

# The Relevance of the Buddhist Theory of Dependent Co-Origination to Cognitive Science

MICHAEL KURAK

*Department of Humanities and Languages, University of New Brunswick, Saint John, New Brunswick, Canada  
E2L 4L5, e-mail: mkurak@unbsj.ca*

(Received: 7 August 2002; in final form: 11 July 2003)

**Abstract.** The canonical Buddhist account of the cognitive processes underlying our experience of the world prefigures recent developments in neuroscience. The developments in question are centered on two main trends in neuroscience research and thinking. The first of these involves the idea that our everyday experience of ourselves and of the world consists in a series of discrete microstates. The second closely related notion is that affective structures and systems play critical roles in governing the formation of such states. Both of these ideas are contained within the Buddhist theory of dependent co-origination. This paper explicates the theory of dependent co-origination in light of the aforementioned developments. It examines the role of the theory of dependent co-origination within Buddhism and it draws attention to critical differences with the neuroscientific account of the same process. Finally, it discusses specific ways in which these differences may be usefully applied to neuroscience research and thinking.

**Key words:** appetite, Buddhism, contingent, dependent, desire, emergence, emotion, interdependence, Kant, neuroscience, perception, self, Spinoza.

## 1. Kant, Cognitive Science, and the Buddha

What is the nature of the everyday consciousness that seems to accompany all ones experiences and by what means is it sustained? These questions must be considered in turn, for the answer we provide to the first will have implications for the second. In the Critique of Pure Reason, Kant argues that the possibility of experience requires a self-same referent, an “I,” to serve as its locus. This permanent is not, however, the self that I feel to be accompanying my experiences, but is rather a formal condition of experience. The self that I know and love, he argues, need not be a substantial continuant (B 133, p. 178). Instead, it may be the case that our normal sense of continuity is sustained by a memory-dependent process in which present “I-states” and their contents are continually transferred to subsequent “I-states,” which then naturally appear to have the same referent or self (A 363, p. 397). There is, Kant concludes, nothing in experience that can refute “the proposition, put forth by some ancient schools, that everything in the world is *in flux* and nothing is *permanent* and enduring” (A 364, p. 398). In fact, if it weren’t for the necessity of a permanent as a formal condition of experience we could “never establish whether this I (a mere thought) is not just as much in flux as are all the remaining thoughts that it strings one to another” (A 364, p. 398).

Putting the issue of the necessity of a formal condition of experience to one side, we can observe that there are at least two other traditions that maintain that experience depends

on the kind of state transitions to which Kant alludes above. The first of these is cognitive science and the second is Buddhism. Within cognitive science there has for some time been a growing consensus among an influential group of theorists that our sense of continuity depends upon the recurrent formation (and dissipation) of momentarily stable states of cooperative neural activity across various regions of the brain (Libet, 1993; Lehman et al., 1998; Damasio, 1999; Freeman, 1999; Edelman and Tononi, 2000). According to these authors understanding how experience is possible involves understanding the dynamics of the formation and transition of recurrent microstates. Although there are worlds of difference at the level of technical detail, this same basic position also lies at the heart of Buddhism.

The Buddha is purported, upon his enlightenment, to have discovered not only the fact that experience consists in a series of discrete moments, but also an understanding of the causal processes responsible for the formation and transition of such states. The canonical Buddhist account of this process, which builds upon the Buddha's original insights, is encapsulated in the theory of *pratītya-samutpāda*. The theory of *pratītya-samutpāda* is central to all Buddhist schools. It is, according to Satkari Mookerjee (1935/1993), "a theory, which in its richness of details, in its various applications and abstruse metaphysical character, will remain forever an object of admiration as a triumphal monument to Buddhistic dialectic" (p. 316). This theory, when understood in the light of recent developments in cognitive science, offers insights into the natural mechanisms responsible for the appearance of a persisting self and world—that is, for human experience.

