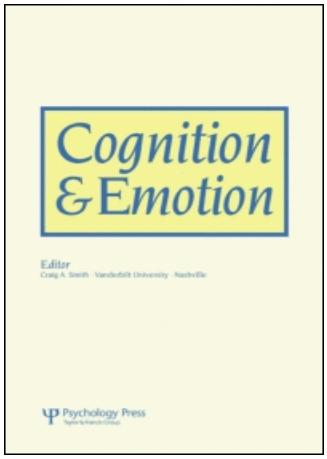

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Affective distinctiveness: Illusory or real?

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The contributions to this special issue illustrate the value of cognitive methods and theory in the study of affect. Together, this work makes a compelling case that it is time to move beyond the question of whether human affect and cognition represent completely independent constructs, and that there is much yet to be gleaned about affect from the perspective of cognitive science. Evidence that aspects of affect can be conceived as cognition leaves open the question of whether *all* aspects of affect are a special case of cognition. We pose a series of questions about whether all aspects of affect can be subsumed within cognition; and if not what the fundamental distinctions might be between affect and cognition, where and on what basis the line might be drawn between affect and cognition, what is the nature of the interactions between affect and cognition, and how are these processes implemented in the human nervous system.

Imagine you attend a magic show and are dazzled and amazed by a magician who enters a closet on one side of the stage and nearly simultaneously exits an identical closet on the other side of the stage. Imagine, further, that you are so taken by this trick that you devote yourself to determining how the trick is performed. After extensive work, you are able to reverse engineer this feat by using a fast-moving conveyer belt that runs beneath the stage between the two closets. You are so delighted by your success, even if bruised by the transition between closets, that you show the trick to the magician who responds that he did not know you too had a twin.

The contributors to this special issue provide rich and thoughtful treatments of the value of cognitive methods and theory in the study of affect. A compelling case is made by the contributors to this special issue that cognitive processes are involved in many human emotions, specifically

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that cognition can cause affect (e.g., Moors, 2007 this issue; Storbeck & Clore, 2007 this issue) and can be influenced by affect (e.g., Rotteveel & Phaf, 2007 this issue). The stronger claim—that affect is simply a form of cognition—is also made in this special issue (e.g., Duncan & Barrett, 2007 this issue; Lavender & Hommel, 2007 this issue; cf. Barnard, Duke, Byrne, & Davidson, 2007 this issue).

Collectively, the contributors to this issue also leave little doubt that there is much yet to be gleaned about affect and emotion from the perspective of cognitive science and that it is time to move beyond the question of whether affect and cognition represent the outputs of completely independent systems. However, evidence that aspects of affect can be conceived as cognition leaves open the question of whether there is something distinctive about affect—that is, whether all aspects of affect are a special case of cognition. The contributors to this special issue differ in their response to this important question, and we seek here to encourage further thought and research on this topic.

THE COGNITIVE REVOLUTION

The cognitive revolution is an intellectual movement that was begun in the 1950s by psychologists, anthropologists, and linguists as a response to the claim by behaviourists that mental processes (including feelings and emotions) did not fall under the purview of science (e.g., see Chomsky, 1959). Mental representations and processes were rendered testable in these early years by virtue of reverse engineering: mathematical and computer models were created that specified stimulus inputs, information processing operations that acted on and transformed these inputs to produce and change representational structures, and information processing operations that led to observable responses. The cognitive revolution has profoundly changed how we think about and investigate mental processes and behaviour as well as the selection of methods we use to investigate these phenomena.

No less a god of psychological theory than William James (1884) presaged the notion that affective processes resemble sensory processes and needed no special conceptual status to be explained:

> And yet it is even now certain that of two things concerning the emotions, one must be true. Either separate and special centres, affected to them alone, are their brain-seat, or else they correspond to processes occurring in the motor and sensory centres, already assigned, or in others like them, not yet mapped out ... If the latter be the case, we must ask whether the emotional "process" in the sensory or motor centre be an altogether peculiar one, or whether it resembles the ordinary perceptive processes of which those centres are already recognized to be the seat. (James, 1884, p. 188)

As valuable as the cognitive paradigm has been in advancing the scientific study of human affect, and as eminent a supporter as is William James, well over a century after James issued this proposition the theoretical question lingers. Scientific theory and research are fuelled by imagining what the alternative possibilities might be. In the spirit of promoting the imagination of what else might be theoretically possible, we raise the following questions about the dominion of cognition over affect.

