Proceedings of the fourth Annual Interontology Meeting, Tokyo, Feb 23-24, 2012

An Emotion Ontology Based on the Perceived-Response Theory

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January 12, 2012

Introduction

Unlike ontology in philosophy, which specifies the substances and processes there are, perhaps in a given domain, ontologies in biomedical science specify the meaning of terms in the life sciences. The aim of biomedical ontologies is to increase the potential for integration of experimental and clinical online data (Rubin et al. 2008). The hope is that a greater integration of online data will lead to more effective data analysis and new discoveries.

Emotion Ontology (EMO) is a new type of biomedical ontology that focuses on providing definitions and disambiguations for the language we use to talk about emotions (Hastings et al. 2011). Emotion terminology in English can be divided into high-level and low-level terminology (Hastings et al. 2011). High-level terms, such as mood, affect, emotion, passion, drive, sentiment and feeling, specify the affect type. Low-level terms, such as despair, anxiety, anger, fear, joy, sadness and schadenfreude, specify a particular type of affect. The majority of high-level and low-level emotion terms can occur as nouns (emotion, anger, anxiety, fear) or as adjectives (emotional, angry, anxious, fearful/afraid). Adjectival occurrences of emotion terms fall into three different groups (Hastings 2011). Emotion terms are commonly said to specify one of three types of affect: a conscious, or occurrent, state of mind, a dispositional state of mind or a personality trait. For example, in saying that John is angry with Mary, we might mean that John is feeling angry with Mary and perhaps displaying behavior consistent with a feeling of anger. Alternatively, we might mean that John is disposed to feel angry with Mary, for instance, when reminded of her past behavior. In saying that John is an angry person, on the other hand, we typically mean that John has a lower than standard threshold for anger.

Hastings et al (2011) offer a definition of '(occurrent) emotion' as a first step towards an emotion ontology. Their definition is based on Scherer's five-component appraisal theory of occurrent emotions. The five components of emotions are: an appraisal evaluation of objects or

events consisting in a mental representation, a neurophysiological component, action tendencies, motor expression behavior and a subjective feeling. For example, if John is occurrently angry with Mary, then he appraises Mary's actions as having a negative effect on him, he feels angry, his body undergoes certain neurophysiological changes, he has a tendency to act in angry ways and his anger affects his facial expression, his verbal expression or his body language. The appraisal component of the emotion is a judgment about what sort of bearing an object or event has on the individual's wellbeing. For example, an event that causes fear may be judged to constitute a threat to the individual's wellbeing.

This sort of theory presumably is not meant to cover affect in the broad sense but is strictly a theory of emotions in a narrow object-directed sense. Moods, for example, do not normally give rise to action tendencies. Drives do but they may lack a subjective component. In what follows, I shall follow suit and focus on emotions proper rather than affect in the broader sense.

The aim of this paper is two-fold. First, I argue that an emotion ontology based on Scherer's five-component appraisal theory is too narrow to capture all possible types of occurrent emotion. Second, I offer an emotion ontology based on the perceived-response theory developed in Brogaard (2011). This ontology can provide the foundation for a classification of emotions into the categories rational and irrational. Possessing irrational emotions that interfere with the individual's daily function can be seen as a mental disorder.

1. Challenges for Appraisal Theories

Recent studies of individuals with a defective amygdala, or emotional brain, indicate that occurrent emotions have neurophysiological correlates. Feinstein et al. (2010), for example, studied a woman whose amygdala was destroyed after a rare brain condition. The researchers exposed her to pictures of spiders and snakes, took her on a tour of the world's scariest haunted house and had her take notes about her emotional state when she heard a beep from a random beeper that had been attached to her. After three months of investigation, the researchers concluded that the woman was not in a position to experience fear.

Though research indicates that occurrent emotions have neurophysiological correlates, it is debatable whether the neurophysiological correlates are components of emotions. For something to be a component of an emotion, it must be essential to the emotion. It cannot be ruled out on a priori grounds, however, that someone with a defective amygdala could experience fear without the presence of actual (as opposed to felt) neurophysiological changes. For exactly the same reasons we cannot expect action tendencies and motor expression behavior to be *components* of affective states as opposed to behavioral correlates.

