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## Criteria for basic emotions: Is DISGUST a primary "emotion"?

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Tornochuk and Ellis argue that DISGUST should be considered a basic emotional system, on a par with the other basic emotional systems such as SEEKING, FEAR, RAGE, LUST, CARE, PANIC and PLAY, which constitute the groundwork for a cross-species emotion neuroscience with immediate implications for understanding emotional imbalances that characterise psychiatric disorders. Disgust is clearly a basic sensory/interoceptive affect (Rozin & Fallon, 1987), and a socially constructed moral emotion (Haidt, 2003a, 2003b), but perhaps it is a category error to classify disgust as a basic *emotion*. It is more akin to a sensory affect. If we consider sensory disgust to be a basic emotional systems, then why not include hunger, thirst, fatigue and many other affective states of the body as emotions?

The basic affects inform organisms of various life-supportive "comfort and distress zones" in both external and internal environments. Affects are the intrinsic brain processes that help animals survive. As surmised by many scholars from Aristotle to present-day affect scientists (Cabanac, 1992), much of animal behaviour is guided by the general principle that things and events that stimulate good feelings in the brain promote survival, while those that feel bad tend to hinder survival. It is possible that the classic psychological concepts of *reinforcement* and *punishment* are actually summary terms for the way many of the basic affective processes of the brain regulate learning (Panksepp, 2005a, 2005b). Thus, a large number of affects seem to be basic tools of the nervous system, providing animals with sets of intrinsic values that can be elaborated extensively via individual and cultural learning. Obviously sensory disgust is a powerful affective feeling that is a genetically ingrained instinctual tool for survival within the brains of many species. It protects us from illness and even more intense feelings of

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revulsion, nausea and possible death. But should we accept DISGUST as a basic neuro-emotional system?

Many emotion researchers have included disgust as a basic *emotion*. Because of abundant conceptual and empirical ambiguities, many others have not. None has included *nausea* as a basic emotion, but perhaps the affective impact of disgust is largely dependent on nausea mechanisms of the brain (even though under certain conditions they can be dissociated; Fessler, Eng, & Navarrete, 2005)? Toronchuk and Ellis (2007 this issue; henceforth T&E) superbly summarise evidence indicating how the powerful affect of disgust is mediated in the mammalian brain, with simple action tendencies, and important brain-stem components that rise into human awareness within insular cortical tissues. It is noteworthy that extensive limbic brain damage that totally eliminates the ability to identify disgust, leaves recognition of the *dynamic* enactments of all the other basic emotions intact (Adolphs, Tranel, & Damasio, 2003). Thus, from a neural perspective disgust seems to be a more fragile, a more neurally and psychologically circumscribed "emotion" than the others.

To avoid conceptual dilemmas, I premised my own search for basic brain emotional operating systems on reasonably clear-cut neural *inclusion criteria* (Panksepp, 1998), as summarised and respected by T&E.<sup>1</sup> I also appreciate their willingness to use my convention of capitalising basic emotion systems, designed to highlight that specific brain networks of psychological importance are being designated. This may help minimise part-whole (mereological) confusions that are rampant in the use of vernacular psychological terms within cognitive neuroscience (Bennett & Hacker,

<sup>&</sup>lt;sup>1</sup> I have long advocated the position that basic emotional systems could be defined in terms of fairly straightforward neuropsychological criteria (Panksepp, 1982, 1992), and should include, at minimum, seven attributes: (1) They should be accessed by certain unconditional environmental stimuli. (2) They should generate a coherent set of behavioural actions and supportive physiological responses. (3) They should be able to gate inputs from the environment. (4) They should be capable of sustaining emotive activity for a substantial period after the precipitating events have passed. (5) Emotional responses should be capable of being triggered by cognitive activities. (6) Emotions should be capable of activating and regulating complex cognitive strategies. And (7) psychiatrically relevant affective experience must be generated by such brain systems. Emotional affects reflect the dynamic operations of such complex brain systems. In my estimation, sensory disgust does not really come sufficiently close to fulfilling the following six criteria. (1) Disgust easily fulfils this criterion. (2) Disgust seems to be more of a fairly discrete sensory reflex rather than generating a complex and dynamic behavioural/bodily response (the behavioural flexibility that T&E discuss largely reflects learning). (3) I am not sure there is much evidence for a perceptual gating function. (4) Disgust seems to be largely stimulus bound as opposed to generating a sustained response that can long outlast precipitating circumstances. (5) To my knowledge, it is not common for feelings of sensory disgust to be evoked by cognitive activities, even though social disgust is typically generated in this way. (6) This criterion is well fulfilled for disgust/distaste because animals and humans exhibit cognitive strategies to avoid such experiences.

2003). Neuroscientific approaches can only clarify *parts* of complex psychological phenomena, never the *wholes*.