*Pratītya-samutpāda* literally means "dependent or contingent origination" (Mookerjee, 1935/1993, p. 316), but is often translated as "conditioned co-arising" or "causal nexus" (Pruden, 1988, pp. 413–417). The theory of *pratītya-samutpāda* suggests that our apparently seamless experience of the world is depends upon a succession of causally induced states in which subject and object recurrently and interdependently arise and dissipate with no underlying permanent substratum to unite them. Given the overt compatibility of such a position with that of recent developments in cognitive science one might suspect that at least some members of the cognitive scientific community would be interested in this theory and perhaps in other aspects of Buddhism. And indeed there are a small number of cognitive scientists that recognize a potential for Buddhism and cognitive science to be mutually informative (e.g., Varela *et al.*, 1991, DeCharms, 1997). Like much of Buddhist philosophy, however, the theory of *pratītya-samutpāda* is difficult to grasp, somewhat sketchy in its form and susceptible to varying interpretations. As a result the nature of its relevance to a scientific explanation of experience remains obscure. In this paper we will elucidate the theory in light of its potential relationship to cognitive science, and highlight its implications for furthering our understanding of the natural mechanisms underlying our everyday sense of self and world. Although these subjects have been briefly discussed by Varela *et al.* (1991) research since published both in Buddhist studies and in cognitive science permits a more detailed analysis to be undertaken.

## 2. The Theory of *Pratītya-Samutpāda*

The theory of *pratītya-samutpāda*, which is foundational to all Buddhist schools, is a 12-member-series that offers an explanatory sketch of how our everyday experience of self

and world is sustained in light of the fact that experience actually consists in a series of relatively discrete moments within which subject and object recurrently arise, persist, and dissipate. To better understand the basic premise of the theory one might consider an analogy with watching a film whose individual frames are continually advanced. For the analogy to work, however, one would have also to think in terms of the subject being replaced coincidentally with each frame such that the viewer and the viewed appeared and disappeared together. Notice that this view differs significantly from a Cartesian theater view in which moments of time are projected across the permanent screen of consciousness. On the Buddhist model this permanent screen simply does not exist. Instead the screen and its contents appear and disappear coincidentally with the viewer. In this case time intervals where neither viewer nor film is present, from the perspective of the viewer, simply do not exist. The result is the impression of an essential nonmomentary self and world.

*Pratītya-samutpāda* generally has two aspects that correspond to two senses of the term *viññāna* (Waldron, 1994). *Viññāna*, etymologically speaking, is “that which makes something known (*viññapti*), i.e., perceives or cognizes (*upalabdhi*), an object (*visaya*, *ālambana*)” (Schmithausen, 1987, 5.2, p. 85). Hence, *viññāna* can be translated either as consciousness or as cognition. Considered as consciousness, *viññāna* is an atemporal constitutively illuminating power that, by containing all possible experience in potential form, is always already complete. This first aspect of *pratītya-samutpāda*, which is largely exemplified in the first few stages of the series, points to a mental function akin to that performed by Kant’s formal condition of experience. In this way, *pratītya-samutpāda* is able to provide the kind of a priori basis that philosophy has historically suggested is required to build a complete account of the possibility of experience. The second aspect of *pratītya-samutpāda* provides an explanatory sketch of those cognitive processes that are responsible, on a moment-by-moment basis, for experience proper. The two aspects of the series together provide a general elucidation of the process by means of which our everyday experience of the world emerges and is sustained.

The *pratītya-samutpāda* series begins then with ignorance (*avidyā*) or, more specifically, “what is hidden by ignorance (*avidyānivṛta*)” (Streng, 1967, p. 217). Ignorance can be defined as a lack of insight into the nature of one’s mental processes. Overcoming ignorance is the main goal of Buddhist practice. It is because we are ignorant that the remaining steps of this causal chain invariably reinforce the fundamentally illusory impression that *I exist* and so suffer the various impressions of the world. The second stage in the series is intention/consequence (*samskāra*). Although *Samskāra* can be literally translated as intention/consequence, but it is often used to mean “mental formational forces” or “impulses.” The paradoxical bivalent meaning of *samskāra*, as intention and consequence, indicates that, as in Brentano’s or Wittgenstein’s philosophy, intention—the active forming part of experiences—and consequence—the receptive experienced part—are ultimately not two distinct things. The role of *samskāra* in the series is to generate consciousness (*viññāna*) by calling upon conditioned emotionally laden memory (*nāma-rūpa*—lit. name and form) to direct attention and to provide meaningful form and content to the emerging moment. This is done in a kind of top-down fashion through informing the six cognitive groups (*śaḍāyatana*—i.e., sight, sound, touch, taste, smell, and states of thought/feeling) as to

