fers a vocabulary to understand relations between parts and wholes of complex phenomena, combines radically different scales of study, poses new research questions, and reconciles divergent data in productive ways. A DST-based approach to emotion reorients intractable theoretical debates, suggesting that all monovalent accounts are inadequate to describe a system with feedback loops, dynamic stabilities, and bidirectional causality. Lewis's demand that psychological theories of emotion be "biologically plausible" warrants amplification and would seem to discount virtually all emotion theories currently prevailing in my home discipline: anthropology.

Lewis's discussion of emotion in his target article, however, suffers from the paradigms of the disciplines on which he draws. The author himself highlights this when he notes psychological theory's tendency "to gravitate to a level of description that is superordinate, global, and functional" (target article, sect. 3.4). Lewis points out that psychological theory offers little help with a core ambiguity in his model – what are the constituent parts of emotional wholes? One problem is that Lewis fails to follow up on his own suggestion that action is critical to cognitive-emotional systems (sect. 3.3.3). By failing to return to the effect of behavior on emotion, Lewis neglects a crucial top-down causal relation in affective dynamic systems and allows a creeping cognitivist bias in appraisal theory to reemerge. He passes over here what is probably the most important avenue for cultural variation to affect neural architecture.

Anthropologists might supplement Lewis's promising model, but cognitivist leanings are even more pronounced in their field, and DST-based discussions have made little inroads. The "social construction" of emotion is narrowly construed as linguistic construction, with little consideration of how behavior might affect neurophysiology. The absence of anthropologists from discussions is particularly lamentable considering the contribution that cross-cultural study might make to understanding emotions as dynamic systems. Cross-cultural case studies offer avenues to test hypotheses produced in an integrated affective science. As Esther Thelen (e.g., 1995) has suggested in her studies of motor development, one way to see the workings of a dynamic system, including its constituent parts, is to perturb the system. The kinds of radical manipulation that might reveal the developmental unfolding of emotional systems are forbidden by both basic ethical considerations and the practical demands of laboratory research. Cross-cultural comparison, in contrast, offers abundant naturally occurring experiments.

Take, for example, variation in grief-like emotional dynamics. Even the most cursory survey of mourning practices reveals that emotion-action dynamics surrounding the death of a loved one vary tremendously. Anna Wirzbicka (2003) takes Nussbaum (2001) to task for universalizing even the concept of "grief," when languages like Polish, Russian, and French have no equivalent. The problem is not merely semantic (although excessive semanticism may marginalize anthropological from other affective scientists). Terms for similar emotions in these languages portray subtly different phenomenological dynamics and socially reinforced practices. Whereas contemporary use of the English "grief" singles out a person's death as an extraordinary event, even implying that it demands special treatment, the Russian language offers no unique designation for the emotions surrounding loss of a loved one, suggesting greater contiguity with other experiences, as Wirzbicka describes.

In Bali, where people are renowned for emotional placidity, children are trained very early to fear grief-like emotions as dangerous to their own health (Wikan 1990). One can imagine a stable emotional dynamic employing some of the psychological component processes that constitute what we designate as "grief" shaped by social forces. If, as Hebb (1949) suggests about neurons, those emotional elements of the brain that "fire together, wire together," the Balinese grief-like dynamic system would likely pit subsystems of fear against grief-like subsystems in inhibitory fashion. The ethnographic corpus offers abundant counterexamples. Anthropologist Renato Rosaldo (1984) describes the extraordinary rage that Ilongot men feel when a kinsman dies. Prior to pacification by the state, this rage led them to hunt heads and murder someone from a neighboring group. In contrast, Myers (1986) describes how Australian Aborigine speakers of Pintupi claim a grief-like emotional state leads them to gash their heads or stab their own thighs. The resulting scars become permanent reminders of losses; the longer one lives, the more reminders accumulate. According to Myers, grief-like emotions allegedly pile up steadily over time.