As T&E recognise, the neural analysis of the affective life-the study of the ancestral voices of the genes as Ross Buck strikingly described it-is a critically important approach to understanding the causal substrates of basic psychological concepts. However, in postulating the existence of basic emotional systems, we must be as concerned with potential exclusion as well as various *inclusion criteria*. Exclusion criteria may be applied so as to exclude all affective states that are better conceptualised as *sensory* or homeostatic affect. I do not consider disgust to be a primary emotion for those as well as various other reasons, including inadequate evidence for some of my explicitly stated inclusion criteria.<sup>1</sup> Although T&E highlight how disgust might fulfil all of my suggested minimal inclusion criteria, the evidence is weak for various other criteria that have been extensively described but are implicit, including that there must exist a complex, dynamically flexible and *psychiatrically relevant* brain action system that can be activated with localised electrical stimulation of the brain (ESB). Also, higher cognitive processes seem to have comparatively little regulatory control over feelings of disgust. Thus, DISGUST may falter on at least three attributes that I have considered important for designating an intrinsic brain system to belong to the class of basic emotions:

1. Primary emotional systems, as far as we know, are intrinsic withinbrain tools for allowing animals to generate complex, dynamically flexible instinctual action patterns to cope with specific environmental enticements and threats. The seven emotional systems I have proposed have abundant evidence for such attributes. Their arousals are not restricted to narrow stimulus-driven survival issues, but ones that can be related to fairly large-scale organismic survival concerns arising from many environmental opportunities and exigencies. Disgust seems to be more tightly linked to specific sensorial aspects, just like tastes and pains-affects that are rarely, if ever, deemed emotional. Also, there is little evidence that localised brain stimulation of specific brain sites can generate a complex instinctual action pattern of disgust. Ever since Hess's (1957) seminal work, it has been recognised that there are brain sites that can generate relatively simple reflex-like retchingnausea responses, but so far there is no evidence that animals escape or avoid stimulation of such brain sites. Postulated disgust circuits have little support of this kind. It may also be recalled that many animals, from penguins to wolves, retch up food in order to feed their young, so this response could be associated with positive feelings, as seems to be the case in humans with bulimia disorders.

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- 2. All the basic emotions have immediate, major psychiatric implications. Indeed, most classic psychiatric syndromes can be easily re-cast as reflecting major imbalances in brain emotional systems (Panksepp, 2004, 2006). In contrast, there is little evidence that feelings of disgust can sustain all-encompassing personality dimensions in the way the basic emotions do (Davis, Panksepp & Normansell, 2003), although it figures heavily in socially constructed moral emotions (Haidt, 2003a, 2003b). When one has imbalances in sensory or homeostatic affects, the resulting health concerns typically require assistance from neurologists rather than psychiatrists or clinical psychologists.
- 3. The arousal of basic emotions sustains complex cognitive scenarios core-relational themes that lead humans to dwell on their emotional problems obsessively and often for extended periods of time (Lazarus, 1991). This is not common for disgust. Feelings of disgust are typically more reflexive and time-limited and less susceptible to cognitive regulation. Even though people can inhibit the outward expressions of disgust, they still experience undiminished internal feelings as long as the precipitating circumstances are present (Gross & Levenson, 1993).

Disgust highlights how important it is to recognise a variety of basic affect categories in mind science. As T&E emphasise, disgust is independent, to some extent, from *distaste*. Many gustatory stimuli, including sourness, saltiness to bitterness, can evoke rejection (distaste) responses in infants with no clear disgust (Steiner, Glaser, Hawilo, & Beridge, 2001). Stimuli that commonly engender unconditional disgust are ones that, if not avoided, have a high probability of leading successively to nausea, sickness, and death. Thus, from many perspectives, disgust is more akin to a *sensory* affect and nausea to a *homeostatic* affect than a primary *emotional* affect.

#### Toward a taxonomy of affects

Regrettably, there is no generally accepted taxonomy of affective capacities of mammalian brains. This permits investigators to utilise the terms affect and emotion in a variety of ways, which may reflect little more than semantic preferences. Clearly, many distinct types of affect—many intrinsic tools for surviving and learning—constitute the basic evaluative functions of the brain. Perhaps affective life needs to be subcategorised into at least three major categories: (1) exteroceptive *sensory* affects; (2) interoceptive *homeostatic* affects; and (3) within brain *emotional* affects (Panksepp & Pincus, 2004). Disgust would generally belong in the first category, even though it also has implications for the second, i.e., nausea is precipitated when body homeostasis is shifted to feelings of illness, with all the cytokine and other

bodily cascades that generate sickness behaviours (Dantzer, 2006). Let us consider these major categories briefly:

1. Sensory affects. These are tightly linked to unconditional stimuli, usually exteroceptive, and many are processed, as T&E discuss, in the insula. Pain, in its various forms, would typically be included in the category of sensory affects. Few would consider the experience of pain to be an intrinsic emotional response, even though it may readily trigger and contribute to emotions such as FEAR, RAGE and PANIC under a variety of circumstances. The sensory-affect category would obviously also include the pleasantness and unpleasantness of various tastes and smells, as well a large number of other sensory driven affective feelings ranging from a variety of itches to the pleasantness of touch and orgiastic feelings from stimulating erotogenic zones of the body. These guidance devices presumably allow animals to find satisfying comfort-pleasure zones that support life and to avoid discomfort-distress zones that help signal conditions that may harm life. Sensory disgust, as evoked by accidentally stepping in and smelling faeces, surely belongs in a sensory-affect rather than basic emotion category.

The study of whole body, complex action patterns is more important for identifying genetically ingrained emotional systems than for studying sensory affects. In general, sensory affects are typically studied by focusing on simpler, often stimulus-bound, responses following the systematic application of sensory stimuli (Berridge, 2000; Peciña, Smith, & Berridge, 2006; Steiner et al., 2001). In contrast, the study of basic brain emotional systems has been most effectively pursued by stimulating specific subcortical regions of the brain, and seeing how dramatically animals respond within constant environmental circumstances. If a state of DISGUST is, in fact, a primary emotional state, I would anticipate that when one induces that state with the most commonly used chemical trigger, lithium chloride (LiCl), one should be able to clearly identify that the animal is in that emotional state through unambiguous DISGUST-specific instinctual action tendencies across species. To my knowledge no one has ever demonstrated that such self-evident behavioural criteria exist for the disgust state, even though, as emphasised by T&E, the state can be easily indexed through the study of conditioned taste aversions, and abundant neuroscience has been done on this robust learned response (Yamamoto, 2007). Indeed, one can also index this affective state by conditioned aversive (22 kHz) ultrasonic vocalisations when animals are returned to locations where they experienced LiCl-induced aversion (Burgdorf, Knutson, Panksepp, & Shippenberg, 2001).

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2. Homeostatic affects. These include a large number of brain-body affective states, monitored both chemo-interoceptively (e.g., hunger and thirst) as well as neuro-interoceptively (e.g., urges to defecate and micturate), that are critical important for survival. They include functions such as hunger and thirst, thermoregulatory extremes, as well as a host of other bodily states ranging from bodily exhilaration to fatigue. Only a few consider such powerful affective states to be *emotional* ones: In a fine recent book, which recognises the enormous importance of deep-subcortical structures in the generations of many bodily feelings, Denton (2006), argues that thirst and hunger-indeed, all the bodily needs from air-hunger to salt-appetite—could be conceptualised as basic "emotions". I do not think this is an optimal conceptual way to parse affective space. Just as with T&E's analysis of disgust, we may be wiser to envision such critically important affective-motivational states of the body, leading to strong affective feelings of the brain, as distinct from the within-brain primary emotional processes. All emotional systems I have studied have been mapped using localised stimulations of specific brain regions that evoke unambiguous emotional-instinctual responses across many mammalian species. The sensory and homeostatic affects have never been mapped in those ways, perhaps because disgust does not yield highly distinct whole body action responses. At the unconditional level, disgust is tightly linked to various homeostatic states of the body, including perhaps levels of immunocompetence (Fessler et al., 2005). Obviously, a cross-species mapping of basic emotions cannot use facial displays as readily as is commonly used in human research (Keltner, Ekman, Gonzaga, & Beer, 2003). However, in passing it might be noted that if facial displays were a truly robust criterion for basic emotional systems, then one should consider infant facial responses to bitter, salty, sweet and sour tastes as sufficient for designating basic emotion systems (Steiner et al., 2001; see also Russell, 1994; Russell, Bachorowski, & Fernandez-Dols, 2003, for a general critique of facial criteria for designating basic emotions). No emotion researcher has ever gone that far in categorising emotional responses, even though no one should have problems in considering those to reflect basic sensory-affective responses.

3. Emotional affects. These appear to arise from complex, evolutionarily dictated action systems of the brain. In contrast, sensory affects seem to derive their valence from sensory-perceptual network functions of the brain. Emotional systems appear capable of generating affective experiences independently of the external environment or peripheral bodyderived sensory processing, as highlighted by many brain stimulation studies (Panksepp, 2005a). Although disgust is a powerful, genetically dictated ability of mammalian brains, at present there is insufficient evidence that it should be deemed an *emotional* response on par with the seven types of emotions—namely SEEKING, FEAR, RAGE, LUST, CARE, PANIC and PLAY—that have been revealed largely through localised affect promoting ESB in all mammalian species that have been studied.

