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Getting Emotional

*A Neural Perspective on Emotion,
Intention, and Consciousness*

Intentions and emotions arise together, and emotions compel us to pursue goals. However, it is not clear when emotions become objects of awareness, how emotional awareness changes with goal pursuit, or how psychological and neural processes mediate such change. We first review a psychological model of emotional episodes and propose that goal obstruction extends the duration of these episodes while increasing cognitive complexity and emotional intensity. We suggest that attention is initially focused on action plans and their obstruction, and only when this obstruction persists does focal attention come to include emotional states themselves. We then model the self-organization of neural activities that hypothetically underlie the evolution of an emotional episode. Phases of emotional awareness are argued to parallel phases of synchronization across neural systems. We suggest that prefrontal activities greatly extend intentional states while focal attention integrates emotional awareness and goal pursuit in a comprehensive sense of the self in the world.

People and cats can stare vacantly out the window and watch the world go by: until something happens. An itch needs to be scratched, a movement grabs our interest, a hunger pang reminds us of lunch, or a wish for company demands our focused attention. Thus, attention crystallizes in the moment and changes our mode of being in the world: from a watcher to a doer, a planner, or an intender. Cats will suddenly gaze from their perch at a spot on your lap, then hunch their bodies, tense their muscles, and spring to their intended place. Humans rapidly hatch a plan to snack or browse the web, thus beginning their stream of intended action by thinking about a sojourn to the kitchen or the office. For both cats and people, cognition converges rapidly to a plan in the service of intention. However, such plans are not always successful: the lap is blocked by an open newspaper, or the plan to snack is hampered by thoughts about one's waistline. That is

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when things get emotional — when goals are blocked and intentions are extended in time. Or, more accurately, that is when the preconscious feelings that accompany the immediate impulse to act begin to blossom into more coherent and more compelling emotional states, and only then can these emotional states themselves become the object of focal attention — at least for humans.

In this article, we examine the progression from watching (or listening), to intending action, to extending that intention through the maze of blocked goals that characterizes real life, with particular emphasis on the emotional and subjective states that accompany this progression. We first argue that directed attention is always intentional and always emotional, as described by Walter Freeman (2000). We then review a psychological model of emotional episodes unfolding in real time, and we propose several levels of goal obstruction that extend the duration of these episodes and contribute to their complexity and intensity. We suggest that attention is focused on the obstructions to our intended actions at first, and only later, when the obstructions persist, does focal attention come to include emotional feelings themselves. We then go on to model the synchronization of neural structures proposed to underlie the evolution of an emotional episode. Like Freeman (2000) and Tucker (e.g. Tucker, Derryberry, & Luu, 2000), we view the synchronization of neural structures as a rapid self-organizing process that consolidates activity across all levels of the nervous system. However, in tracking this process of synchronization over time, we come to the conclusion that prefrontal cortical structures are among the last to come fully on board. It is these structures that mediate attention to the meaning of events in the world as well as the possibilities for acting in accordance with those events. And it is these structures that, at least on some occasions, mediate integration of awareness of external reality with awareness of emotional feelings generated in the body. We emphasize that preattentive or background emotional feeling *always* accompanies intended action, but that focal attention to emotion arises *only* when those intentions are extended over time.

Before going on, we note that we have tried to avoid the complexities involved in defining and cataloguing aspects of consciousness by confining our discussion to two kinds of cognitive states. The first is focal attention, also described as direct, deliberate, or executive attention. This state corresponds to explicit or higher-order consciousness in some accounts, or at least to a major component of explicit consciousness. The second is preattentive or background awareness, as when something is subjectively felt but not ‘cognitively accessed’. With respect to affects, such as those accompanying emotions, preattentive awareness can include feelings (e.g., tightness in the chest) before they are the object of focal attention. Our use of preattentive awareness is similar to the notion of implicit consciousness in some accounts.

At the Psychological Level of Description

Emotion theorists make very specific claims about the direction of attention. The position shared by most investigators is that attention is guided by emotion

toward perceptions, interpretations, memories, goals, and plans that are relevant to whatever the emotion is about. In fact the biological function of emotion is to impel appropriate behaviour, given past learning and present circumstances, by steering attention toward useful options for acting on the world and urging one to pursue them. Thus, cognition in general and attention in particular are assumed to be guided by emotional relevance. This conclusion is supported by many lines of research. Emotion has been found to cue the recall and recognition of emotionally relevant events (Bower, 1981). Emotion influences the style of information processing and the organization of thinking (Isen, 1984), partly by drawing attention to semantic forms with which it is associated (Mathews, 1990). Sad versus happy emotions differentially affect attentional style and content (Isen, 1990). Anxiety narrows attention to specific themes or percepts (Mathews, 1990). Emotion also biases judgements and attributions, assigning significance to affectively salient causes (Dodge, 1991). Critical junctures in plans are highlighted by emotion (Oatley & Johnson-Laird, 1987). Moreover, interest, one of the most ubiquitous of emotions, appears to be necessary if learning is to take place at all (Renninger, 1992).

Although conventional emotion theories are right about the influence of emotion on attention, they have generally not been successful at modelling the ebb and flow of emotional experience—or any experience for that matter—in a realistic way. This is partly because emotion theorists continue to segregate the cognitive processes giving rise to emotions from the cognitive processes following from emotions. The former are referred to as appraisals, defined as evaluations of a situation in terms of its relevance for oneself, specifically one's goals or wellbeing (e.g., Lazarus, 1968). Appraisal approaches attempt to determine the specific perceptions, evaluations, interpretations, and so forth, that are necessary and sufficient to elicit a particular emotional state. Thus, most theorists divide the emotion-cognition connection into two linear causal processes: some study cognitions (appraisals) that give rise to emotions and others study emotions that influence cognition. This approach is consistent with and perhaps demanded by the cognitivist tradition in which emotion theory grew up. Frijda (1993; Frijda & Zeelenberg, 2001) is among the few emotion theorists who have begun to emphasize reciprocal causal processes that link cognition and emotion within a single appraisal event. Other contemporary approaches specify a continuous stream of evaluative events in which appraisals and emotions are interspersed (Ellsworth, 1991; Lazarus, 1999; Parkinson, 2001; Scherer, 2001). This is a good start. But to model the flow of cognition and emotion realistically, one cannot ignore the fundamental structure of an emotional episode, triggered along with an intention to act. In such episodes (watch what happens when you look up from the page and think about going out for dinner with your best friend), appraisal, emotion, and intention arise together.

The cognitivist or computationalist theoretical framework in which emotion theory was fashioned is being replaced in many areas of psychology by attention to the properties of self-organizing dynamic systems. Emotion theorists who have taken a dynamic systems approach (Fogel, 1993; Lewis, 1995; 1996;

Scherer, 2000) view emotions as evolving wholes, rather than end-points in a cognitive computation or starting points in the production of a cognitive bias. Emotional wholes are seen as cohering in real time through the interaction of many constituent processes, and it is the synchronization of these processes, as well as the properties of the whole, that becomes the focus of investigation. However, it is extremely difficult to study the real-time interaction of such constituent processes with behavioural methods. Observational techniques cannot see them, self-report cannot access them, and experimental manipulation cannot segregate them. Thus, we believe that dynamic systems approaches to emotion will be most fruitful when they go beneath the level of behaviour and look at biological systems — most notably the brain.

