

Asymmetries in Affect-Laden Information Processing

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Prologue

The disciplinary pale of economics, my undergraduate major, was appealing in terms of its quantitative logic and formal proofs, but its emphasis on forecasting aggregate end products rather than on understanding underlying mechanisms was less so. The assumptions about rationality were demonstrably incorrect at the level of an individual's behavior, but it was possible that such irrationalities cancelled after aggregation or that aggregate behavior was characterized by emergent properties that were not explicable in terms of individual behavior. In any case, economic models were thought to predict aggregate social behavior reasonably well, and there were more important economic factors to study at that juncture. Nevertheless, the role of affect and cognition in rational and irrational social behavior intrigued me, and social psychology afforded an opportunity to study these processes and mechanisms.

At that point in its history, I discovered, the science of social psychology centered on reportable mental contents, even though most cognitive, affective, and social processes occur unconsciously, with only selected aspects reaching awareness. If the thoughts and processes people experience represent only a small subset of the structures and operations that needed to be explored and understood, then it seemed reasonable that principles and measures of the human brain and physiology could offer theoretical concepts and rigid constraints as well as an expanded set of manipulations and measures with which to explicate the mechanisms and processes of social behavior. Rather than a passive, dispassionate recorder and processor of information, the brain is a builder of meaning within a social context in ways sculpted by experience, personal and ancestral. There was an abyss between social and biological levels of analysis that needed to be bridged first, though, so parts of our early work were designed to help bridge this abyss.

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Disciplinary boundaries or favored paradigms never stopped Bill McGuire from seeking answers, and his example served as a beacon during dark times. Interdisciplinary research involving social scientists, cognitive scientists, and neuroscientists is now fairly common and is indeed advancing our understanding of phenomena in all three disciplines. I suspect we have only begun to see the benefits of reaching beyond the disciplinary pale for understanding complex social behavior, including economic behavior.

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Bill McGuire, throughout his illustrious career, has championed the view that the construction of mental contents is influenced by and fundamental to understanding the social as well as the perceptual world in which we live. The self-concept is not a summary statistic of objective features but a construction based on goals and social context (McGuire & Padawer-Singer, 1976). The inferences drawn from beliefs (e.g., syllogisms) are not coldly calculated conditional probabilities but a calculus shaped in part by wishful thinking (McGuire, 1981). In this chapter, I focus on McGuire's pioneering contributions to our understanding of how the human mind constructs a unique reality for each individual at each moment in time, with a special emphasis on asymmetries in affect-laden information processing.

Cognitive and Affective Asymmetries in Thought Systems

If one is asked to list all the characteristics that describe or do not describe Bill McGuire, most people would list more characteristics with less mental effort in the former case than in the latter even though there are more characteristics that do not than those that do describe Bill. This *cognitive* asymmetry exists because people are better able to think affirmationally than negationally. From an evolutionary biological perspective, the ability to discern what an organism is—whether a newcomer is hostile, a potential partner is solicitous, a potential ally is captious, or a child is dependent—is more important for reproductive success than is the ability to discern the innumerable characteristics that do not describe each. Small wonder that the brain evolved to preferentially process information about what a stimulus is rather than about what it is not.

McGuire and McGuire (1992) provide compelling evidence for this cognitive bias. They demonstrated, for example, that participants generated more thoughts when given the task of describing what a thought topic is than what it is not (Experiments 1–4)—indicating a positivity bias in thinking ability—and they preferred to describe a topic in terms of what it is rather than what it is not (Experiments 5–8)—suggesting a positivity bias in thinking proclivity.

Positive and negative *affective* asymmetries, in McGuire and McGuire's (1992) terminology, "concern whether people think more effectively about the desirable or the undesirable characteristics possessed or lacked by a topic of thought" (pp. 295–296). McGuire demonstrated an affective *negativity* bias in situations in which a person needs to cope with events in the external environment ("realistic thinking situations") and an affective *positivity* bias in sit-

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uations in which the person is more concerned with hedonic gratification in fantasy ("autistic thinking situations"). This work has contributed to our understanding of the antecedent conditions for the activation of positive and negative information processing and has helped create the foundation for asking broader questions about the architecture and operation of the affect system itself—a topic to which we turn next.