Thus, perhaps T&E also need to consider more extensively that: (1) feelings of disgust are hard to evoke by cognitive ruminations; (2) they are unconditionally closely linked to sensory precipitating events, in more stimulus-bound reflexive ways than the above emotions; (3) disgust only begins to take on an "emotional" status through learning, as T&E highlight in several sections of their paper (e.g., "activation of the DISGUST system usually involves learning" and the fact that disgust typically arises "as a reaction to cues associated with increased likelihood of illness"); (4) disgust reactions do not have as clear implications for psychiatric disorders as the above emotional systems (Panksepp, 2006) even though it is relatively common motivator for obsessive-compulsive disorders, but probably because of the contamination anxiety engendered (Johnson-Laird, Mancini, & Gangemi, 2006); and (5), finally, feelings of disgust may not lead to the profound off-line cognitive deliberations as do the basic emotions, suggesting that it is more of a sensory presence, rather than a psychic "energy" (see Ciompi & Panksepp, 2004, for discussion of the energy concept in modern emotion theory) that can motivate prolonged cognitive ruminations—arouse major "core relational themes" in the terminology of Lazarus (1991).

It is also worth emphasising that disgust, beside its sensory-bodily attributes, does become a way of symbolising human social-relationships in emotion theory. Such powerful affects can be resymbolised in the social domain, from social disgust to disdain. Indeed, within the emotion community, I would imagine that most would deem social-disgust to be more of an *emotional* process than sensory-bodily disgust. However, those feelings are better understood as cognitive-cultural affectations than a basic emotional response. Indeed, social-disgust is easy to model in animals: Animals avoid potential social and sexual partners if past encounters were followed by LiCl-induced gastrointestinal distress (Peters, 1983; Pettijohn, 1981). Such effects can be long-lasting, compromising reproductive success—juvenile males that had received repeated LiCl pairings with oestrus females, exhibited sustained decreases in copulatory behaviour in adulthood (Koch & Peters, 1987). Such aversions are not simulated with foot shock (Peters, Blythe, Koch, & Kueker, 1989).

I expect T&E would agree that such acquired social-rejection responses are not well conceived as primary emotional processes. But why would it be different for the vast literature on conditioned taste aversions that they summarise? If one tries to squeeze them under the basic emotion concept, I fear we will eventually have to include a host of bodily feelings, from various sensory DELIGHTS to an enormous range of body/mind states, from exhilaration to FATIGUE.

Nothing I have said diminishes the importance of studying and understanding disgust and nausea as universal affective processes of mammalian brains and bodies, nor the value of the wide-ranging coverage of the topic that T&E have shared. Clearly feelings of disgust help animals sense conditions that need to be avoided in order to prevent disease. I would add that there is a wonderful literature that has used nauseainducing manipulations, such as LiCl, to devalue conventional food rewards to estimate the ability of animals to have evaluative experiences (Dickinson & Balleine, 2000). However, the mere existence of a powerful affect does not a basic emotion make.

Are there other basic emotional systems across mammalian species than I have outlined (Panksepp, 1998)? Perhaps, but I am not aware of compelling evidence, including items suggested by T&E such as social dominance. For instance, if the seeking of social "DOMINANCE" were a primary emotional state, as T&E suggest in their cited 2006 unpublished paper, I would be happy to include it prominently in my own thinking. However, I have also long challenged myself with that idea (see Panksepp, 1998, p. 429), but aside from seemingly compelling evolutionary arguments, there is little neural evidence for such a distinct emotional system within mammalian brains. Dominance may largely be an acquired endpoint arising from the concurrent operations of several emotional systems-SEEKING, RAGE, FEAR, LUST and especially juvenile PLAY fighting-interacting to produce a very special and important type of social learning that can be tightly controlled by certain brain chemistries (see Panksepp, Jalowiec, DeEskinazi, & Bishop, 1985). This does not diminish its importance as an *ecological universal* nor its functional prevalence within the evolution of the cognitive mind. Obviously, we need to understand what is happening in the brain when dominance and submission emerge (e.g., see Kroes, Panksepp, Burgdorf, Otto, & Moskal, 2006, 2007; Panksepp, Burgdorf, Beinfeld, Kroes, & Moskal, 2004, for our work in the area).

Many evolutionarily important brain functions may be constructed readily from learning based on other existing emotional systems. Even though dominance issues are incredibly important for psychiatric concerns (Panksepp, Moskal, Panksepp, & Kroes, 2002), by my light disgust is surely a more basic neuro-affective prime than dominance. However, at present I see no obvious scientific advantage or robust empirical justification for conceptualising either as a basic *emotion:* If *DISGUST*, why not DELIGHT and many other affects? For effective communication and well-focused scientific research, it is important to minimise category errors. Of course, such issues remain debatable because this emerging corner of brain science remains conceptually murky. I thank T&E for bringing this issue to the forefront of discussion.

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