Before moving to the brain in the present article, we briefly review our own psychological model of emotional processes. Lewis (2005) describes interacting elements that give rise to a global appraisal-emotion amalgam or *emotional interpretation* (EI) over the time course of what is often called an ‘emotion episode’. According to this model, appraisal constituents (e.g., perceptual events, mental images) cause or activate emotional constituents (e.g., feelings, action tendencies) that reciprocally influence the direction of attention in appraisal, which simultaneously tunes the emotional response, and so forth, in a rapidly converging feedback relation linking multiple elements. This interaction of constituents soon gives rise to the consolidation and integration of appraisal *and* emotion in a stable and coherent psychological state. As sketched in Figure 1, the evolution of a self-organizing EI begins with a *trigger* phase, as positive feedback rapidly recruits new psychological components, often in response to a perturbing event or situation in the world. For example, an EI might be triggered by the refusal of one’s child to perform a routine task — or by the memory or image of a child’s stubborn refusal. Positive feedback continues briefly in a phase of *self-amplification*, as the psychological system becomes transformed by reciprocally augmenting changes in attention, emerging goals, and the onset of emotional sensations. During self-amplification, cognitive activities are increasingly focused on emotionally-relevant cues. One may focus on the defiant child’s body language, the stubborn look of resentment on her face, and the dirt spots suggesting further rebelliousness, while anger brews and the urge to yell ‘rises in one’s throat’. This phase flows seamlessly into a *self-stabilizing phase*, as negative feedback consolidates relations among thoughts and images, goals and plans, feelings and intentions, and so forth. Images of the child as exasperating but lovable may consolidate, while anger becomes focused but controlled, and a plan for appropriate discipline begins to unfold. A coherent and stable appraisal and plan of action may consolidate within a few tenths of a second. As is typical of self-organizing systems, the stabilization of an EI allows for a higher level of organization or complexity, represented by the additional horizontal lines branching out from the central line in Figure 1. We can think of this organization ramifying ‘inward’ via the interlocking of complementary cognitive forms (e.g., images in context, associated memories, analogies, rehearsed strategies) and ‘outward’ via the establishment of a planned action sequence that begins to

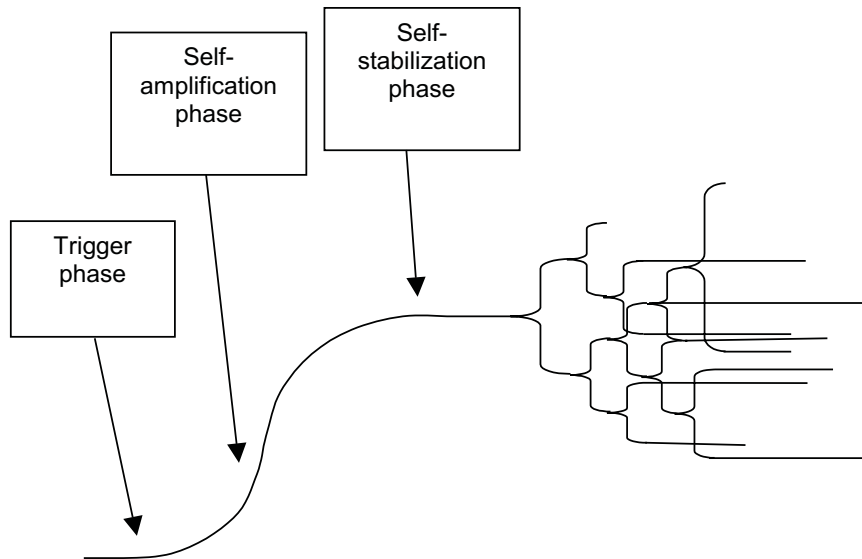


Figure 1. Sketch of a self-organizing emotional interpretation progressing in real time.

unfold as the body moves through space. The elaboration of dialogue and negotiation is a common expression of this tendency.

The phrase ‘emotional interpretation’ suggests only that this consolidating psychological macrostructure is both emotional and interpretive. However, we agree with Freeman that it is also fundamentally intentional. Emotions, including the interest that leads us to pick up an article and the anxiety that compels us to avoid making a harsh remark, concern improving our relations with the world through some action or change of action. Muscles tense, the tongue moves or the lips compress, hands reach, and bodies twist in new directions. Emotion theorists incorporate goal-relatedness in their portrayal of emotions, and each basic emotion can be catalogued with the class of goals to which it relates: fear and escape, anger and self-assertion, shame and hiding, desire and seeking, interest and exploration, sadness and succour. However, emotion theorists regard goals as stored representations that become activated, compared with present states, and finally deactivated when they have been attained. This conception bears the stamp of the cognitive revolution from which it sprung (e.g., Newell & Simon, 1972). In real life, however, goals emerge through a messy juxtaposition of past attainments and present opportunities, elaborated through emotional processes including physical sensations, and they tilt us forward in a continuous preoccupation with the future. That is the essence of Freeman’s (2000) intentionality, and our use of the term *goal* follows suit.

Describing EIs in terms of interacting appraisal and emotional constituents, even with the addition of intentionality, is awkward at best and misleading at worst. If appraisal and emotion characterize the macrostructure that emerges

from the interaction of psychological constituents, then these terms cannot properly describe the constituents themselves. Furthermore, the constituents that give rise to global states may not fit into one category or the other. They may be neither appraisal nor emotion, or they may be identifiable as a component of either or both (Colombetti & Thompson, 2005). For example, is heightened attention to a salient stimulus a constituent of emotion or appraisal? Thus, the difficulty psychologists encounter in studying constituent elements using behavioural techniques is reflected in the difficulty of classifying them. In a recent article, Lewis (2005) bypassed this difficulty by moving to a neural analysis. It is relatively easy to distinguish constituent neural systems in terms of structure and, to a lesser degree, function, and to specify the mechanisms of connection by which they interact. From this starting point, one can concretely model reciprocal causal relations among interacting constituents, leading to emergent wholes, in a manner that is appropriate for discussing processes of self-organization. One can then analyse the subjective as well as objective aspects of emotional episodes by examining these interactions in detail.

Continuing this line of reasoning, we now pose a question of relevance to the present issue, and one that may only be answerable by bridging the psychological and neural levels of description: When do emotions become the focus of attention and how does focal attention to emotions contribute to their function? This question — and related questions concerning emotion and consciousness — have been of great interest to emotional neurobiologists, Damasio (e.g., 1999), Lane (e.g. 1997, 1998) and Panksepp (e.g., 1998, 2005), and they have taken critical steps toward answering them. However, by using our model of emotion episodes, with its temporal framework and its emphasis on increasing complexity, and by integrating this model with a focus on intentional action, we can move further in this direction. In fact, our proposal for relating emotion to consciousness hinges on the pragmatics of intentional states: intentions can be short-lived or enduring, depending on how ready the world is to accommodate them. We propose that, under normal circumstances, obstructed (or diverted) intentions are the condition for background emotional awareness, whereas greater obstructions correlate with focal awareness of emotional states. Associating emotional awareness with temporality is certainly not a new idea. Öhman and colleagues (e.g., Öhman *et al.*, 2000) argue that emotion guides attention without consciousness and that the explicit awareness of emotional stimuli is precisely what takes time. Damasio (1999) distinguishes between the core consciousness that emerges transiently with emotions and the “extended consciousness” that requires additional integration over time. However, our approach links emotions with consciousness in the service of intentions or goals, especially when they become extended over time. We argue that focal awareness (or explicit consciousness) of emotions can be functional or dysfunctional, depending on the circumstances.