Affective Asymmetries: The Positivity Offset and the Negativity Bias

Affective discriminations have traditionally been conceptualized as being bipolar (hostile–hospitable) and have been measured using bipolar scales to gauge the net affective predisposition toward a stimulus. Such an approach treats positive and negative evaluative processes (and the resulting affective states) as equivalent, reciprocally activated, and interchangeable (Cacioppo & Berntson, 1994). Even though physical constraints may restrict behavioral manifestations to bivalent actions (approach–withdrawal), early behavioral theorists recognized that approach and withdrawal were behavioral manifestations that could come from distinguishable motivational substrates. Conflict theory was enriched by conceptualizing approach and withdrawal separately, investigating their unique antecedents and consequences, and examining the psychological constraints that typically led to the reciprocal activation of approach and withdrawal tendencies (e.g., Miller, 1961). Our understanding of affective asymmetries may similarly benefit from expanding the principle of reciprocal evaluative activation to accommodate the distinguishable activation of positive and negative evaluative processes, the investigation of their unique antecedents and consequences, and the examination of the psychological and physiological constraints that produce various modes of evaluative (e.g., reciprocal) activation.

We proposed an evolutionary model of affective processes in which a stimulus may vary in terms of the strength of appetitive evaluative activation (i.e., positivity) and the strength of defensive evaluative activation (i.e., negativity) it evokes (Cacioppo et al. 1997, 1999; Cacioppo & Berntson, 1994;). Although the representation of these separable processes along the bivariate plane in Figure 7.1 may look like the statistical dimensions from studies of the structure of affect, the dimensions in Figure 7.1 are entirely theoretical constructs. The model posits that positive and negative evaluative processes generally have antagonistic effects on a predisposition to respond, the net effect of which is mapped on the z-axis in Figure 7.1.

Whereas a bipolar model allows only for reciprocal activation between positivity and negativity (and hence is represented as the "reciprocal" diagonal on the bivariate plane in Figure 7.1), the evaluative space model (ESM) posits multiple modes of activation of these motivational substrates: (a) reciprocal activation occurs when a stimulus has opposing effects on the activation of positivity and negativity, (b) uncoupled activation occurs when a stimulus affects only positive or only negative evaluative activation, and (c) nonreciprocal activation occurs when a stimulus increases (or decreases) the activation

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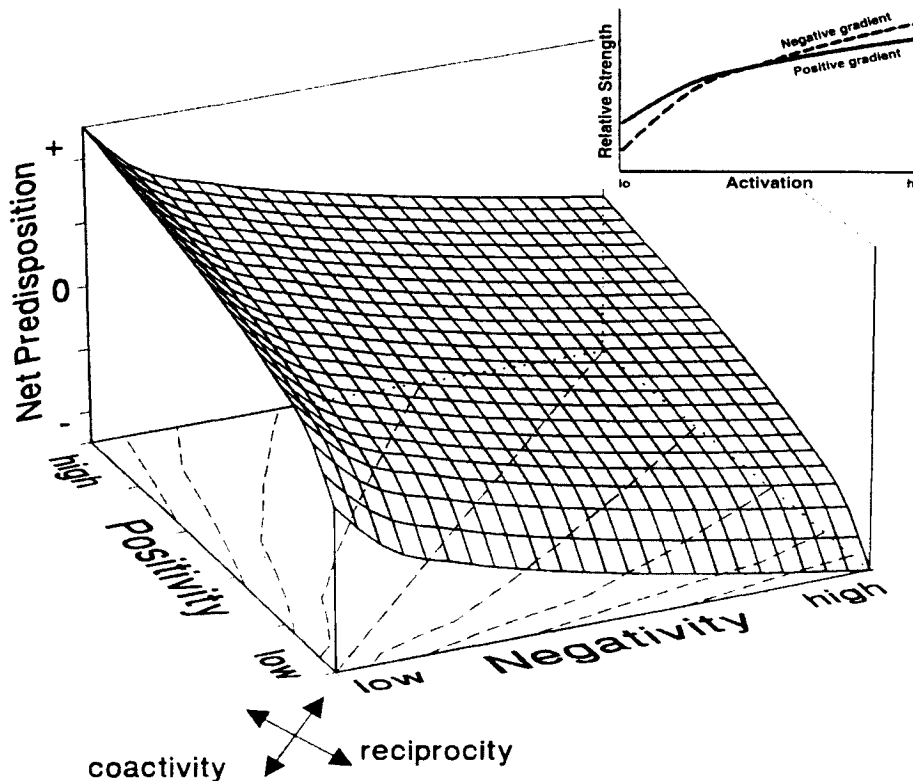