Question 1

Are cognitive methods and theories the appropriate means to examine the non-cognitive, unique parts of affective processing? Or is evidence that affect can fruitfully be studied using cognitive theories and methods strong evidence that there are no unique parts to affective processing? The assumptions with which one begins a study and the theories and methods one employs in the study can dramatically alter what is found (Cacioppo & Berntson, 1994). Eder, Hommel, and De Houwer (2007 this issue) begin this special issue by noting that "recent research on affect and emotion relies heavily on cognitive methods and cognitive or cognitively inspired theorising" and they provide a compelling review that these developments have provided new insights into human affect and affective processes. The evidence that cognitive methods and theories can contribute to our understanding of affect leaves open the question of whether affect is nothing more than a form of cognition, perhaps a form of cognition that is focused on affairs inside rather than outside the body.

Zajonc's (1980) seminal paper on the topic, in which he argued that cognition and affect were distinctive, was also based on findings from cognitive paradigms (dichotic listening task and tachistoscopic presentations of visual stimuli). Zajonc's fruitful use of cognitive paradigms led him to conclude that cognition and affect were categorically different. Among the distinctions Zajonc noted were that: (a) affective reactions are primary in that the first level response to the environment is affective; (b) affect is basic in that, unlike cognition and language, affect is universal among the animal species and it forms the first link in the evolution of complex adaptive functions that eventually differentiated animals from plants; (c) affective reactions are inescapable in that it may not be voluntarily controlled, and that when emotional regulation is achieved it comes at the expense of considerable cognitive resources and effort; (d) affective judgements tend to be irrevocable in that such judgements feel valid and are beyond rational counter-argumentation ("A passion must be accompanied with some false judgement, in order to its being unreasonable; and even then 'tis not the passion properly speaking, which is unreasonable, but the judgement", Hume, 1898, cited by Zajonc, 1980, p. 157); (e) affective judgements

implicate the self in that they represent the state of the individual in relation to the object; (f) affective reactions are difficult to verbalise and, therefore, rely more on nonverbal channels for communication, in contrast to a mathematic expression—a quintessentially cognitive entity—which is difficult to impossible to convey through nonverbal channels; (g) affective judgements need not depend on cognition, which he argued based on the weak correlation between what he termed discriminanda and preferenda but which is perhaps better supported by research on decorticate animals (Panksepp, in press); and (h) affective reactions may become separated from content.

A key finding for this latter point was Zajonc's work showing that participants showed exposure-related increases in liking for the stimulus (the mere exposure effect) even though they were not cognizant that the stimuli had been presented (cf. Rotteveel & Phaf, 2007 this issue). Whether or not this was sufficient evidence to conclude affect and cognition were distinct has been debated for the past quarter century. Eder, Hommel, and De Houwer (2007 this issue) and Storbeck and Clore (2007 this issue) each critique the evidence and reasoning upon which Zajonc reached his conclusion that affect and cognition derive from independent psychological systems. For instance, processing ease, which increases with exposure frequency, is sufficient to promote positive affect (Winkielman & Cacioppo, 2001).

As compelling as might be the case, one is left with the questions of whether affect can be studied using cognitive theories and methods is strong evidence that affective processes fall within the dominion of cognitive processes, and, if not, whether cognitive methods and theories are the appropriate means to examine the non-cognitive, unique parts of affective processing. The choice of research paradigm determines the scope of the research findings, so it should not be surprising that cognitive paradigms tap into the cognitive processes. We are reminded that, prior to the cognitive revolution, the methods and theories of behaviourism were fruitfully employed to investigate affect and behaviour (e.g., Miller, 1948). That is, behavioural theories and methods proved useful in understanding affective behaviour, but in retrospect this did not prove to be especially strong evidence that a behavioural explanation for affect was correct or best. One wonders what will be said in 100 years about the current hegemony of cognition over affect.