What happens when goals emerge? The urgings of our emotions compel us to satisfy them immediately. Even positive emotional states such as interest, attraction, and excitement are goal-related and they propel action as much as do fear and anger. In fact, intentions *are* the emotional thrust of goal pursuit. If the goal

can be attained right away, action takes its course and the emotions that directed it disappear quickly, often before we know they were ever present. We swat the mosquito, shout to a friend, pick up an interesting object, kick off our shoes, or avoid the unpleasant image on page three of the newspaper. However, goals are very often elusive, their satisfaction is delayed or blocked entirely, alternate routes present themselves, and attention is taken up for an extended period with the means for attaining them. These states of extended goal pursuit stretch out intentionality (and emotion) in time, and any emotional episode lasting for at least half a second may be characterized by some degree of goal blockage. Three levels (or stages) of extended intentional states can be distinguished, and their relations to focal attention are portrayed in Figure 2. At the first level, the simple delay of a goal is usually unnoticed, and the self-stabilizing phase of an EI includes the budding of automatized plans for attaining it through well-rehearsed action (e.g., lining up to get on a bus, speeding up to change lanes, bending down to pick up a napkin). Focused attention to emotional feeling plays no part in this process, even though preattentive emotional feeling is present, propelling action plans. At the second level, many goals require directed cognitive efforts and remain out of reach until those efforts pay off. This state of affairs is pivotal in the interpersonal world, where conflicting agendas require ongoing thought, planning, and negotiation, but it is common in other domains as well. We suggest that in this condition of extended goal-blockage emotions continue to consolidate and even intensify, preattentive awareness of feeling states is enhanced, but one's focal attention is occupied by the features of the blockage and the strategies for overcoming it (e.g., preparing a response to a frustrating comment, the weight of a table that has to be moved and the positioning of one's hands), not by emotions. Finally, at the third level of goal blockage, the intensity of the emotion, or its informational value, invites the emotional feeling itself into focal attention. And this has unique consequences. It may enhance the stability and coherence of the current EI by focusing attention on one's intentional state (e.g., I'm really angry and I'm going to beat you in this match). It may thereby reduce the complexity of current cognitive elaborations (as sketched in Figure 2). One misses a loved one who is impossibly far away, fantasizes about steps toward a reunion, and only then becomes conscious of the longing. However, it can also trigger a new EI fueled by a new intention. The three-year old cannot reach the toy that has fallen through the grate. Only when he becomes aware of the intensity of his grief does his attention shift from the toy and the grate to finding his mother. The pounding music through the wall draws out a blend of anger and anxiety that becomes, itself, the focus of attention. Only then do plans to assert one's rights replace the original goal of being left alone. Thus, emotions accompany intentions and move us toward or away from the things we desire or fear; but it may be during states of obstructed and extended intentionality that emotions become the object of explicit awareness and refine present intentions or establish intentions of their own.

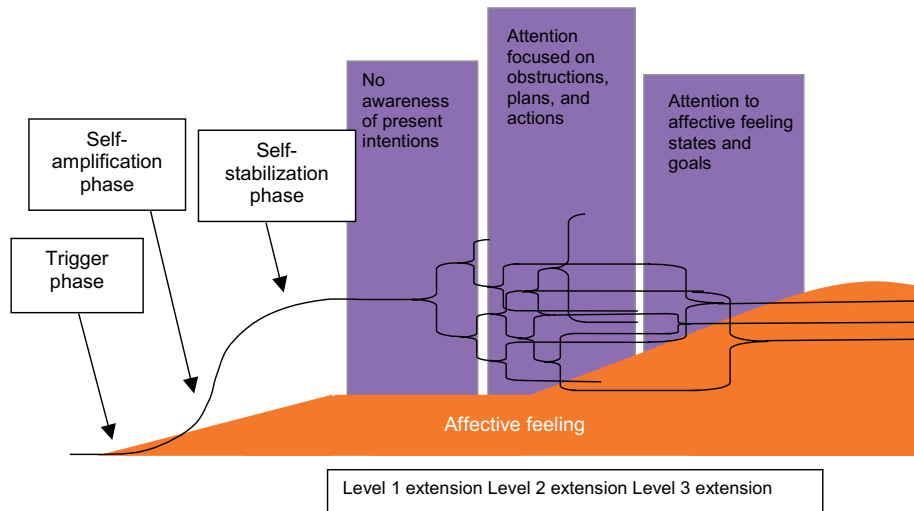


Figure 2. The evolution of an emotional interpretation in relation to attention. The stretching out of intentional states over time (through goal blockage) determines the contents of focal attention.

At the Neural Level of Description

The brain is the ultimate self-organizing system. In the cerebral cortex alone, approximately 20 billion cells, each with thousands of connections, provide a massive population of interacting units in a state of continuous flux. Despite its potential for immense noise, chaos, or disorder, this system converges rapidly to highly-ordered, synchronous states (e.g., Thompson & Varela, 2001). Each of those states taps enormous cooperativity across the elements in this system, even at relatively great distances. And this convergence, or synchronization, occurs whenever we calculate a tip or recite a poem. Corresponding with neural self-organization, but at a different level of description, the components of cognition and attention can be said to converge and form into coherent thoughts and plans. The various sensory, motor, and executive systems become linked, working memory becomes engaged, actions are selected and refined, and so forth. Some scientists have studied the parallels between neural coherence and cognitive coherence (e.g., Engel *et al.*, 2001; Skarda & Freeman, 1987; Thompson & Varela, 2001), and most studies of neural coherence indeed focus on phase synchrony, involving synchronous activation between distant groups of neurons, in the cerebral cortex (usually at the frequency range of gamma oscillations). However, as neuroscientists become increasingly interested in emotion, they have begun to examine coherence or synchrony across subcortical as well as cortical systems, with particular emphasis on the brain stem, hypothalamus, hippocampus, and amygdala (e.g., Kocsis & Vertes, 1994; Paré *et al.*, 2002). What they have discovered is that the same processes of phase synchrony at work in the

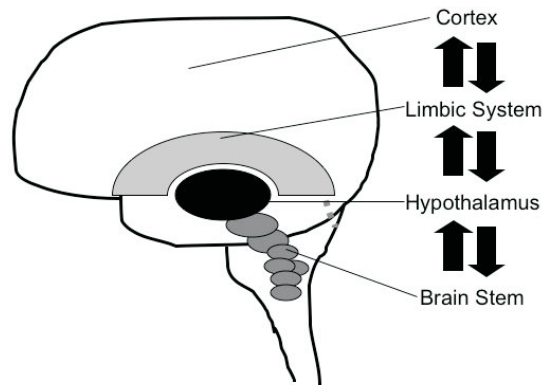


Figure 3. Vertical integration across four levels of the neuroaxis. The sketch highlights the bidirectional flow of information that integrates functioning over the entire brain.

cortex also take place across multiple subcortical systems. There is evidence for spontaneous coupling or synchrony at the theta frequency range across brainstem, hypothalamic, limbic, and paralimbic systems when animals are motivationally aroused, exposed to violated expectancies, or required to learn new contingencies — in other words, when they are emotional (see Lewis, 2005, for a review and synthesis).