Figure 7.1. The evaluative space model (ESM). Activation functions are quantitative depictions of the output of a processor for zero to maximal levels of input. The ESM posits that two separable affective processors are activated by appetitive (positive) and aversive (negative) information, respectively. All combinations are possible through multiple modes of evaluative activation, so a two-dimensional plane is required to depict these processor states. The distinctive activation functions for positivity and negativity are highlighted in the inset. The outputs of these processors are combined to produce a net predisposition of an individual toward (+) or away from (-) the target stimulus. This is represented by the overlying surface. From "The Affect System Has Parallel and Integrative Processing Components: Form Follows Function," by J. T. Cacioppo, W. L. Gardner, and G. G. Berntson, 1999, *Journal of Personality and Social Psychology*, 76, 842. Copyright 1999 by the American Psychological Association. Reprinted with permission.

of both positivity and negativity (Cacioppo & Berntson, 1994). Accordingly, the ESM model of evaluative space does not reject reciprocal activation but rather subsumes it as one of the three possible modes of activation and explores the antecedents for each mode of evaluative activation *and* as the consequent behavioral predisposition (i.e., z-axis).

The model further posits that positivity and negativity are distinguishable (stochastically and functionally independent in specifiable circumstances), are characterized by distinct activation functions (positivity offset and negativity bias principles), are related differentially to ambivalence (corollary of ambivalence asymmetries), have distinguishable antecedents (het-

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eroscedacity principle), and tend to gravitate from a bivariate toward a bipolar structure when the underlying beliefs are the target of deliberation or a guide for behavior (principle of motivational certainty). The aspect of this model most germane here is the differential activation functions for the appetitive and defensive systems underlying affective predispositions and responses, so we turn to this feature in the remainder of this chapter.

Activation Functions

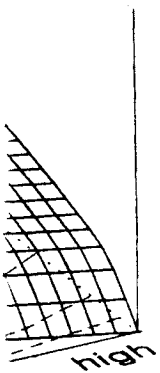
One consequence of incoming information being processed at least in part separately by appetitive and defensive systems is that evolutionary forces could sculpt different activation functions for these systems (i.e., "positivity" and "negativity"). We have suggested that these activation functions differ in several important ways, two of which are apropos to our understanding of affective asymmetries of the type highlighted by McGuire and McGuire (1992): (a) a *positivity offset*, by which we mean that the output of positivity is higher than the output of negativity at very low levels of affective input, and (b) a *negativity bias*, by which we mean the increase in output per quantum of input is greater for negativity than for positivity.

The *positivity offset* is the tendency for a weak positive (approach) motivational output at zero input, an intercept difference in affective activation. As a consequence of the positivity offset, the motivation to approach is stronger than the motivation to withdraw at low levels of evaluative activation (e.g., at distances far from a goal). The evolutionary significance of the positivity offset is understandable. Without a positivity offset, an organism in a neutral environment may be unmotivated to approach new objects, stimuli, or contexts. Such organisms would learn little about novel or neutral-appearing environments and their potential value or threat. They would also know little about the terrain when predator or prey appeared, decreasing their chances of survival. With a positivity offset, however, an organism facing neutral stimuli or environment would be weakly motivated to engage in exploratory behavior following the habituation of an initial neophobic response. Such a tendency has important survival value, at least at the level of a species.