the nature of the object(s) with which they are currently engaged. In fact, each of the six cognitive groups, which are not to be literally identified with the sense organs, is often said to have its own corresponding *vijñāna* through which it is rendered potent. Such a position is consistent with a cooperative functional neural group approach to explaining consciousness. Once the six cognitive groups have begun to settle on a state, contact (*sparsha*) with the object(s) becomes possible. Out of contact springs sensation (*vedana*). The moment has not fully formed, however, and the nature of the object has not been fully revealed until the significance of the resulting sensations is appraised in light of one's immediate desires (*trishnā*)—a process which also has the effect of imputing the impression of existence to the emerging object(s). *Trishnā* literally means “thirst.” Hence, we must understand desire here to indicate an appetitive drive or craving for something of which one may or may not be conscious. As will be explained in more detail later, *trishnā* refers to a critical point in the processing stream because it is here that an opportunity arises to moderate the effects of the largely unconscious processes that have come before. After this point the self that we commonly sense to be accompanying our experience becomes fully present in the context of appropriating, or clinging to (*upādāna*), the resulting “facts.” By means of this process of appropriation those emotional memory systems that were required earlier in the series are altered in a manner consistent with the determined significance of the object(s) (i.e., through learning). Hence, as Freeman (1999) argues, consciousness “is an order parameter and an operator that comes into play in the action-perception cycle as an action is being concluded, and as the learning phase of perception begins” (p. 186). In this way, the ground is prepared for the continuation of the processing cycle into the next moment (*bhāva*); a process which, once again, is accomplished within the context of relating the remnants of previous experience (*jāti*) to the six cognitive groups. The *pratītya-samutpāda* series ends with the observation that this cycle will, unless it can be transcended, repeat itself until old age and death (*jarā-maranam*).<sup>1</sup>

### 3. The Role of the *Pratītya-Samutpāda* Series in Buddhism

Since for Buddhism it is precisely the impression of an essential non-momentary self that binds one to suffering, an important aspect of Buddhist practice consists in gaining insight into the nature of the underlying mental processes that are responsible for this impression as a means of overcoming their influence. Although liberation from their influence cannot be gained solely by intellectual reflection, the theory of *pratītya-samutpāda* offers rational support to the Buddhist practitioner in his or her quest. Of central importance to the *pratītya-samutpāda* series is the generation and perpetuation of the contents of emotionally laden memory systems (*anusaya*). On a moment-by-moment basis, it is these latent contents or dispositions that are reflexively drawn into making sense of the world. Hence, it is these

<sup>1</sup>The *Abhidharmakosabhāṣyam* suggests: “The ‘part’ that receives the name of consciousness in a present existence [i.e., mind-moment] is called *jāti* in a future existence. . . . From *jāti* until sensation, . . . there are four parts of the present existent, *nāma-rūpa*, the six *āyatana*, contact and sensation which are, in a future existence designated by the expression old age and death, the twelfth part of this twelvefold series” (Pruden, 1988, p. 404, square brackets mine).

latent contents that are ultimately responsible for conditioning immediate appearances in a manner that sustains the illusory impression that *I exist across experiences*, as opposed to arising and ceasing with them. This is made clear, for example, in the follow passage from *The Book of Kindred Sayings*:

[Even] if one does not will, O monks, does not intend, yet [a disposition] lies dormant (*anuseti*), this becomes an object for the persistence of consciousness. There being an object, there comes to be a support of consciousness. Consciousness being supported and growing, renewed existence takes place in the future. Renewed existence in the future taking place, old age and death, grief, lamentation, suffering, sorrow and despair come to pass. Such is the arising of this entire mass of suffering (Rhys-Davids, C. A. F. and Woodward, F. L., trans., 1894/1904: *Samyutta Nikāya*, Pali Text Society, London (191–230), in Waldron, 1994, p. 205).