These social patterns of emotional action, following DST logic, likely affect lower-level physiological systems. How profound these changes are is an empirical question that might be addressed with such techniques as neural imaging, tests of autonomic nervous behavior, or endocrine sampling. Anthropologists often shy away from these because of long-standing complaints about "biological reductionism," arising from our field's traumatic experiences with overly simplistic evolutionary, "racial," and genetic explanations of psychological differences among peoples. In contrast, DST is hardly reductionist, and a culturally sensitive dynamic model of how emotional states emerge and consolidate physiologically could take behavioral variety into account. A DST-based explanation of variation also yields a model of culture that is more satisfying and less idealist than many of those dominant in anthropology, yet without neglecting symbolic, social, and cultural influences on development.

Considering cross-cultural data may also increase the recognition of emotion systems' flexibility on a microscopic scale. For example, in ongoing research with athletes involved in extremely demanding martial arts and no-holds-barred fighting, practitioners suggest that very basic emotional responses, like fear when being choked near unconsciousness or the vestibulospinal reflex to the sense that one is falling, can be "unlearned" (Downey, in press). Studies of altered states in meditative practice, possession rituals, and religious ecstasy yield similarly suggestive data. Although the evidence is anecdotal, these accounts are pervasive, suggesting that the phenomenology of emotional changes induced by these practices is relatively consistent. A DST approach to cross-cultural difference in emotional psychology offers the possibility of making physiologically testable hypothesis about emotional responses while recognizing that neural plasticity may be greater than we can imagine. Lewis's exploratory discussion suggests that DST might support greater conversation between brain scientists and anthropologists about both human variation and the nature of stable patterns in emotion.

Generating predictions from a dynamical systems emotion theory

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Abstract: Lewis's dynamical systems emotion theory continues a tradition including Merleau-Ponty, von Bertallanfy, and Aristotle. Understandably for a young theory, Lewis's new predictions do not follow strictly from the theory; thus their failure would not disconfirm the theory, nor their success confirm it – especially given that other self-organizational approaches to emotion (e.g., those of Ellis and of Newton) may not be inconsistent with these same predictions.

As one who has long urged a self-organizational approach to emotion, to the emotional guidance of attention, and to the circular causal relations between emotion and the more cerebral conscious processes such as thoughts, perceptions, and so forth (Ellis 1986; 1995; 2001a; 2001b; 2001c), I applaud the groundbreaking achievements of Marc Lewis in this direction. My reasons for advocating a self-organizational approach were originally derived

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from Merleau-Ponty's (1942/1963) physiological fleshing-out of phenomenology, combined with a systems conception of entities and processes – a tradition that traces back at least as far as James (1890/1968; consciousness is not an entity but a function), von Bertallanfy (1933/1962; living systems are those that can maintain their pattern across energy and material exchanges), and arguably as far back as Aristotle (*De Anima*; living organisms are those whose parts do not remain the same when disconnected from each other). Merleau-Ponty (1942/1963) also endorsed this process way of thinking; his "psychophysical forms" maintain continuity of the whole across changes in their parts, and can change the pattern of the whole very quickly even when the parts remain the same.

Lewis adds considerable value to this kind of theory by providing neurophysiological specificity, primarily in terms of synchronies of oscillations for gamma and theta wave forms distributed widely through specific brain areas already correlated with emotion, attention, and related psychological processes. By bringing such specificity to the theory, he encourages testing of new predictions involving these distributions of wave patterns. The new predictions are traced to basic principles of self-organization theory: for example, higher and lower level processes mutually influence each other (circular causation); higher level processes maintain stability across perturbations (negative feedback), and can shift abruptly from one global attractor to another (positive feedback) given a fairly discrete perturbation or, in emotion/appraisal terms, a "trigger."

Because of this high degree of specificity in working out the theory and its predictions, one need not wonder "Yes, but isn't this just a reiteration of the common notion that biological feedback systems behave in ways that maintain homeostasis at holistic levels, and that emotion is in the service of these biological needs?" In Lewis's theory, there is no doubt that much more is being asserted. He not only pulls together self-organization theory with a biological underpinning, but suggests specific mechanisms that lend themselves to subserving the proposed self-organizing structure. Most of Lewis's new predictions have to do with synchronies of 30–80 Hz gamma and 4–8 Hz theta oscillations in various widely distributed brain areas. This focus on wave patterns is not merely a reiteration of the old, mostly neglected idea that the brain is a relatively homogeneous soup in which these wave patterns flow around. On the contrary, Lewis makes use of modular divisions of labor among different brain areas known to orchestrate different emotional and appraisal processes.