Exploratory behavior can provide useful information about an organism's environment, but exploration can also place an organism in proximity to hostile stimuli. Because it is more difficult to reverse the consequences of an injurious or fatal assault than to return to an unpursued opportunity, the process of natural selection may also have resulted *ceteris paribus* in the propensity to react more strongly to negative stimuli than to positive. Termed the *negativity bias* (because it refers to the slope or gain of the activation functions), this heightened sensitivity to negative information is a robust psychological phenomenon. The positivity offset and negativity bias are apparent in the inset in Figure 7.1, which depicts the separate activation functions for positivity and negativity. Note that the intercept for the activation function for positivity is higher than the intercept for the activation function for negativity, whereas the slope for activation of negativity is steeper than the slope for the activation of positivity.

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These affective asymmetries may help explain the variations in the negativity and positivity biases noted by McGuire and McGuire (1992). For example, when people rate someone they do not know, they rate the person on the positive side of the scale's neutral point (Anderson, 1981). This is precisely what one would expect if the information presented about the target person was neutral. Such an effect may be based on the diagnosticity of neutral information or the morality or competence of the behaviors ("Don engages in normal behavior so he is probably ok"; cf. Skowronski & Carlston, 1989). Gardner (1996) examined whether diagnosticity was the critical feature by having participants rate either a hypothetical person (toward whom participants generally felt positive even without any information), an (imaginary) aguaphore fish (toward which participants generally felt neutral without any information), and an (imaginary) entophore insect (toward which participants generally felt negative without any information; see also, Cacioppo et al. 1997). Participants rated each after either receiving no additional information or neutral and nondiagnostic information (e.g., the person is susceptible to the laws of gravity; the entophore has six legs). Results indicated that the person, the aguaphore fish, and the entophore insect were each rated slightly more positively after deliberating about neutral and nondiagnostic information.

Evidence for the positivity offset and negativity bias has also been found in paradigms in which diagnosticity and morality or competence are irrelevant. The rating of triadic (p-o-x) structures consisting of oneself (p), another person (o), and a topic (x) as more pleasant, harmonious, stable, and expected when a positive link (attraction) exists between oneself and the other is consistent with the operation of a positivity bias, as is the finding that this effect emerges earlier than the agreement or balance effect (Cacioppo & Petty, 1981).

Note that the circumstances in which *negative* affective asymmetries were brilliantly observed by McGuire and McGuire (1992) involved significant affective activation, such as the effects of economic progress versus economic decline on electoral support for incumbents and the relative effects of gains versus losses. Inspection of the inset in Figure 7.1 confirms that it is just such circumstances in which an affect system should modulate information processing differently *ceteris paribus*, producing a greater weighting of negative than positive information.

Miller's (1961) research on rodent behavior provided some of the earliest evidence for a negativity bias and provides some evidence that this is a general behavioral process, as we would expect given the posited evolutionary heritage. Evidence supporting a negativity bias has been found in domains as varied as impression formation, person memory, blood and organ donation, personnel evaluations, and voting behavior and has been found to characterize the judgments of children as well as adults (Cacioppo & Gardner, 1999). Taylor (1991) summarizes a wide range of evidence showing that negative events in a context evoke stronger and more rapid physiological, cognitive, emotional, and social responses than neutral or positive events (see also Skowronski & Carlston, 1989).

Ito, Cacioppo, and Lang (1998) measured the positive and negative feelings evoked by 472 slides selected to represent the full affective space captured by the International Affective Picture System. Arousal ratings were

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used to index the intensity of the affective stimulus (which was plotted on the abscissa), and the unipolar positivity and unipolar negativity ratings were used to index the magnitude of the affective response (which were plotted on the ordinate). Analyses revealed that the intercept was significantly higher for ratings of positive stimuli than for negative (i.e., a positivity offset). Results also revealed that the slope of the regression line for the ratings of the negative stimuli was significantly steeper than the regression line for the ratings of the positive stimuli (i.e., the negativity bias). Said more simply, positive stimuli have a greater impact than negative stimuli at comparably low levels of activation, but the opposite is the case at equally high levels of activation.