In order to think about neural synchronization across multiple subsystems, and to establish its importance for emotion as well as cognition, we will review the functional anatomy of the major hierarchical levels of the neuroaxis. A more complete analysis would include bodily processes as well, though these go beyond the scope of the present article. We can roughly divide the brain into three levels, each more advanced and appearing later in evolution than the previous one. Figure 3 provides a rough sketch of some of the systems housed at each of these levels.

1. The brain stem and hypothalamus

The shaft of nerve tissue at the core of the brain (divided into midbrain, pons, medulla) contains sets of nuclei for programmed responses to internal and external events. These nuclei control relatively primitive, packaged response patterns (e.g., defensive and attack behaviour, vigilance, feeding, freezing, sexual behaviour, facial expressions), each highly independent and stimulus-bound, and many of which go back to our reptilian ancestors. In higher animals, the actions of many of these systems are coordinated by or synchronized with activity in the hypothalamus, which sits just above them. The hypothalamus controls the internal milieu, including the organs and vascular systems, partly through output to

the autonomic nervous system via direct axonal pathways, and partly through the release of hormones into the blood. It also receives information from these systems in return, and thus functions as a central regulator of bodily responses to relevant environmental events. Brainstem systems orchestrate emotional behaviour even in the absence of higher brain systems. For example, animals without a forebrain display 'sham rage', which has the behavioural appearance of rage. Panksepp (1998) argues that there is nothing 'sham' about this rage: it exemplifies a basic emotion system functioning without cortical inhibition. He emphasizes that partially independent brainstem (and striatal) circuits can be identified for anger, fear/anxiety, love/attachment, interest/excitement, sadness, joy, and sexual desire — hence the brain stem is the seat of many basic emotions, and the behavioural propensities it orchestrates may be considered the *action tendencies* discussed by emotion theorists (e.g., Frijda, 1986). Critically, the brain stem also produces a variety of neurochemicals (e.g. dopamine, norepinephrine) that modulate activity in the cortex and virtually all other brain systems. Many of these chemicals also affect bodily systems, such that bodily responses are prepared to correspond with brain changes. At the same time, the hypothalamus produces neuropeptides that set body and brain systems into coherent goal-directed states, such as territorial aggression, scavenging for food, courting and mating, and so forth. These states are organized at a higher level than the more elementary modes of the brainstem, and their neurochemical outputs organize more comprehensive action orientations than the diffuse arousal modes elicited by brainstem neuromodulators (Panksepp, 1998).

2. *The limbic system*

Although the validity of the notion of a limbic system has been challenged (LeDoux, 1995), this phrase refers to a series of structures between the brainstem and the cortex thought to mediate a number of emotional and cognitive processes. Over the course of evolution, this rough semicircle of structures grew out of the diencephalon and evolved profoundly in mammals. These structures mediate learning and memory, whereas lower structures are involved in controlling perception and action according to fixed 'programs' that require no learning. The processing of sensory input and motor output is slowed down in the limbic system, so that responses can be fit more precisely to the learned aspects of situations (Tucker *et al.*, 2000). According to Tucker and colleagues, this slowdown was necessarily accompanied by the evolutionary advent of emotions, whose motivational force works by maintaining the focus of attention and action rather than by triggering some 'fixed action pattern'. Indeed, the limbic system mediates emotional states that orient attention and action to whatever is presently meaningful. For example, the amygdala (AM), a key limbic structure, is involved in tagging neutral stimuli with emotional content (LeDoux, 1995; Rolls, 1999), thereby creating chains of associations based on emotional experiences. Connections from the AM to lower (hypothalamic and brainstem) structures activate motivational response systems given current stimulus events, and

connections from the AM up to the cortex entrain perception, attention, and planned action to these events. The AM requires the participation of lower structures to produce emotional states, while the converse is not true (Panksepp, 1998). Other limbic structures, including the septal and hippocampal structures, also support emotional behaviors (e.g., play, sex, nurturance) and organization of episodic memory and attention (e.g., MacLean, 1993).

3. *The cerebral cortex*

The layers of the cortex surround the limbic system, and the recently evolved cells that inhabit these layers are the locus of what we normally call cognition, perception, and attention. In the cortex, the time between stimulus and response appears to be greatly stretched out (Tucker *et al.*, 2000). Inputs from the world and potential actions connect with each other through a matrix of associations, comparisons, synthesis across modalities, planning, reflection, and sometimes, but not always, volitional control. These operations take time, and emotions maintain a coherent orientation to the world during that period of time. For example, deliberate action is guided by attention to alternative plans, and anticipatory attention is constrained by emotions concerning the pursuit of particular goals. Thus, cortically mediated actions are functional, not only at the level of some phylogenetically ancient blueprint, but also at the level of a continuously refined model of the world, achieved by selecting, comparing, and pursuing particular plans while integrating the information fed back by the world. The cortex is also a key system for the cognitive control of emotional responses — often referred to as ‘emotion regulation’. In particular, the prefrontal regions and related midline structures execute sophisticated perceptual and cognitive activities (including attention, monitoring, decision-making, planning, and working memory) that are recruited by (and that regulate) the emotional responses mediated by brainstem and limbic structures (Davidson & Irwin, 1999; Barbas, 1995; Bechara *et al.*, 2000).

There are three cortical systems that are especially important for emotional processes: the anterior cingulate cortex (ACC), the orbitofrontal cortex (OFC), and the insula. All three regions are at the outskirts of the prefrontal cortex. They are phylogenetically older and closer to the limbic system and are therefore called ‘paralimbic’, and they appear to mediate cognitive activities relevant to emotional states (Barbas, 2000; Rolls, 1999). The ACC is found on the medial surfaces of the posterior prefrontal cortex (PFC). ACC activation has been associated with monitoring and evaluating potential actions, monitoring and resolving conflicts (as in error detection), and selective attention more generally (Carter *et al.*, 2000; Gehring *et al.* 1993; van Veen *et al.*, 2001). The executive system mediated by the (dorsal) ACC is activated in contexts requiring voluntary choice as well as directed attention and learning (Frith *et al.*, 1991; van Veen *et al.*, 2001). However, the more ventral regions of this complex system have been closely linked with emotional processing. OFC activity is associated with encoding and holding attention to context-specific, motivationally relevant

contingencies (Rolls, 1999). Such processes are thought to extend or build onto the more basic conditioning functions of the amygdala (Cardinal *et al.*, 2002). OFC function is far more flexible than that of the AM. The OFC is responsive to changes in the hedonic tone of anticipated events (Hikosaka & Watanabe, 2000; Rolls, 1999), and it is activated when 'implicit appraisals' of motivationally relevant situations are held in mind (Schoore, 1994). Its downstream connections are also integral to emotional states, and its activity has been frequently implicated in regulation of emotion through the inhibition of AM activation (Davidson *et al.*, 2000; Hariri *et al.*, 2003; Lévesque *et al.*, 2003; Ochsner *et al.*, 2002).