A central Buddhist aim, therefore, is to reduce significantly the unreflective impact of emotionally laden memory on experience. Unfortunately, since subsets of this “mass of suffering” only become visible in the context of being drawn into service, such a reduction turns out to be a difficult and prolonged task requiring the consistent practice of a comprehensive strategy.

In Buddhism this strategy is commonly referred to as the eightfold path. The eightfold path can be broken up into three main areas—the “threefold training” (*trishiksha*). These areas are composed of (1) training in moral discipline, (2) training in mind, and (3) training in wisdom. By training in moral discipline is meant cultivation of wholesome intentions and activities (e.g., compassion, generosity, justice) and avoidance of unwholesome intentions and activities (e.g., greed, lying, slander). Training in mind is done through meditative practices. Training in wisdom involves the cultivation of insight (*prajñā*). These three elements work together to reduce the negative effects of desire and clinging and ultimately to liberate one from the unreflective impact of ones dispositions.

The effects of such a reduction on any given moment of processing can be understood more fully with reference to the *pratītya-samutpāda* series. Desire (*trishnā*), once again, is sandwiched between sensation (*vedana*) and appropriation (*upādāna*). One of the main functions of desire is to drive action that will result in its own reduction. To do this effectively requires ongoing feedback to monitor progress toward a goal and, in the latter stages of the processing stream, this means judging the significance of sensations to “me.” A reduction in desire at this point then will have two main effects. First, there will be a reduction in motivation and in the emotional intensity of action. Second, there will be a reduction in the intensity of the relationship that is perceived to exist between the object(s) and myself. In other words, the significance of sensations to me will be less of a concern. This, in turn, will affect both learning and the strength of the impression of the actuality of the object(s) and of myself. Hence, by reducing the impact of our desires and preferences in the latter stages of processing one can affect the nature of what is experienced, of what is remembered and of what is unreflectively drawn into future processing.

Interestingly, the Yogācāra Buddhists argue that, because momentary mind can only entertain mind-states serially, if there were no emotionally laden memory system

(*ālayavijñāna*), but only momentary mind, entrance into *nirvāna* would occur simply upon any fully wholesome act. As Waldron (1994) notes

If there were no mind with all the seeds [dispositional memory], this would entail the further consequence that when a supramundane moment of mind occurs in the Formless Realm, the other mundane *cittas* [minds] would be non-existent, that is, . . . when the counteractant (*pratīpaksa*) is present, then since all of the counteracted (*vipaksa*) have ceased, *nirvāna* without remainder (*nirupadhiśesanirvāna*) would be attained naturally and without effort (pp. 27–28).

As a result of the persistent influence of emotionally laden memory systems on processing, the experience of a self is present even in long-practicing Buddhists. Nevertheless, according to the Buddhists, over time vigilance in such matters paves the way for the emergence of a mode of knowing that does not rely on appropriation and clinging and, hence, does not generate an illusory sense of self. In particular, once the influence of desire and emotionally laden memory within the processing stream has been sufficiently reduced the impression of an actually existing world standing over against an actually existing self begins to lose some of its efficacy. It is in this way that training in moral discipline is effectively aligned with training in wisdom. Eventually one gains insight (*prajñā*) into the fluxional and interdependent nature of experience and ignorance (*avidyā*) is dispelled through the realization of the four noble truths. The four noble truths are (1) the truth that all existence is characterized by suffering; (2) the truth that the origin of suffering is craving, desire, or thirst which breeds attachment and thus, further arising and passing away; (3) the truth that the absolute elimination of craving brings the cessation (*nirodha*) of suffering; (4) the truth of the eightfold path that leads to the cessation of suffering.