But the very specificity of these predictions may pose a problem: What if these specific wave patterns are not the only possible mechanisms that could subserve a self-organizational emotion/appraisal system? This possibility would raise two undesirable consequences:

(1) Even if Lewis's predictions do not pan out, this would not falsify his basic theory. But in the scientific method as strictly understood, failure of predictions should falsify a theory. If not, then they are not really a test of the theory. Moreover, the predictions, in order to falsify the theory, must be very strict inferences from the theory, so that the falsity of the predictions would entail the falsity of the theory. That is, from "A → B," we can infer "not-B → not-A," but if A does not strictly entail B, then neither does the failure of B entail the failure of A. The problem, then (not an uncommon one in the recent behavioral sciences), is that Lewis's predictions are not really strict implications from his theory. Instead, they are framed as observable consequences that one "may" or "might" expect, or that "could" be reasonable consequences of the theory.

In my view, this is not a damning problem, because it is highly appropriate at such an early stage in the development of a theory that predictions should be framed in such tentative terms. But the fact that in this case the predictions are not really definitive tests of the theory should also be noted. They are the kinds of predictions whose failure would necessitate further tweaking of the theory, perhaps in terms of some alternative self-organizational framework, and not of abandoning it. This is especially the case when there are actually many alternative stories about brain mechanisms that can subserve a self-organizational emotional system (e.g., see Newton 2000; Ellis 2001a; 2001b; 2001c).

(2) An inverse problem is that, because there are many other versions of self-organizational emotion theories, and even non-self-organizational theories that could predict the same empirical results, it is unclear that the panning out of the predictions would confirm the theory. Instead, it would confirm that some one of these various alternative ways of accounting for the predicted results must be true. Here again, this is the case because the predictions are not strict inferences from the theory. If they were, then it would be much less likely that any alternative account would also be consistent with the same data.

But here again, the reason for this problem has to do with the youth of the theory. We can make very good use of the self-organizational framework proposed by Lewis even if not all of the specific mechanisms he proposes turn out to be the ones that subserve the self-organizational structure he has described. Indeed, it is characteristic of self-organizational structures that they could be subserved in some number of different ways. The very fact that the theory is so heuristic increases the probability of its truth, because in the realm of emotion theory it is difficult to find one coherent theory that can account for the often ill-fitting phenomena at the many different physiological and psychological levels that are involved.

Applications to the social and clinical sciences

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Abstract: Fully interpreted, Lewis's dynamic systems modeling of emotion encompasses psychological-adaptation thinking and individual and group differences in normal and abnormal behavior. It weakens the categorical perspective in evolutionary psychology and the clinical sciences; and suggests continuity between "normal" or "abnormal" behavior in whatever way this is self and culturally constituted, although culture/linguistic factors and selfhood are neglected. Application of a dynamic systems model could improve formulation of clinical problems.

Lewis's dynamic systems model of emotion comprehensively integrates psychological and neural components serving emotional cognition, action tendencies, and motivated behavior, including visceral somatic behavior. Its feedback circuits and mechanisms of neural integration provide a coherent, realistic, and comprehensive formulation of the way a neurocognitive system works in areas basic to virtually all adaptive behavior. I focus on themes not sufficiently elaborated in Lewis's very satisfying formulation.

Lewis's theory of emotion describes a largely monolithic, solipsistic, and universal brain/behavior amalgam. It models how an agent/self appraises, regulates, and operates. When played out in relation to ecology, culture, and historical conditions it produces a complex structure of (cognitive, emotional, visceral/somatic) behavior. Populations of real agents confronting shared environmental conditions would yield more or less distinctive behavior structures. An interesting question is the extent to which such conditions would shape the architecture of Lewis's model. However, there is little mention of factors that introduce individual differences, especially group or cultural differences. Furthermore, when individual differences are referred to, Lewis seems mainly interested in how they affect the model itself,, leaving aside the latter's role in shaping and consolidating human differences (in normal/abnormal, cultural behavior). The role of genes and of temperament in shaping, conditioning, or favoring pathways and centers of Lewis's model is unclear. Potential clinical implications of formulation seem to be not appreciated.