The OFC and ACC are highly interconnected and, as mentioned, both have been characterized as loci for the interaction of attention and emotion (Barbas, 1995; Lane *et al.*, 1998). However, each is associated with a distinct 'style' of processing. The ACC is a pivotal structure in the dorsal cortical trend, and it plays a role in integrative, holistic, and synthetic processes. It is involved in the direction of attention to potential actions, the evaluation of their utility for intended outcomes, and the selection or generation of a unitary stream of action through its connections to the motor areas (see Goldberg, 1985; Cardinal *et al.*, 2002). The ACC is implicated in the generation of intentions (no doubt in interaction with other structures, including the hippocampus), and it dispatches signals on to the motor areas for execution (as noted by Luu *et al.*, 1998, damage to this area can produce dissociation between actions and intentions). In contrast, the orbitofrontal cortices (and related areas such as ventromedial PFC) belong to the ventral cortical trend, and these structures mediate attention to the environment rather than to anticipated actions. OFC activity is stimulus-bound, reactive rather than proactive, and it processes perceptual information in great detail. It allows us to ascertain and anticipate the rewarding or punishing character of a given stimulus (see Goldberg, 1985). In general, the OFC mediates information processing in reaction to intentions that have already been established, but not the generation of intentions *per se*. The dorsal cortical trend has been characterized as the 'where' system, concerned with action, spatial location, and context, whereas the ventral trend has been characterized as the 'what' system, attuned to the categorical properties of objects and people. We will show how the differences in 'cognitive style' that characterize these two trends can help map out the cortical terrain in a way that contributes to our understanding of emotion and consciousness.

A final cortical structure is the insula, an 'island' of tissue tucked between the temporal lobe and prefrontal cortex, which mediates the integration of information from multiple sensory modalities, including information about the state of the whole body (Craig, 2002). Because the insula is thought to be a critical structure for the perception of emotional feelings, we review the relevant findings in some detail. The insula is responsive to autonomic arousal (Critchley *et al.*, 2001), temperature, pain, itch, sensual touch, muscular contraction and relaxation, and other distinct somatic sensations (Craig, 2002). It is densely interconnected with the amygdala, hypothalamus, OFC, and regions of the brain stem (Craig, 2002), and hence it can be readily activated by the cascade of changes

initiated in emotional responses. Indeed, while it has long been associated with visceral sensations, and with the viscerally-mediated emotion of disgust, recent research suggests a role for the insula in mediating affective feeling in general (e.g., Craig, 2002; Critchley *et al.*, 2004). Increased activation in the insula has been consistently associated with the intensity of emotion experience (Lorberbaum *et al.*, 2004; Phan *et al.*, 2004), unsuppressed emotional responses (Eisenberger *et al.*, 2003; George *et al.*, 1996; Levesque *et al.*, 2003, Taylor *et al.*, 2003), autobiographical emotional memories (Damasio *et al.*, 2000; Lane *et al.*, 1997; Reiman *et al.*, 1997), interoceptive awareness (Critchley *et al.*, 2004), and emotional awareness (Lane *et al.*, 1998). While a number of studies have found insula activation to be associated with sadness (Lévesque *et al.*, 2003; Mayberg *et al.*, 1999; Phan *et al.*, 2003), it has also been associated with a range of other emotions and experimental paradigms (e.g., Damasio *et al.*, 2000; Eisenberger *et al.*, 2003; Reiman *et al.*, 1997). Insula activation has been found to increase with the intensity of both positive and negative pictures, and it has been linked with participant reports of an image's self-relatedness (Phan *et al.*, 2003). Finally, the viscerosensory functions of the insula, and its location between the OFC and temporal lobe, place it at the root of the ventral trend — an anchor point joining the ventral cortex to the amygdala and other limbic structures. Thus, one could say that while the OFC mediates apprehension of the outside world, the insula mediates apprehension of the internal world. For this reason, Craig (2002) has dubbed the insula the sensory cortex of the limbic system.

The hierarchy of brain levels is often construed in terms of domination or control of lower levels by higher levels. Indeed, the cerebral cortex subordinates the more primitive functions of limbic system and brain stem. However, as emphasized by Tucker *et al.* (2000), there are two important caveats. First, more primitive brain systems continue to evolve, so that their functions can provide support to the higher levels of control. For example, visual systems in the cortex rely on midbrain nuclei that tune them to sudden movements, higher cognitive processes depend on cerebellar coordination, and so forth. Second, as shown in Figure 3, the downward flow of control and modulation — e.g., from cortex to limbic system to brain stem — is reciprocated by an upward flow of synaptic activation and neurochemical stimulation. The brain stem and hypothalamus entrain limbic structures by means of neuromodulators and neuropeptides, locking in perceptual biases and associations, and they also recruit cortical activities to ancient mammalian and even reptilian agendas, which we have identified as emotional *action tendencies*. Primitive agendas and requirements thus flow up the neuroaxis from its most primitive roots at the same time as executive attention, planning, and knowledge subordinate each lower level by the activities of the cortex. If not for the bottom-up flow, the brain would have no energy and no direction for its activities. If not for the top-down flow, recently evolved mechanisms for perception, action and integration would have no control over bodily states and behaviour. It is the reciprocity of these upward and downward flows that links sophisticated cognitive processes with basic motivational mechanisms.

The reciprocation of motivational and executive flows, up and down the neuroaxis, appears to be responsible for the rapid synchronization of the entire brain through a process of “vertical integration” (Tucker *et al.*, 2000). This process of synchronization is hypothesized to occur whenever a significant change in internal or external events triggers an emotion, and thus demands the initiation of a cognitive or motor response. Vertical integration is considered necessary to coordinate perception, attention, and action planning with basic action tendencies, so that the animal can behave flexibly, skilfully, and intelligently when motivated (Tucker *et al.*, 2000; cf. Buck, 1999). In recent work, Lewis (2005) identified several mechanisms of integration through which vertical integration comes about. Most important among these are reciprocal (feedback) circuits among participating structures and neuromodulatory actions that enhance particular global organizations. Both processes may depend largely on the temporal phase-locking (particularly in the theta range) of activity between neural populations up and down the neuroaxis. Moreover, phase-locking between cooperating systems is hypothesized to arise spontaneously across many independent sites, but to be modulated in a top-down fashion by the global resonance to which it gives rise. In dynamic systems theory, this top-down control of bottom-up coordination is referred to as circular causality (Haken, 1977), and it has important properties for establishing and maintaining self-organizing wholes (but see Bakker, 2005, for an alternative view). For now we wish to explore the implications of vertical integration for emotional episodes. We propose that the evolution of an EI maps on to vertical integration and corresponds with it temporally. A careful analysis of the temporal profile of this mind-brain relation may provide a valuable perspective for understanding emotional awareness.