#### 4. Desire and Epistemology

The idea that desire and preference play a central role in determining the contents of experience and memory is perhaps not contentious. However, the idea that they also play a role in imputing the impression of existence to both self and world may be received with some skepticism. Although the subject cannot be discussed at length in the present context there are, besides the Buddhists, at least two notable philosophers who support such a position. The first of these is Spinoza and the second is Kant.

According to Spinoza's psychology, the ability of the human mind to affirm its actual existence over time, together with that of the world, depends on appetite or desire. Spinoza (1677/1982) argues along the following lines. The *conatus* with which each thing acts or endeavors to persist is nothing but the actual essence of the thing itself (Part III, Pr. 7, p. 109). In the case of the human mind this essence is appetite or desire, which is the same thing except that desire is appetite accompanied by the consciousness thereof (Part III, Pr. 9., Schol., p. 110). Hence, the *conatus* with which the human mind endeavors to persist or act is desire or appetite. Now, in the case of the human mind, the endeavour to persist consists in the affirmation of its present existence together with that of the body (Part III, Pr. 10, p. 111) and world (Part II, Pr. 16 and Pr. 17, p. 77). Hence, appetite or desire is that with which the mind affirms its present existence together with that of the world.

In fact, Spinoza goes so far as to suggest that if the mind were, at any time, to cease to affirm the present existence of the body (and of the objects with which it is engaged)—that is, if the mind were, at any time, to cease completely to be appetitive—then it and its capacity to perceive through the senses would be instantly annulled (Part III, Pr. 11, Schol., p. 112)!

Although Kant does not go quite so far, the same ontic implication of desire is reinforced a century later in the Preface to the *Critique of Practical Reason*. There he defines “the power of desire as the power of being the cause, through ones presentations, of the actuality of the objects of these presentations” (Kant 1788, Ak.V, p. 16, n. 19, in the *Critique of Judgement*, 1790/1987, CJ 177, p. 16, n. 18). He then argues that to allow desires and preferences access to intuitions, sensations, perceptions, cognitions, etc., is to cause them to appear as actually existent (cf. Kant 1790/1987, Section 2, CJ 204, p. 45). On Kant’s line of thought, the pleasure or displeasure that is associated with any sensation results from desires and expectations being met or not met. In other words, the associated pleasure or displeasure results from how a perceived stimulus, whether real or imagined, affects or will affect “me.” But the power of a stimulus to affect me implies its, and my, existence (cf. Kant 1781/1787/1996 B275-6, 1996, pp. 289–290). Hence, allowing desire access to the processing stream is, at least in part, responsible for the impression of the actual existence of self and world.

With respect to this thesis in general, and to Spinoza in particular, it is noteworthy that Damasio (2003) has recently published a book in which he argues that Spinoza prefigures contemporary neurobiological theory concerning “the natural mechanisms responsible for the parallel manifestation of mind and body” (p. 12). In current biological terms Damasio argues that Spinoza’s conatus “is the aggregate of dispositions laid down in brain circuitry that, once engaged by internal or environmental conditions, seeks both survival and well-being” (p. 36). On Damasio’s model such dispositions function as emotionally salient stimuli detectors and triggers for sites in the brain that execute emotions. The triggered emotions are then viewed as having value in assisting the organism to preserve life and to achieve that which it is, consciously or unconsciously, seeking. Thus, Damasio conceives Spinoza’s conatus as a kind of homeostatic drive mechanism set to preserve life and enhance flourishing. This is not incorrect, but it does not go far enough.