Question 2

If affect involves information processing, then is it not by definition a special form of cognition? Behaviourists treated the mind as a black box. Cognitive scientists replaced the black box with a computer box, and the operations of the mind were modelled using the language of information

processing theory (Miller, Galanter, & Pribram, 1960). According to this perspective, thinking is information processing, including but not limited to perception, encoding, representation, storage, retrieval, response selection, and response execution. Information processing covers a very broad waterfront indeed. Information processing has been variously defined but a common definition for it is the manipulation of data so that new data appear in a useful form. That is, information processing is any operation on a datum that changes its form or function. Such a definition includes but is not limited to the coding, retrieval, and combination of information in perceptual recognition, learning, remembering, thinking, problem solving, and performance of sensorimotor acts (see, also, Moors, 2007 this issue, or Marr, 1982, for discussions of what constitutes cognition).

The difficult question is not whether all cognition is information processing but whether all information processing is cognition. If the former is true, it tells us what cognition is not, but this alone does not provide clear guidance about what might be a fundamental distinction between cognition and affect, where and on what basis is the line drawn between cognition and affect, and when is it useful to do so. If the latter is true, then by definition affect falls within the domain of cognition. The definitive nature of the latter is inviting if only because it would end a long-standing debate but there are some unintended side effects if we accept this argument. If we accept that all information processing is cognition, then a spinal cord reflex is a cognitive act even when the spinal cord has been dissected from the brain. According to the topological account of cognition (see Moors, 2007 this issue), cognition is limited to the brain. But if cognition is equated with information processing in the brain, synaptic transmissions and intracellular processes become cognitive processes, as do DNA to RNA transcriptions that occur within the brain. In fact, the simplest biochemical reaction is an operation on data that changes their form and function, and therefore it meets the definition of information processing. Does this event also fall under the dominion of cognition as long as it occurs in the brain even when it has nothing to do with behaviour?

Marr (1982) distinguished between computational, algorithmic, and implementational levels of analysis, and cognition could be limited to the transformation and construction of mental representations (i.e., the algorithmic level) and not to information processing in general (e.g., implementational level). The ability to specify an algorithm for a series of information processing operations that correspond to the physical implementation of affective processing does not render it as cognitive, however, any more than the ability to specify an aperiodic time series in terms of a periodic time series using a Fourier Transform renders the aperiodic time series periodic.

Finally, restricting cognition to the more limited definition of information processing to include perception, encoding, representation, storage, retrieval, response selection, response execution, and related constructs from computer science may still provide sufficient explanatory scope to subsume all aspects of affect, especially when the absence of the conscious perception of a stimulus can be characterised in terms of preattentive or nonconscious cognitive processes. But this begs the question of whether the activation of a smile or disgust display in an anencephalic infant (Steiner, 1973) represents a nonconscious cognition. If so, then what besides location separates these reflexive actions from spinal cord reflexes? If the answer rests with the underlying neurobiology, then does affect fall within the domain of cognition or the domain of the neurosciences?

Question 3

Is a similarity in neural substrates sufficient evidence to conclude that cognition and affect are the same? William James (1884) suggested this as a litmus test for the question of whether cognition and affect represented different aspects of the same process. Evidence that the *entirety* of the neural substrates for two outcomes is identical can be strong evidence against the hypothesis that these outcomes are the result of different mechanisms. However, is evidence that cognition and affect share *some* neural underpinnings to be interpreted to mean that cognition and affect reflect the operation of the same general mechanism? All behaviours rely on lower motor neurons as the final common pathway, but such shared neural structures does not mean all behavioural outcomes are the product of the same underlying mechanism (see Eder & Klauer, 2007 this issue, for a similar argument). The upper motor neurons innervating the cell bodies of the final common pathway, for instance, represent at least two very different central motor systems (Solodkin, Hlustik, & Buccino, 2007).