Integrating Neural and Psychological Descriptions in Time

An EI was argued to proceed from a trigger, to a self-amplification phase, and then to a self-stabilization phase, in which the complexification of appraisal ramifies over time. What goes on in the brain over this time course? At the start of an emotional episode, brainstem systems are activated, often by the amygdala, and primitive orienting responses and action tendencies arise along with the release of particular neurochemicals to other brain and bodily systems. Positive feedback between the amygdala (or striatum) and the brain stem amplifies these activities and recruits cortical activities (through pathways directly from limbic structures as well as the hypothalamus and brain stem). These activities include sensory focusing and synthesis by posterior and temporal cortex, targeting emotionally relevant environmental events, parietal integration of sensory and somatic states, and, critically, activation of the insula where emotional feelings are synthesized based on inputs from body and brain stem. Thus, perception of the external world and the internal milieu are among the earliest cortical involvements in the self-amplification of a new EI. In this initial self-amplifying phase, activity builds on itself and the profile of change is exponential. However, as more and more neural and bodily components become recruited to the emerging

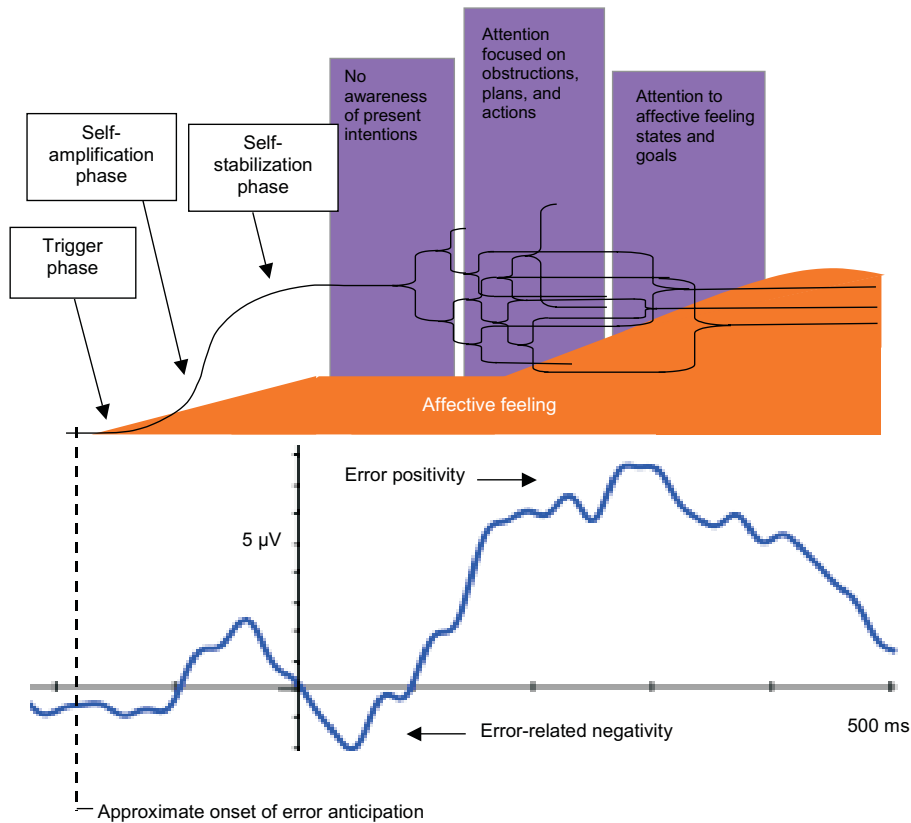


Figure 4. Comparison of the evolution of an emotional interpretation with the evolution of a cognitive ERP. The error-related negativity does not imply explicit consciousness of the error. The error positivity has been linked with explicit consciousness of the error along with its emotional implications.

constellation, disparate processes settle into an ongoing resonance, characterized by negative feedback. This is the self-stabilizing phase of the EI. Now, deviations or fluctuations are damped, because many different neural subsystems reinforce each other's ongoing activity, and functional synchronization (as well as temporal synchronization, e.g., within the theta band) extends across brain regions through processes of vertical integration. Thus, in the self-stabilization phase, multiple activities across the neuroaxis contribute to a unitary emotional state, cognitive appraisal, and intended action, hypothetically due to the synchronization of oscillations among subcortical, cortical, and paralimbic systems. This synchronization of activities across all levels of the neuroaxis embodies the animal's intention to *do* something about its state in the world (Freeman, 2000). Emotions are useless without intentions to act, and intentions can be translated into actions effectively only through the coordination of the many neural systems that have been designed by evolution to work together in emotional states.

How can the evolution of an EI be shown to correspond with the evolution of synchrony in the brain, and what evidence is there to estimate the time course of this process? As shown in Figure 4, we suggest that the stabilization phase of an EI corresponds with the stabilization of cortical oscillations — the tip of the iceberg of whole-brain synchronization — at a particular time point, and this shows up as an event-related potential (ERP) in scalp EEG when averaged over trials (see Makeig *et al.*, 2002). ERPs have been conceptualized as the averaging of phase-locked cortical waveforms (synchronized to a stimulus) across trials. For example, Makeig *et al.* (2002) claim that perceptual ERPs result from the compilation of alpha-band oscillations, synchronized by the triggering effect of a visual stimulus. In Figure 4, an ERP component called the error-related negativity (ERN) is shown to correspond with the onset of self-stabilization in an EI. The ERN is commonly observed after subjects have made an error of which they are implicitly aware, and it is thought to be triggered by response-monitoring cognitions that begin prior to the response itself (by about 200–300 ms), even though it is measured following that response. The ERN is followed by a second component, the error-positivity (Pe), a positive peak that hypothetically reflects additional cognitive processing of the significance of the error and its emotional concomitants (Nieuwenhuis *et al.*, 2001). Indeed, Luu and colleagues (2003) have argued that action-monitoring ERPs, including the ERN and Pe, reflect the onset of phase synchronization at the theta band, and this hypothesis is particularly interesting in light of evidence for the large-scale synchronizing properties of theta oscillations (Buzsaki, 1996; von Stein & Sarnthein, 2000).

So far, we have suggested that vertical integration parallels and in fact mediates the evolution of an EI, as multiple brain regions are recruited to a particular agenda. This results in the consolidation of an emotional state, a global appraisal, and a coherent intention to act. Now we are ready to tackle the question that is most central to our discussion: What role is played by the subjective attributes of emotion — both preattentive emotional feeling and direct attention to emotion — in this progression? We begin by examining the timetable of vertical integration more carefully. Previously we touched on Tucker *et al.*'s (2000) contention that the time between a stimulus and a response, or between an emotional perturbation and a resulting action, expands enormously as one travels up the neuroaxis from the brain stem to the cortex. In other words, action tendencies are released by brainstem nuclei immediately when neighbouring brainstem nuclei pick up coarse perceptual information, but top-down, cortically-mediated planned behaviour is initiated only after perceptual events have been thoroughly processed, outcomes have been rehearsed in working memory, and so forth. The slowing of the animal's response results, according to these authors, from (1) the evolution of sensory organs that can apprehend the world at a distance (e.g., smell, vision, and hearing), allowing time to prepare a response, and (2) the coevolution of more advanced brain structures, allowing learning, memory, response selection, and planning to intercede between the impulse and the action, given this extended preparatory period.

We propose that the slowing down of time from brain stem to cortical responding is extrapolated further in the cortex itself. It is generally accepted that the prefrontal cortex is the ultimate buffer between emotional impulses and behaviour, through the medium of executive processes including inhibitory control, working memory, and response monitoring. Mesulam (2002) describes the PFC as allowing us to be diverted from the automaticity of the 'default mode' from stimulus to response — thus mediating one of the most revered aspects of human cognition: thought itself. Residing at the apex of cortical integration, the PFC synthesizes information about the anticipated impact of events in the world with information concerning the opportunities and consequences of intentional action. Hence, the PFC allows for the greatest slowing down and stretching out of the distance between impulse and action. The PFC and related structures (e.g., the ACC) can function to delay the initiation of action almost indefinitely and to tailor it carefully once it has been initiated. Thus, from our perspective, frontocortical activities are late to get on board the wave of vertical integration and, once they do, they are capable of maintaining whole-brain synchrony for extended periods of time while actions are delayed and/or modified.