Damasio credits Spinoza with the insight that, of necessity, all living organisms seek to preserve and enhance their existence and that to do this requires that the organism receive constant feedback concerning the ongoing state of both its body and its surroundings. To seek, of course, is to attempt to obtain or to achieve something that one desires and currently does not possess. Hence, it is to suffer an absence. On the Buddhist model suffering *is* self. Our sense of self, put simply, results from the moment-by-moment focused attempt to overcome a present uncomfortable state and/or to retain a present comfortable state. In this way the urge to satisfy a thirst or “lack” ends up generating the impression of self in time by driving each momentary self to grasp after something in the next moment. Damasio (2003, 2001) has worked out, at a neurobiological level, some of the main structural details that are involved in this mechanism. Indeed it might be argued that role of desire is implicit in the tack that he takes. However, there are at least two main reasons why Damasio does not

assign to desire or appetite the kind of critical role that the Buddhists do in driving those natural mechanisms that are responsible for the generation and sustenance of self and world. First, Damasio (2003) does not follow Spinoza's logic through to his identification of the conatus with appetite or desire. As a result he does not sufficiently recognize Spinoza's connection of desiring and seeking with the generation of the impression of an actually existing self and world. Second, Damasio's investigations (Damasio, 2003) are focused on what happens *after* an emotionally salient stimulus is detected (p. 53). Consequently, the question of what drives the detection process does not fall squarely within his domain of investigation. The result is that the role of desire or appetite in driving the detection process and the generation of the self from one moment to the next is not sufficiently emphasized. Damasio perhaps comes closest to these insights when he observes that: "In spite of the transformations that the body must undergo as it develops, renews its constituent parts, and ages, the conatus continues to form the *same* individual and respect the *same* structural design" (p. 36).

## 5. Furthering the Connection With Neuroscience

As a first approximation, a neuroscientific account of the coemergence of self and world roughly parallel to that offered by the Buddhists would begin with the appetitive drive to act in light of the contents of emotionally laden dispositional memory. This choice of a starting point is functionally equivalent to the second stage of the *pratītya-samutpāda* series and is in keeping with Freeman's analysis (Freeman, 1999) of the intentional dynamics of the limbic system. On this analysis the urge to make observations, or to intend anything at all, is manifested in terms of a kind of hypothesis or expectation about what is to be perceived or done next. The hypothesis is based on the contents of latent emotional memory systems combined with feedback from the preceding moment of experience. At a neural level it has the effect of governing brain dynamics so as to make it increasingly likely that the brain will settle on a "meaningful" state.

Obviously at any given moment not all of the stimuli available to an organism are of equal value. Moment-by-moment the neural system must do something akin to making judgments about where to direct its attention and about what to do next. Such judgments are motivated by an appetitive drive to act and are triggered by the detection of "emotionally competent stimuli"—to borrow Damasio's terminology (Damasio, 2003). Our latent dispositions and preferences, which on the Buddhist model go by the name *nāma-rūpa*, are drawn into the service of directing attention and filling out the content of each particular expectation. These expectations permit contact with the object(s) and sensation by encouraging local sensory dynamics to stabilize around an intelligent focus.

Recently, researchers interested in the neural dynamics of perceptual categorization and consciousnesses have begun to focus on elucidating this capacity of the brain to use latent memory to structure experience. Although there is still some disagreement about the role of various brain structures in perceptual categorization there is widespread agreement about the fact that systems of inherent bias, embodying preferences for this over that, are an essential component of the process (Freeman, 1999; Liotti et al. 2000; Edelman



and Tononi, 2000; LeDoux, 2002). On the emerging model there are two main routes by which such governance appears to be exercised. First, portions of the so-called limbic system are able to influence even the very early stages of sensory processing through the wide dispersal of action potentials to the various sensory and memory processing areas of the cortex (Amaral et al., 1992, Freeman, 1999). Having the same information so widely dispersed encourages the coordination of global activity around a particular focus or hypothesis. The formation of the resulting tentative focus permits a tentative consciousness to contact, as it were, the objects with which it is now engaged. This focus is then clarified further by information received through a slower but more detailed route through the sensory cortex (LeDoux, 2002). The clarification of focus prompts further evaluation of the moment in light, once again, of desires, preferences and goals, which leads to the appropriation of a result and the emergence of a more complete sense of self.

