response that is naturally dominant or is experimentally made to be dominant momentarily through priming procedures.

Research during the cognitive revolution in psychology showed that, rather than responding directly to stimuli as presented, people's default tendency is to cognitively transform incoming stimuli using their expectations and knowledge. Positive affect empowers such an approach, leading to relational, global, or category focused processing. Negative affect reduces such tendencies, leading to more perceptual, local, or item-level processing. As a result, many of the textbook phenomena of cognitive psychology occur readily when in happy moods, but only in reduced form or not at all in sad moods. We suggested that, perhaps ironically, the phenomena on which the cognitive revolution in psychology was based thus appear to have an affective trigger. Finally, we noted that the breadth of impact of affective information is ultimately governed by how such information is constrained. Four affective conditions -- emotion, mood, attitude, and temperament -- were distinguished with respect to whether their affective information is constrained in its applicability by having an object (emotions, attitudes) or not (moods, temperaments), and by whether it is active only during a current state (emotions

and moods) or persists as part of a latent disposition (attitudes, temperaments). We suggested that intelligent agents generally tend to seek to constrain or limit the applicability of negative affective information but to unconstrain or make more general the implications of positive affect.

## References

- Anderson NH. Integration theory and attitude change. *Psychological Review* 1971;78:171–206.
- Barrett LF. Emotions as natural kinds? *Perspectives on Psychological Science* 2006;1:28–58.
- Bartlett, FC. *Remembering: A Study in Experimental and Social Psychology*. Cambridge: 1932.
- Bhalla M, Proffitt DR. Visual-motor recalibration in geographical slant perception. *Journal of Experimental Psychology: Human Perception and Performance* 1999;25:1076–1096. [PubMed: 10464946]
- Bless H, Clore GL, Golisano V, Rabel C, Schwarz N. Mood and the use of scripts: Do happy moods really make people mindless? *Journal of Personality and Social Psychology* 1996;71:665–678. [PubMed: 8888596]
- Bodenhausen GV, Sheppard LA, Kramer GP. Negative affect and social judgment: The differential impact of anger and sadness. *European Journal of Social Psychology* 1994;24:45–62.
- Bower GH, Monteiro KP, Gilligan SG. Emotional mood as a context of learning and recall. *Journal of Verbal Learning and Verbal Behavior* 1978;17:573–585.
- Bruner, JS. Going beyond the information given. In: Bruner, JS.; Brunswik, E.; Festinger, L.; Heider, F.; Muenzinger, KF.; Osgood, CE.; Rapaport, D., editors. *Contemporary approaches to cognition*. Cambridge, MA: Harvard University Press; 1957. p. 41-69.
- Clore GL, Bar-Anan Y. Feeling Sad and Thinking Small: Affective regulation of global focus. *Society of Personality and Social Psychology, Memphis*. 2007 Feb 2, 2007;
- Clore, GL.; Colcombe, S. The parallel worlds of affective concepts and feelings. In: Musch, J.; Klauer, KC., editors. *The psychology of evaluation: Affective processes in Cognition Emotion*. Mahwah, NJ: Erlbaum; 2003. p. 335-369.
- Clore GL, Huntsinger J. Feelings as information for judgment and cognitive processing. *Trends in Cognitive Science*. in press
- Clore, GL.; Schnall, S. The Influences of Affect on Attitude. In: Albarracín, D.; Johnson, BT.; Zanna, MP., editors. *Handbook of attitudes and attitude change: Basic principles*. Mahwah, NJ: Erlbaum; 2005. p. 437-490.
- Clore, GL.; Storbeck, J. Affect as information about liking, efficacy, and importance. In: Forgas, J., editor. *Affect in Social Thinking and Behavior*. New York: Psychology Press; 2006. p. 123-142.
- Clore, GL.; Wyer, RS.; Dienes, B.; Gasper, K.; Gohm, C.; Isbell, L. Affective feelings as feedback: Some cognitive consequences. In: Martin, LL.; Clore, GL., editors. *Theories of mood and cognition: A user's handbook*. Mahwah, NJ: Erlbaum; 2001. p. 27-62.
- Collins A, Loftus E. A spreading activation theory of semantic memory. *Psychological Review* 1975;82:407–428.
- Damasio, AR. *Descartes' error: Emotion, reason, and the human brain*. New York: Avon; 1994.
- Diener E, Diener C. Most people are happy. *Psychological Science* 1996;7:181–185.
- Fishbein, M.; Ajzen, I. *Belief, attitude, intention and behavior*. Reading, MA: Addison-Wesley; 1975.
- Forgas JP. Mood and judgment: The Affect Infusion Model. *Psychological Bulletin* 1995;117:39–66. [PubMed: 7870863]
- Gasper, K. How thought and emotional awareness influence the role of affect in processing: When attempts to be reasonable fail, Doctoral dissertation. University of Illinois; Urbana-Champaign: 1999.
- Gasper K, Clore GL. Attending to the big picture: Mood and global vs. local processing of visual information. *Psychological Science* 2002;13:34–40. [PubMed: 11892776]
- Greene JD, Sommerville RB, Nystrom LE, Darley JM, Cohen JD. An fMRI investigation of emotional engagement in moral judgment. *Science* 2001;293:2105–2108. [PubMed: 11557895]
- Goodale, MA.; Milner, AD. *Sight Unseen: An exploration of conscious. and unconscious vision*. Oxford: Oxford University Press; 2004.