Evidence for delay in prefrontal involvement comes from the ERP literature. The appearance of a meaningful stimulus or the recognition of one's own erroneous response evokes frontal or frontocentral ERP components about 200–500 ms later, whereas posterior perceptual components appear within 50–100 ms of stimulus onset. Specifically, emotional faces and other affective stimuli have been shown to evoke emotion-sensitive activity in the occipital and temporal visual cortices as early as 80 or 90 ms after stimulus onset (Batty & Taylor, 2003; Pizzagalli *et al.*, 2003; Rolls, 2000), while OFC, ACC and other prefrontal activity tends to come on line somewhat later. MEG and ERP studies have generally found OFC and ACC activation beginning at 220 ms (Schnider *et al.*, 2002; Streit *et al.*, 1999). However, frontal activation associated with conscious recognition or evaluation of a stimulus may occur considerably later (Schnider *et al.*, 2002; Dehaene *et al.*, 2003). There is evidence that ACC systems become activated within 200–300 ms when emotional judgements need to be made (e.g., in the frontal N2 response). In a recent ERP study by Tucker *et al.* (2003), participants were presented with positive vs. negative adjectives, and had to endorse the words (yes or no) as either describing or not describing themselves or a friend. Results showed an initial main effect of word valence (good vs. bad) at frontal midline scalp sites between 304 and 332 ms after stimulus onset. Source localization indicated a cortical generator for this scalp difference in the vicinity of the right dorsal ACC. A main effect of endorsement (yes/no) was found about 100 ms later, at frontopolar sites, peaking at 436 ms. This activity was modeled with a cortical generator in the region of the right OFC. Imaging data also suggest a delay between the perceptual processing of stimuli and frontocortical mediation in preparation for a response. In a study by Cunningham *et al.* (2004), white participants viewed images of both black and white faces, which were presented for either 30 ms or 525 ms time-periods. During the short (implicit) presentation condition, amygdala activation was greater for black than white faces,

presumably indexing anxiety. In contrast, when faces were viewed for longer, there was increased frontal activation and the difference in amygdalar response was reduced, suggesting reappraisal and self-regulation. Furthermore, Ochsner *et al.* (2002) found that both ACC and right OFC activation corresponded with amygdala deactivation when subjects were asked to reappraise (more positively) their interpretations of disturbing images. These data are consistent with a role for the PFC in response regulation — or emotion regulation as it is often called — more generally (see also Davidson & Irwin, 1999; Hariri *et al.*, 2003; Lévesque *et al.*, 2003). Moreover, frontal activities may become integrated with other neural changes more slowly, even after initial activations are observed, and they may maintain their organization longer than other cortical activities, reflecting their enmeshment with memory constellations that change more slowly than perceptual events. As noted by Streit *et al.* (1999) such ventral prefrontal areas as the OFC may first become activated in relation to the initial encoding of events, as indicated by single-cell findings of early OFC activation, but then repeated iterations of information processing may entrain the OFC with other frontal regions in explicit processes involving working memory and elaboration of associations. In fact, the complexification of interpretations, strategies, and plans presumably mediated by the PFC may last a great deal longer than the perceptual gestalt with which they are associated. This ‘slowing down’ goes well beyond the evolution of our sensory systems and parallels instead the evolutionary developments of language and thought that permit extended planning.

Thus, the slowing down and stretching out of intentional states may set the occasion for a final phase of vertical integration, incorporating the PFC in an extended sequence of iterative processes. Furthermore, this phase may parallel the complexification that builds up in a self-stabilizing EI, once appraisals have consolidated but goals are not yet attained, and more articulated and focused cognitive activities are required to attain them. Although Freeman (2000) may be right in ascribing intentional action to all animals, we suggest that the slow-down of planned action through frontocortical processes elaborates intentionality in a uniquely human way: from a momentary surge — exemplified by the pouncing of a cat onto a mouse or onto its owner’s lap — to a rich and articulated psychological preoccupation with a particular future state — characteristic of human consciousness.

Emotional Awareness and Intentionality: Toward a Neuropsychological Timeline

Emotional feeling serves its earliest function in the self-amplification phase of an EI, when intentionality first emerges. At the psychological level, it drives our attention to focus on particular aspects of situations and it initiates our compulsion to reorient the stream of action toward the targets of that attention. But affective feeling may feed back directly to neural changes as well. Here we refer to Panksepp’s (2005) radical proposal that neural function and phenomenology are two features of the same unitary process. In Panksepp’s view, affective

feeling initiated by the brain stem directly signals other information-processing systems in the brain to attend to the situation associated with the affect (e.g., the excitement of *seeking* tunes perceptual systems to novel vistas to be explored). He states that ‘an emotive system for resource acquisition is an intrinsic part of the nervous system, and...it entails an affective feel — an invigorated positive feeling of engagement with tasks...The affect would be a good way to encode the importance of arousal of a brain system that motivates such behavioral richness’ (p. 26). However, during the initial phase of an EI, affective feeling remains largely preattentive. While it initiates attentional focusing and other cognitive activities, it is not yet the focus of these activities. The research reviewed earlier suggests that the insula may be involved in affective feeling at this level, though Panksepp argues that the outputs of brainstem activity are all that are necessary for implicit affective feeling. We suggest that the proximity of the insula to the limbic system, and its direct connections to both amygdala and brain stem, make it a likely organ of affective feeling even in the early phases of an EI. Research concerning the role of the insula in unsuppressed emotional responses (Eisenberger *et al.*, 2003; George *et al.*, 1996; Lévesque *et al.*, 2003, Taylor *et al.*, 2003) also suggests that higher cognitive processes are not necessary for the emotional feelings mediated by the insula, and may at times suppress them. Indeed the insula has been proposed as a key mediator of Damasio’s (1994) somatic markers (Craig, 2002), which operate largely at a preattentive level of awareness.

We described three levels of goal blockage that increasingly extend the duration of a self-stabilizing EI, enhance its complexity, and stretch out intentionality over time. At the first level, an expectable and unremarkable delay in goal satisfaction requires no explicit planning or decision-making. Background awareness of emotional feeling, mediated by the insula, is enough to maintain attention to the task at hand and to direct perceptual and cognitive activities toward achieving the desired outcome. Vertical integration has by now recruited coordinated activities across the neuroaxis, including the posterior cortex, but prefrontal cortical systems are not yet committed to the new intentional state, and may in fact maintain some pattern of activity that remains from a prior EI. One frequently remains engaged in an intricate conversation while speeding up or slowing down in order to change lanes. Gabriel *et al.* (2002) discuss the role of the posterior cingulate cortex in automatized routines that have already been well-learned. This region of the action-oriented cingulate may be responsible for small modifications in the execution of automatized routines, but it is not involved in challenging situations that require explicit attention and new learning (Gabriel *et al.*, 2002).