As an illustration of this process suppose that while walking down a wooded path ones attention was suddenly directed by what, for a moment, appeared to be the nose of a bear poking out past a large tree. The mechanism underlying the formation of this moment will involve the amygdala, which is known to be involved in the processing of fearful stimuli. The amygdala, perhaps being already primed by a vague background fear of the woods, will very rapidly generate a rough characterization of the available stimuli from signals received from the sensory thalamus, which will trigger discharges of action potentials to be sent widely to various cortices. This wide dispersal of “information” will encourage the brain to settle on seeing the nose of a bear and, in light of preferences for survival, will begin to set the body ready to act. Less than a half second later, however, signals sent through a more indirect but careful route through the sensory cortex might mediate this processing “decision” with information suggesting that, for example, it is the nose of a large dog. In these latter stages of processing, which involve a kind of re-representation of the stimuli, desires and preferences will influence final determinations concerning the meaning and significance of the moment. With respect to our example, how one feels about dogs will significantly influence both what is appropriated and the nature of the self that coemerges with such judgments. In other words, the nature of the appropriator that is created in the process of appropriation is dependent on his or her history of desires and preferences with respect to the object under determination; a history that, in all likelihood, will be reinforced *ad infinitum* or until death.

The second way that desire, preference, and fear influence perceptual categorization is by means of neuromodulators. Groups of nuclei in the brain stem and hypothalamus have fibers that project diffusely throughout the brain. Whenever anything significant occurs they fire, releasing neuromodulators in the various cortical units (Edelman and Tononi, 2000). Neuromodulators enhance (or inhibit) the synaptic transmission of those neurons that happen to be active at the time (LeDoux, 2002). Their effect is to further encourage the coordination of the brain activity around a particular focus. In light of the unique anatomical properties of such nuclei, and their capacity to influence perceptual categorization, they have been called “value systems” by some researchers (Edelman and Tononi, 2000). By forming a dynamic unit with the other regions of the brain these value systems, which embody

preferences for this over that, play a role in governing the processes by which experience becomes possible.

## 6. Implications for Cognitive Science

Having abandoned the notion that experience depends for its possibility on some “thing” cognitive scientists have, since the nineteenth century, increasingly turned their attentions to explicating the processes on which experience depends. Some of the most promising research in this area supports the basic view that self and object, the constituents of conscious experience, emerge interdependently and recurrently in brief states. It also supports the view that transitions across these momentary states are governed significantly by latent affective memory systems. In this paper we have argued that these recent discoveries are prefigured in the Buddhist theory of *pratītya-samutpāda*. We have also identified some ways in which this theory goes beyond present neuroscience research and thinking. First, it maintains that a fundamentally appetitive force is critical to generating and sustaining the impression of the actual existence (i.e., over time) of self and object(s)—a position that is supported by both Kant and Spinoza. Second, it identifies a significant role for an appropriative process in bringing self and object fully into focus as existents. Third, it is integrated with ethics and epistemology in ways that neuroscience now appears to aspire toward.

These Buddhist insights point to specific questions that provide opportunities for future research and thinking. Perhaps the most obvious of these questions concerns whether appetite, in some form, really is central to generating and sustaining our impression of a stable “existent” self and world; and if it is central to this sense of permanence then what can be discovered about the underlying neurobiological systems? It might also be inquired as to whether an appropriative mechanism in which the self becomes present to itself can be identified at a neurobiological level? Although devising experimental tests for these questions would undoubtedly be quite challenging I can see no principled reason to conclude that it would be impossible to do so.