- Haidt J. The emotional dog and its rational tail: A social intuitionist approach to moral judgment. *Psychological Review* 2001;108:814–834. [PubMed: 11699120]
- Huntsinger, JR.; Sinclair, S.; Dunn, E.; Clore, GL. When intergroup bias feels right (or wrong). University of Virginia; 2007. Unpublished manuscript
- Isbell LM. Not all happy people are lazy or stupid : evidence of systematic processing in happy moods. *Journal of Experimental Social Psychology* 2004;40:341–349.
- Isen AM, Shalcker TE, Clark M, Karp L. Affect, accessibility of material in memory, and behavior: A cognitive loop? *Journal of Personality and Social Psychology* 1978;36:1–11. [PubMed: 621625]
- Kimchi R, Palmer SE. Form and texture in hierarchically constructed patterns. *Journal of Experimental Psychology: Human Perception and Performance* 1982;8:521–535. [PubMed: 6214605]
- Mayer JD, Salovey P, Caruso DR. Emotional intelligence: Theory, findings, and implications. *Psychological Inquiry* 2004;15:197–215.
- Navon D. Forest before trees: the precedence of global features in visual perception. *Cognitive Psychology* 1977;9:353–83.
- Ottati V, Terkildsen N, Hubbard C. Happy faces elicit heuristic processing in a televised impression formation task: A cognitive tuning account. *Personality and Social Psychology Bulletin* 1997;23:1144–1156.
- Proffitt DR. Embodied perception and the economy of action. *Perspectives on Psychological Science* 2006;1(2):110–122.
- Riener, C.; Stefanucci, J.; Proffitt, D.; Clore, GL. An effect of mood on perceiving spatial layout. *Vision Sciences*, Sarasota; Florida: 2003 2003 April.
- Schnall S, Haidt J, Clore GL. Irrelevant Disgust Makes Moral Judgments More Severe for Those who Listen to Their Bodies. *Personality and Social Psychology Bulletin*. in press
- Schwarz N, Clore GL. Mood, misattribution, and judgments of well-being: Informative and directive functions of affective states. *Journal of Personality and Social Psychology* 1983;45:513–523.
- Schwarz, N.; Clore, GL. How do I feel about it? The informative function of mood. In: Fiedler, K.; Forgas, J., editors. *Affect, cognition, and social behavior*. Toronto: C. J. Hogrefe; 1988. p. 44-62.
- Schwarz, N.; Clore, GL. Feelings and Phenomenal Experiences. In: Higgins, ET.; Kruglanski, A., editors. *Social Psychology. A Handbook of Basic Principles*. 2. New York: Guilford Press; 2007.
- Stefanucci, J.; Proffitt, DR.; Clore, GL. Skating down a steeper slope: The effect of fear on geographical slant perception; Paper presented at the 5th Annual Meeting of the Vision Sciences Society; 2005.
- Storbeck J, Clore GL. With Sadness Comes Accuracy; With Happiness, False Memory: Mood and the False Memory Effect. *Psychological Science* 2005;16:785–791. [PubMed: 16181441]
- Storbeck J, Clore GL. The Affective Regulation of Cognitive Priming. *Emotion*. in press
- Wallbott HG. In and out of context: Influences of facial expression and context information on emotion attributions. *British Journal of Social Psychology* 1988;27:357–369.
- Wegner, DM. *The illusion of conscious will*. Cambridge, MA: MIT Press; 2002.
- Wilson, TD. *Strangers to ourselves: Discovering the adaptive unconscious*. Cambridge, MA: Belknap/Harvard Press; 2002.

**Table 1**

## Constraints on affective meaning

	<b>Current State</b>	<b>Chronic Disposition</b>
Object Salient	Emotion	Attitude
No Object Salient	Mood	Temperament