The sharing of neural substrates indicates that some component processes (e.g., sensory, autonomic, somatomotor) may be shared, or that the function in which an overlapping area is involved may be the same. Well-defined localisation of sensory and motor functions poses as a hypothesis but does not prove that more complex integrative processing by the brain is similarly compartmentalised. As Uttal (2001) pointedly noted:

> We need to distinguish between a nonhomogenous brain in which different regions can influence different mental or behavioral processes, on the one hand, and the hypothesized role of these regions as unique locations of the mechanisms underlying these processes, on the other. It is the failure to make this distinction that fuels many of the more imaginative theories of cognitive localization in the brain. (Uttal, 2001, p. 11)

Duncan and Barrett (2007 this issue) review evidence that affective processes include areas of the brain involved in classic forms of cognition, and Storbeck and Clore (2007 this issue) review evidence that the amygdala—an area known to be involved in emotion—is also involved in cognition. Investigators differ in their interpretation of the significance of such findings, however. Passingham, Stephan, and Kötter (2002) have argued that each cortical region has unique patterns of cortico-cortical connections, and that it is these more distributed subsystems of brain regions that produce the observed (more localised) differences in neural activity during different tasks. Uttal (2001) extends this argument to include cortico-limbic connections. The more general point is that what appears to one investigator to be a minor difference in neural circuits may represent qualitatively different functional mechanisms to another (Davis & Shi, 1999). Theoretical advances are promoted more by competing theoretical hypotheses than by empirical observation of a partial overlap in neural substrates.

The specific methods that are used to identify "overlapping" areas are also critical to interpretation. For instance, functional magnetic resonance imaging (fMRI) studies of the amygdala have found it to be activated by positive and negative stimuli (Wager, Phan, Liberzon, & Taylor, 2003). Given the spatial insensitivity of fMRI to specific regions within the amygdala, however, the simple activation of the amygdala in response to positive and negative stimuli says nothing about whether the same neuronal sets or circuits within the amygdala are shared. Moreover, the basolateral amygdala receives inputs whether appetitive or aversive stimuli are presented, but the projections from the basolateral amygdala appear to travel to the central nucleus of the amygdala in the case of aversive stimuli whereas they are more likely to travel to the ventral striatum in the case of appetitive stimuli (Davis & Shi, 1999; M. Davis, personal communication, 14 May 2007). Contemporary fMRI studies cannot distinguish between these circuits when imaging the amygdala.

It is also the case that showing that cognition and affect *differ* in some neural underpinning is not strong evidence that cognition and affect do *not* represent the operation of the same general mechanism. The region of the sensory cortex that represents the left and right hand are easily distinguishable by spatial location, even using fMRI, but this does not imply that they represent different central or psychological systems. Again we see that the interpretation of the neurobiological substrates of affect cannot be divorced from the extant theoretical formulation(s) regarding the role of these substrates in affect and cognition.

Finally, we need to remain cognizant of the possibility of the category error in investigations of the neural substrates of cognition and affect. The categorical error in cognitive neuroscience refers to the intuitively appealing notion that the organisation of cognitive (or affective) phenomena maps in a

one-to-one fashion into the organisation of the underlying neural substrates. Memories, emotions, and beliefs, for instance, were each once thought to be localised in a single site in the brain. We now know that most complex psychological or behavioural concepts (e.g., think more complex than motion perception) do not map into a single "centre" in the brain but rather each is associated with several different neural mechanisms. What appears at one point in time to be a singular construct (e.g., memory), when examined in conjunction with evidence from the brain (e.g., lesions), often reveals a more complex and interesting organisation at both levels (e.g., declarative vs. procedural memory processes). The last of these revisions we suspect is far from having been written.