Finally, one might ask whether Buddhism could productively serve as a model for the manner in which a neuroscientific theory of the parallel manifestation of self and world ought to be integrated into ethics. The significant degree of alignment that we have discovered between the Buddhist theory of dependent co-origination and recent neuroscientific thinking suggests that a closer look at this possibility is warranted. Near the end of his book Damasio (2003), impressed with the degree to which various aspects of Spinoza’s philosophy prefigures his own neurobiological views, argues for a way of integrating Spinoza’s ethics into neurobiology that relies on his interpretation of Spinoza’s conatus as a kind of homeostatic drive mechanism. Simply put Damasio argues for an understanding of ethics in terms of biological mechanism and the drive for self-preservation. However, if the conatus is understood in terms of desire then this suggests an integration of neuroscience and ethics will revolve around mechanisms of appetite and appropriation. Buddhism offers an alternative way of integrating neurobiology with ethics that is centered on increasing human freedom through gaining a degree of control over these mechanisms—that is, the mechanisms

responsible for sustaining the (fundamentally illusory) impression of the existence of self. Such a focus as this would provide productive links between religion, ethics, and science.

## References

- Amaral, D. G., Price, J. L., Pitkänen, A. and Carmichael, S. T., 1992: Anatomical organization of the primate amygdaloid complex, in J. P. Aggleton (ed.), *The Amygdala: Neurobiological Aspects of Emotion, Memory, and Mental Dysfunction*, Wiley-Liss, New York, pp. 1–66.
- Damasio, A., 1999: *The Feeling of What Happens: Body and Emotions in the Making of Consciousness*, Harcourt, Florida.
- Damasio, A., 2003: *Looking for Spinoza: Joy, Sorrow, and the Feeling Brain*, Harcourt, Florida.
- DeCharms, C. R., 1997: *Two Views of Mind: Abhidharma and Brain Science*, Snow Lion Publications, Ithaca, NY.
- Edelman, G. M. and Tononi, G., 2000: *A Universe of Consciousness: How Matter Becomes Imagination*, Basic Books, New York.
- Freeman, W. J., 1999: *How Brains Make Up Their Minds*, Phoenix, London.
- Kant, I., 1781/1787/1996: *Critique of Pure Reason*, W. S. Pluhar (trans.), Hackett Publishing, Indianapolis, IN.
- Kant, I., 1790/1987: *Critique of Judgment*, W. S. Pluhar (trans.), Hackett Publishing, Indianapolis, IN.
- Mookerjee, S., 1935/1993: *Buddhist Philosophy of Universal Flux*, Motilal Banarsidass, Dehli, India.
- LeDoux, J., 2002: *Synaptic Self: How Our Brains Become Who We Are*, Viking Press, London.
- Lehmann, D., Strik, W. K., Henggeler, B., Koenig, T. and Koukkou M., 1998: Brain electric microstates and momentary conscious mind states as building blocks of spontaneous thinking: I. Visual imagery and abstract thoughts, *Int. J. Psychophysiol.* **29**, 1–11.
- Libet, B., 1993: *Neurophysiology of Consciousness: Selected Papers and New Essays*, Birkhäuser, Boston.
- Liotti, M., Brannan, S., Egan G., Shade, R., Madden, L., Abplanalp, B., Robillard, R., Lancaster, J., Zammaripa, F., Fox, P. and Denton, D., 2000: Brain responses associated with consciousness of breathlessness (air hunger), *Proc. Nat. Acad. Sci. U.S.A.* **98**(4), 2035–2040.
- Pruden, L. M. (trans.), 1988: *Abhidarmakosabhāṣyam*, Asian Humanities Press, Berkeley.
- Schmithausen, L., 1987: *Ālayavijñāna: On the Origin and Early Development of a Central Concept of Yogācāra Philosophy*, The International Institute for Buddhist Studies, Tokyo.
- Spinoza, B., 1677/1982: *The Ethics and Selected Letters*, S. Shirley (trans.), Hackett Publishing, Indianapolis, IN.
- Streng, F., 1967: *Emptiness: A Study in Religious Meaning*, Abingdon Press, New York.
- Waldron, W. S., 1994: How innovative is the *ālayavijñāna*? The *ālayavijñāna* in the context of the canonical and *Abhidharma Vijñāna* theory, part 1, *J. Ind. Philos.* **22**, 199–258.
- Varela, F. J., Thompson, E., and Rosch, E., 1991: *The Embodied Mind: Cognitive Science and Human Experience*, MIT Press, Cambridge, MA.