To assess the generalizability of this effect across stimulus items, Ito, Larsen, Smith, and Cacioppo (1998) replicated the regression analyses using 620 words—verbs, nouns, adverbs, and adjectives—from the Affective Norms for English Words database, and we subsequently conducted similar analyses on the 555 trait adjectives from Anderson (1965). As predicted by the ESM, evidence for a positivity offset was found in that the most neutral positive words were judged slightly but significantly more extreme than the most neutral negative words, and evidence for a negativity bias was found such that the slope of the evaluatively negative words was steeper than the slope of the evaluatively positive words. The human mind treats hedonic information differently when constructing a representation of the world within an ecological niche because, at least in the long run, doing so has adaptive advantage over depicting reality objectively.

Evidence From Social Neuroscience

One of the core predictions of the ESM is that appetitive and aversive information are processed separately at the earliest stages of hedonic information processing and are combined to produce a more integrated guidance in the form of a predisposition to respond positively (or approach) or negatively (or withdraw). Although we have reviewed elsewhere the neural evidence for the separability of positivity and negativity (e.g., Cacioppo & Berntson, 1994, 1999; Cacioppo & Gardner, 1999; Cacioppo et al., 1997, 1999), a report by O'Doherty, Kringelbach, Rolls, Hornak, and Andrews (2001) is illustrative. They conducted a functional magnetic resonance imaging (fMRI) study in which participants performed a gambling task while in a scanner. An increase in the activity of the lateral orbitofrontal cortex (OFC) was related to the participants' receipt of punishment, and the converse pattern was recorded in the medial OFC. O'Doherty et al. concluded that (a) reward and punishment may be processed in distinct subregions of the OFC and (b) the magnitude of activation varied as a function of the magnitude of the reward or punishment. These results add to the increasing evidence that the processing of appetitive and aversive information can be separable at early stages of information processing.

We have further examined whether the negativity bias can operate at the evaluative categorization stage prior to response selection or execution (Ito, Larsen, Smith, & Cacioppo, 1998). Event-related brain potentials (ERPs),

which we have shown previously to be more sensitive to evaluative categorization than response stages of information processing (Cacioppo, Crites, Berntson, & Coles, 1993; Cacioppo, Crites, Gardner, & Berntson, 1994; Crites, Cacioppo, Gardner, & Berntson, 1995), were recorded to pleasant, neutral, and unpleasant pictures embedded within sequences of other neutral pictures. Results showed that (a) the evaluative categorization of pleasant or unpleasant stimuli in sequences of neutral stimuli was associated with larger amplitude late positive brain potentials (LPPs) over centroparietal regions that peaked at approximately 550 ms and (b) the evaluative categorization of unpleasant stimuli was associated with a larger amplitude LPP than was the evaluative categorization of equally probable, equally evaluatively extreme, and equally arousing pleasant stimuli. These results provide support for the hypothesis that the negativity bias in affective processing occurs as early as the initial evaluative categorization stage.

In a follow-up, Ito and Cacioppo (2000) used the online measurement of categorization processes provided by ERPs to assess the implicit and explicit categorization of stimuli along evaluative (pleasant, unpleasant) and nonevaluative (people, no-people) dimensions. Participants were exposed to stimuli that simultaneously varied along both dimensions, but half the participants were instructed to count the number of pictures that depicted people (or the absence of people; nonevaluative categorization task) and half were instructed to count the number of pictures that depicted pleasant (or unpleasant) scenes (evaluative categorization task). As in our prior research, the LPP was sensitive to participants' explicit categorization task such that (a) the LPP was larger in the evaluative task when a pleasant picture was presented within a series of unpleasant than in a series of pleasant pictures and when an unpleasant picture was presented within a series of pleasant than in a series of unpleasant pictures and (b) the LPP was larger in the nonevaluative task when a picture depicting people was presented within a series of pictures depicting no people than in a series with people and vice versa. In addition, the LPP was larger in the evaluative task when an unpleasant picture was presented within a series of pleasant pictures than when a pleasant picture was presented within a series of unpleasant pictures (i.e., the negativity bias).