At the second level of goal obstruction, deliberate cognitive efforts are required to attain goals that cannot be achieved on the fly. There is ample evidence to indicate that the dorsal ACC often becomes involved at this level. Both neuroimaging and electrophysiological methods implicate the ACC in response selection and performance monitoring. For example, ACC activation is commonly associated with the ‘inhibitory N2’, a negative ERP peak 200–400 ms

after a visual stimulus, which taps successful performance on tasks requiring one to make difficult choices, inhibit prepotent actions, or overcome misleading cues. The ACC is also assumed to underlie the error related negativity (ERN, e.g., Luu *et al.*, 2003; van Veen & Carter, 2002), which taps error monitoring, as depicted in Figure 4. Both the inhibitory N2 and the ERN peak about 200-400 ms following the initiating event (cognitive registration of anticipated error in the case of the ERN). And because the ERN is thought to precede explicit consciousness *of the error*, we may tentatively conclude that early ACC involvement directs focal attention to the stream of action rather than to internal cognitive or emotional events. The role of the ACC in explicit, volitional consciousness has been well documented (Allman *et al.*, 2001; Bechara & Naqvi, 2004; Dehaene *et al.*, 2003; Lane *et al.*, 1997). Moreover, a number of studies have demonstrated little ACC activity when subjects are viewing emotional pictures passively but pronounced ACC activity when they are making judgements about those pictures (Hariri *et al.*, 2003; Lane *et al.*, 1998, and Taylor *et al.*, 2003). We have suggested that the kind of attention mediated by the ACC is integrative and holistic, focused on action and its anticipated consequences. Thus, recent perceptual information about the obstructive features of the world should serve as a springboard to the 'aiming' of intended action mediated by the ACC. Yet the question remains: what is the content of consciousness at this level of goal obstruction? We propose that the obstructions themselves are at least implicit in consciousness, but the means for overriding them occupy focal attention more centrally. That is, one's attention is focused on the actions one is about to undertake and on the changes in the world that are likely to result from them. The beam of attention is focused on the objects of intentionality. An extended stay at this level of deliberate goal pursuit probably involves a great deal of entrainment among dorsal and lateral prefrontal systems, as attention moves back and forth from the specifics of the obstructions to the strategies needed to overcome them. However, neither explicit awareness of the blocked goal itself nor of the emotion arising from it need play any part in this process. Only implicit awareness of affect is necessary to continue to guide attention, planning, and action.

The third level of goal obstruction is designated by changes in the internal milieu rather than changes in the world, but it follows upon the failure (either actual or anticipated) of intended actions to achieve desired outcomes. If one's goal is to escape an impending threat, then the continued failure to reach a safe haven amplifies feelings of fear and anxiety until they cannot be ignored. If one's goal is a sexual exploit, then the delay in achieving it generates a level of excitement that can flood one's awareness and interfere with conversation. If one wishes to defeat an opponent in tennis, then every point lost increases frustration and anger until awareness of these emotions becomes insistent and focal. Or, when anger turns to sadness, because defeat seems inevitable, the awareness of a sense of bleak deflation may suddenly occupy focal attention and cause one to give up. In all these examples, it is either intensity or unexpected change in emotional feeling that brings it into focal awareness.

At this final phase of an EI, vertical integration may in a certain sense be complete. Now, cingulate and prefrontal processes may finally be fully coordinated with limbic and brainstem activities. This state of affairs does not necessarily take a long time to evolve. It does not take long to realize one's fear when an approaching stranger refuses to look away. But to pinpoint the time course of explicit emotional awareness, we can look again to the ERP waveform shown in Figure 4. The Pe peaks about 300-500 ms following the ERN — that is, about 800 ms following the first cognitive perturbation in the sequence. Because the Pe is associated with explicit awareness of the emotional significance of events (Nieuwenhuis *et al.*, 2001), and because its cortical generator is apparently in the ventral region of the ACC (van Veen & Carter, 2002), one may speculate that dorsal-ventral integration is completed within this time frame. Now attention to actions, mediated by the dorsal ACC, becomes integrated with attention to emotional contingencies in the environment, mediated by the ventral PFC (including the OFC), and with attention to emotional feelings themselves, mediated by the insula through its connections to the ventral PFC. Indeed, the OFC and other ventral prefrontal structures must be crucial arbiters of emotional awareness. As reviewed earlier, these areas are thought to process context-specific, motivationally relevant contingencies in the world, to mediate explicit emotional appraisals, and to support a system of emotional working memory that extends the perception of emotional states over time (e.g., Rolls, 1999; Schore, 1994). Damage to these systems has been associated with unrestrained actions, freed up from the anxiety generated by the anticipation of negative consequences (Bechara *et al.*, 2000; Blair *et al.*, 2001; Damasio, 1994). What we are proposing is that ventral prefrontal activation tunes attention to how things are, not just how we would like them to be. Now the insula's map of the internal milieu, intensely coloured by emotional feeling states, is made fully available to prefrontal processes mediating appraisal. As well, the neuromodulators and neuropeptides that enhance the activity of specific circuits in all parts of the brain now constrain focal attention mediated by the PFC toward those aspects of the world that match primitive motivational agendas. The prefrontal cortex can now be said to be captured by messages about one's emotional state.

One could argue that the emotional responses needed to make prudent decisions and maintain appropriate behaviour need not be the focus of direct attention. Indeed, the appraisal and regulatory activities mediated by the ventral PFC may not require focal attention to function smoothly. However, we do not claim that the stimulus-bound, reactive 'cognitive style' of the ventral trend is sufficient for focal attention to emotional states. Its role in cognitive processes, characterized by preoccupation with the details of experience, would be inadequate for a gist-like sense of the self in the world. Instead, we are proposing that the integration (or synchronization) of activity in ventral prefrontal structures *with* that of dorsal prefrontal systems mediates comprehensive awareness of emotional states. The stimulus-bound processing of the ventral trend should be sufficient to perceive the emotion-relevant properties of the outside world as well as the bodily concomitants of emotional states mediated by insular activity.

However, the synchronization of these processes with dorsal and lateral prefrontal systems, mediating working memory, response selection, and planning, should be necessary for a comprehensive awareness of the inner world, the outer world, and the generation of intended actions designed to adjust the relation between the two.

What does emotional awareness buy us? One possibility is that the extended integration of an explicit emotional consciousness catalyses awareness of intentions themselves. When we are pursuing goals, adjusting our actions to compensate for the obstructions in our way, we are not aware of the goals — only of the obstructions and our efforts to overcome them. However, explicit emotional awareness may compel us to include, in our appraisal of our actions in the world, an appraisal of what is propelling those actions. That would be the best way to make sense of the feelings we experience. The integration we have modeled among dorsal and ventral systems would permit awareness to bump up and down between what we are doing and how we are feeling, such that a global gestalt of ourselves *as* intentional beings can finally emerge. We further suggest that explicit awareness of one's intentional state may scale back the ramifications of cognitive complexity that have emerged in a stable EI. One may continue to strive for the same goal, but with renewed focus, vigor, and concentration. Or, one may abandon the present intention because it is unattainable or less relevant than was previously assumed. With focal attention to one's feelings and intentions dominating consciousness, there are now opportunities to engage volitional processes and aim them in a novel direction. Whether explicit consciousness of emotion is an evolutionary adaptation that contributes to perspective-taking and volition, or whether it is a byproduct of the evolution of our wonderfully complex cognitive capacities, we are lucky to have it. It not only enriches our sense of ourselves as emotional and volitional beings but it also allows us to look up from the details of the world to the gist of our movement through it.

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