Question 4

How much of the central nervous system would need to be eliminated to reject the hypothesis that affective reactions are necessarily cognitive? In the *Expression of Emotions in Man and Animals*, Charles Darwin (1872) observed that:

> I put my face close to the thick glass-plate in front of a puff-adder in the Zoological Gardens, with the firm determination of not starting back if the snake struck at me; but, as soon as the blow was struck, my resolution went for nothing, and I jumped backwards with astonishing rapidity. My will and reason were powerless against the imagination of a danger which had never been experienced. (p. 38)

In this comment, Darwin illustrated the distinct although interacting, and sometimes conflicting, dispositions that can arise from affective and cognitive processes. Darwin (1872) did not suggest that all emotions were irrational, rapid, and mandatory, but he was struck by those that were and he posited that these emotions were similar to the emotional responses he observed in nonhuman animals.

Affective processes are early evolutionary developments that serve important adaptive and survival functions. As such, they are observable not only in nonhuman animals but at lower levels of the neuraxis in humans, including levels such as the brainstem and spinal cord, where cognitive operations—as conceived by most people—are minimally represented. Infants are born with simple affective reflexes (Steiner, 1973), and lesion studies in animals point to a surprisingly adaptive and organised behavioural repertoire under affectively evocative circumstances.

Following up on an observation of Walter Cannon on "sham rage" in decorticate cats, the notable physiologist, Philip Bard pursued his dissertation on the brain mechanisms of this rage-like reaction, which was easily triggered in animals after removal of the cerebral cortex (Bard, 1928; see Dror, 2001, for review). These early studies noted striking signs of rage and

aggression in response to stimuli that would yield pain in intact animals. This research ultimately lead to the Cannon–Bard "thalamic-theory" of emotions (see Cannon, 1927), proposed as an alternative to the James and Lange afference model of emotion that was popular at that time. The rage-like reaction was termed sham rage because of the assumption that, in the absence of the cortex, the animal could feel no pain. This was an important political consideration in the face of early 20th century antivivisectionism (Dror, 2001). Although the hierarchical evolutionary model of John Hughlings Jackson (1884/1958) would suggest some level of awareness might exist at subcortical levels, the phenomenological features of the sham-rage syndrome are not of paramount importance for our consideration. What is more important is that decortication would be expected to degrade cognitive operations of any significance. Nevertheless, there remains in the decorticate clear evidence of an enhancement of affective expression, manifest not only in behaviour but in autonomic and neuroendocrine activation. One need not stop at the cortex—surgically decererbated animals and tragic cases of developmental decerebrate states in humans document considerable affective organisation within the brainstem (e.g., Berntson & Micco, 1976; Grill & Kaplan, 2002; Steiner, 1973), at a level of the neuraxis where cognitive operations, at least as traditionally conceived, are minimal. Moreover, as noted above, even spinal networks evidence affective organisations in the form of flexor (or pain) withdrawal reflexes that parallel Darwin's avoidance response from the puff-adder. One perhaps could define cognition broadly enough to include even spinal reflexes, but would the construct of cognition at that point be so broad as to lack meaning and invite equivocation?

Storbeck and Clore (2007 this issue) review LeDoux's (1995) proposal that the amygdala can elicit emotion in the absence of the cortex and conclude that "the low route does not play a role in processing the complex stimuli typically used in social and emotional research ... [and] the amygdala, and emotion in general, does not function independently of perceptual and cognitive processes". Barnard et al. (2007 this issue) take a very different approach to this literature, arguing that phylogenetically older neurobehavioural organisations for adaptive action constitute specifiable subsystems the ascending influences of which impact perception and cognition (see, also, Berntson, Cacioppo, & Sarter, 2003). The value of decorticate studies would not seem to be to suggest that these mechanisms in isolation explain complex forms of human behaviour but rather to determine the different neurobehavioural organisations across the neuraxis, investigate whether these organisations operate serially or in parallel, and examine the nature of both descending and ascending influences among these neurobehavioural organisations.