More interesting is that the LPP also revealed implicit categorization along the nontask relevant dimension—with clear evidence of an implicit negativity bias in which rare unpleasant stimuli spontaneously received greater processing than did rare pleasant stimuli. Moreover, the explicit task of categorizing stimuli along a nonevaluative dimension neither diminished nor delayed the LPP to variations in the evaluative dimension. As would be expected at low levels of hedonic activation (see Figure 7.1), the negativity bias and implicit categorization effects have not been observed when using mildly evocative experimental stimuli such as words ("pleasant," "unpleasant"; Cacioppo, Crites, & Gardner, 1996; Crites & Cacioppo, 1996) rather than more evocative emotional pictures (e.g., Ito, Larsen et al., 1998; Ito & Cacioppo, 2000). We interpreted these results as evidence for the operation of adaptively beneficial implicit categorization processes, triggered by significant proximal stimuli, serving broad, cross-situational goals.

Chronometric implicit measures of associations or attitudes have provided provocative evidence for unseen processes underlying thought and

judgments. The specific implicit constraints from the event-related implicit approach.

The ERP underlying component is information about region over which each implicit processing visual processing sensory process

Smith, Cacioppo, the target stimuli (frequency components analysis: P1 amplitude) than that for P1 over the occipital time in which this component maximal at about component of the ERP these results suggest and aversive stimuli

These observations ensure the general negative sources negativity bias nucleus, and amygdala served abilities to consciously perceive correlations between blood flow in the brain (Dolan, 1999). The resolution visual afford relatively (motivate) attention. Emotion serves to gain in the environment

Individuals often have automatic responses to emotions, archaic span. Emotions

judgments. This literature is not sufficient at this juncture to indicate which specific implicit processes each is marking, however. The theoretical constraints from the neurosciences regarding the timing and spatial location of event-related brain potentials may address this limitation in the typical implicit approaches.

The ERP waveform can be represented as a small number of orthogonal underlying components. Component scores index the extent to which each component is present at each moment in time (thereby revealing temporal information about the operation of separable implicit processes), and the scalp region over which the component is maximal may help constrain the nature of each implicit process (e.g., occipital region would suggest altered attention or visual processing, centroparietal region would suggest more associative or polysensory processing; Fabiani, Gratton, & Coles, 2000).

Smith, Cacioppo, Larsen, and Chartrand (2003) manipulated the valence of the target stimuli (pleasant, unpleasant, or neutral) and the probability of the stimuli (frequent vs. rare) in three separate studies. In each study, principal components analysis confirmed that the score for the first positive-going component (P1 amplitude) to all frequent stimuli and to rare negative stimuli was larger than that for P1 amplitude to rare positive stimuli. This component was maximal over the occipital scalp region and peaked at about 140 ms—in the same range of time in which the earliest endogenous attentional components appear. Moreover, this component was only modestly correlated with the LPP, which again was maximal at about 550 ms over the centroparietal areas. Given that the P1 component of the ERP is a proximal index of attention allocation to valenced stimuli, these results suggest an extremely rapid (< 120 ms) differentiation of appetitive and aversive stimuli manifesting as a negativity bias in attention allocation.

These observations are preliminary, and additional research is needed to ensure the generalizability and validity of these interpretations. Two independent sources of evidence, however, suggest a possible pathway for the P1 negativity bias that involves the superior colliculus, posterior pulvinar nucleus, and amygdala. First, patients with striate cortex lesions show preserved abilities to localize and discriminate visual stimuli that are not consciously perceived (blindsight). Second, neuroimaging studies have revealed correlations between amygdala, superior colliculus, and pulvinar cerebral blood flow in masked (“unseen”) emotional conditions (e.g., Morris, Ohman, & Dolan, 1999). Thus, whereas the striate cortex visual pathway affords high-resolution visual processing, the superior colliculus and pulvinar pathway afford relatively fast but low-resolution visual processing that can guide (motivate) attention without intention or awareness. Such an affective asymmetry serves to guide attentional and cognitive resources to potential threats in the environment even before they can be recognized.

Conclusion

Individuals often are revered for cultivated tastes and seemingly dispassionate responses to life's challenges, but the affect system and its output the emotions, archaic in origins, saturate human existence throughout the life span. Emotions guide, enrich, and ennoble life; they provide meaning to

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