Question 5

Are feelings a necessary condition for affect or emotion? If feelings, which are conscious and communicable through language, are a criterial attribute of affect, then the lesion work reviewed above may be viewed as irrelevant to our understanding of core issues in affect and emotion. Many believe that nonhuman (or at least nonprimate) animals do not have feelings, which would render comparative studies of affect pointless. Yet comparative studies have revealed general principles underlying affect and emotion that have been found to hold for the human animal, as well (e.g., Darwin, 1872; LeDoux, 2000; Panksepp, in press). For instance, the existence of adaptive reflexes that are modulated by more recently evolved descending cortical mechanisms (e.g., the inhibition of the flexor withdrawal reflex when receiving a life-saving injection; e.g., Berntson & Cacioppo, in press) and the existence of neural mechanisms that originally evolved to serve one purpose that are later co-opted to serve another purpose (e.g., Eisenberger, Lieberman, & Williams, 2003) are well known in animal and human research.

The modulation of the operation of lower neurobehavioural organisations by cognition may not constitute evidence that these lower neurobehavioural organisations are "cognitive." Cognition can strongly influence respiration, but one needs neither cognition nor a cortex to respire. Hypoxia, which is associated with the activation of the anterior insula, including spindle neurons, and the anterior cingulate in humanoid primates, produces a feeling of oxygen hunger and a strong urge to breathe. Craig (in press) reviews evidence that these neural structures are necessary for the *feelings* of oxygen hunger, and he further argues that feelings of emotion are also bodily readouts and rely on these neural structures (see Duncan & Barrett, 2007 this issue). These structures are not required for normal respiration or for a respiratory response to hypoxia, however. The evidence from decorticate studies indicates that these neural structures are not required for orchestrated affective behaviour either.

LeDoux (2000) has perhaps argued most strongly in recent years that advancing our understanding of affect and emotion may be slowed if subjective feelings are used as the defining feature:

> It is widely recognized that most cognitive processes occur unconsciously, with only the end products reaching awareness, and then only sometimes. Emotion researchers, though, did not make this conceptual leap. They remained focused on subjective emotional experience. The main lesson to be learned is that emotion researchers need to figure out how to escape from the shackles of subjectivity if emotion research is to thrive. (LeDoux, 2000, p. 156).

CONCLUSION

Reverse engineering observable behaviours using the notation of cognitive science has led to a rapid expansion of theories and methods in the behavioural sciences, and the contributions of this special issue underscore the power and importance of cognitive theories and methods for understanding affect and emotion. As was the case in the magic trick involving "transportation" with which we began, however, the ability to reverse engineer a feat does not necessarily mean the underlying mechanism has been duplicated. This uncertainty is inherent in scientific inquiry and the reason theories are just that. Scientific theories represent intellectual structures that provide adequate predictions of what is observed, and useful frameworks for answering questions and solving problems in a given domain. It is parsimony that favours the interpretation that the ability to reverse engineer a feat also implies the underlying mechanism has been duplicated. The hazards of letting parsimony off its leash are important to recognise, as well, for parsimony can promote the status quo at the expense of imaginative theorising and hypothesis testing. As Albert Einstein opined:

> The mere formulation of a problem is far more essential than its solution, which may be merely a matter of mathematical or experimental skills. To raise new questions, new possibilities, to regard old problems from a new angle requires creative imagination and marks real advances in science. (http://quotes.zaadz.com/quotes/topics/science?page = 7)

We look to the current special issue not as the final word but as an important step toward addressing a new set of questions that are of fundamental importance in research on affect. Yes, there is much yet to be gleaned about affect from the perspective of cognitive science, but can all aspects of affect be subsumed within cognition, and if not what is the fundamental distinction between affect and cognition, where and on what basis might the line be drawn between affect and cognition, what is the nature of the interactions between affect and cognition, and how are these processes implemented in the human nervous system? As long as we remain open minded enough to raise new questions and possibilities and to regard old problems from a new angle, the 21st century science of affect and emotion should indeed be an exciting period of inquiry.

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