As argued by Brogaard (2011), the only essential component of conscious, or occurrent, emotions, are mental representations with a particular phenomenology. That emotions are mental representations as opposed to mere subjective feelings is inherent in our vernacular concepts of emotion. In ordinary language we say things like: 'John fears the dog', 'Mary is

happy that Tom is back', 'Alice is angry with Peter'. The object directedness implicit in our talk about emotions suggests that emotions, unlike subjective feelings, are directed towards objects or events in the world.

The mental representations in question are not to be understood as appraisals of objects or events. There are three reasons to think appraisals are not components of emotions. First, if emotions were appraisals in a strict cognitive sense, we would not be able to extend emotion language to most non-human animals. A dog that is afraid of the mailman probably does not represent the mailman as threatening in a strict cognitive sense.

Second, appraisal theories cannot account for emotional responses to fiction. When engaging in a fiction, we respond with emotions (Carroll 1990). We are genuinely moved by fictions. They trigger affective responses: reflexes, moods and complex emotions such as sadness, fear and anger. We are genuinely distressed by the death of Anna Karenina. We take pride in Dorothy Gale's courage, sweetness and tolerance.

But in the case of fiction the objects represented by our emotional states have no bearing on our wellbeing. I am well aware that the dangerous snake on the screen presents no threat to my wellbeing. I know it is not real. I don't even have an appearance as of it being real. It's not like the Müller-Lyer Illusion in which I have a perceptual appearance as of two lines being of unequal length despite the fact that I know they have the same length (see **fig. 1**).

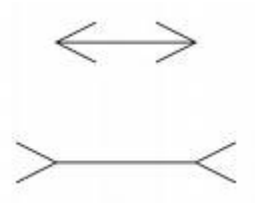

Fig 1: Müller-Lyer Illusion

While it appears to me that the lines in the Müller-Lyer Illusion have different lengths, it doesn't appear to me that Anna Karenina is actually suffering. I am well aware that Anna Karenina did not exist and hence did not suffer. So, I do not really desire for her suffering to end. As our emotional responses to fiction are genuine, genuine emotions do not consist of an appraisal of an event or object's bearing on wellbeing.

One could hold that emotions directed at fiction are pretense- or make-believe-emotions, not genuine emotions. But the bodily responses can be just as intense as emotions directed towards real objects. A closely related possibility is to say that our emotions about fictional characters are grounded in beliefs about what is fictionally the case. On this view, we believe that it is fictional that Anna Karenina suffered and respond to this with somatic changes. But this

sort of response is at odds with the idea that emotions have an appraisal component that assesses an object or event's bearing on wellbeing. Anna Karenina did not exist and hence did not suffer.

I believe the right response here is to reject the idea that emotions have an appraisal component that involves an assessment of an object or event's bearing on our well-being. We can believe that Haitians suffer and respond with emotions to their suffering, even if it does not have any bearing on our own wellbeing. It is our perception of their suffering that gives rise to our emotional responses, not their suffering in relation to our wellbeing. Similarly, the suffering portrayed in fiction can give rise to emotional responses, even if it has no bearing on our wellbeing.

Third, appraisal theories leave out an important aspect of emotions. Emotions represent physiological changes in the body. But standard appraisal theories deny that emotions require bodily sensations. Martha Nussbaum (2001), for example, argues that emotions are evaluative and eudaimonistic judgments. Fear consists partially in a judgment to the effect that something threatens my safety or wellbeing, or the safety or wellbeing of someone I care about. My fear of a snake consists in part in the belief that it is dangerous and that I have no control over what it is going to do. I fear the snake because it is a threat to my wellbeing (2001: 27-31). One argument Nussbaum offers in favor of this theory is that one could be in an emotional state despite there being no changes in one's body state. For example, finding a person's pulse and blood pressure being quite low despite an impending danger would not make us conclude that the person was not in fear. As she puts it:

> Would we withdraw our ascription of grief if these elements [bodily sensations] were missing? I believe that the answer is that there are no such elements. There usually will be bodily sensations and changes involved in grieving, but if we discovered that my blood pressure was quite low during this whole episode, or that my pulse rate never went above sixty, there would not, I think, be the slightest reason to conclude that I was not grieving. If my hands and feet were cold or warm, sweaty or dry, again this would be of no criteria value. Although psychologists have developed sophisticated measures based on brain activity, it is perhaps intuitively wrong to use these as definitive indicators of emotional states. We do not withdraw emotion-ascriptions otherwise grounded if we discover that the subject is not in a certain brain-state. (2004: 195)

However, Nussbaum's argument does not suffice to show that perceptual experiences of bodily changes are not constitutive of emotions. It only suffices to show that bodily changes are not constitutive of emotions. It seems clear that the way we individuate emotions has some bearing on the bodily perceptions they give rise to, which suggests that perceptual experiences of bodily changes are constitutive of emotions, even if bodily changes are not.

3. Conjunctive Theories of Emotions

Stanley Schachter defends a two-factor theory of emotion according to which human emotions contain two parts: physical arousal and a cognitive element. According to Schachter, both of these elements must be present for one to experience an emotion. Some form of arousal occurs (e.g., increased heart rate, perspiration, a faltering voice, and so on), one then interprets this arousal, and subsequently experience the emotion.

The two-stage theory is based on empirical research to the effect that unexplained arousal can be experienced as different emotions according to cognitive circumstances. Schacter and Jerome Singer (1962) gave 184 male college students one of two types of injections: a mild stimulant (adrenaline) or a placebo injection (a saline solution). The students were told that they were given an injection of a new the vitamin compound "Suproxin" to test their vision. One group of subjects was told about the injection's potential side effects (shaky hands, pounding heart, short breathing). A second group was told that the injection would produce side effects such as itching, numb feet, and headaches. A third group was told that there would be no side effects. After the injections the participants were left alone for 20 minutes with a stooge (blind to the subject's condition). The stooge was either told to behave joyfully, for instance, play with paper, or behave rudely and angrily. The subjects' emotional states were measured relative to the stooge by observation and self-report. Subjects who were misled or naive about the injection's effects behaved similarly to the stooge, either joyfully or angrily. Those who were informed of the expected effects of the stimulant and were given the placebo had little emotional response to the stooge. The informed students were thus able to correctly attribute their feelings to the stimulant, whereas the uninformed or misinformed students were affected by the behavior of the stooge.

This led Schacter to suggest that, what emotional experience one has depends on how one interprets the situation one is in. Emotional experience thus seems to require judgment in addition to perception of bodily changes.

Schacter's two-stage theory, or some version thereof, is now widely accepted. We can call this group of theories 'conjunctive theories'. These theories hold that emotions are conjunctive states of mental representations of bodily changes and mental representations directed at the external world. Most researchers sympathetic to the James-Lange theory of emotions now admit that emotions involve a mental representation directed at the external world (James 1884 and Lange 1885). Jesse Prinz, for example, argues that emotions are perceptions of changes in the body states coupled with core relational themes which reliably cause those changes. Core relational themes include, for example, dangers, losses, threats, and achievements. According to Prinz, then, emotions are perceptions of changes in our somatic condition, but they are also appraisals, where an appraisal is 'any representation of an organism-environment relation that bears on well-being' (2004: 57). In the case of fear, for example, the representations 'that trigger bodily response will do so in virtue of being recognized as dangerous, either explicitly or implicitly by similarity to previously established elicitors' (2004: 55). So, on Prinz's view it is central to fear that one is threatened or in danger from the object of the fear.

4. The Connection Problem

However, conjunctive theories of emotions run into trouble. John is working for the police catching stray dogs. He is currently in front of a stray dog. The dog is extremely dangerous. It clearly presents a threat to John's wellbeing. As John is used to being around dangerous stray dogs, he does not normally have any fear response to them. But today he is having a clear fear response. John perceives the fear response as being a response to a snake right behind the stray dog. In the envisaged scenario, John's fear is fear of the snake, not fear of the dog. Yet conjunctive theories predict otherwise. Given the conjunctive theories, John perceives changes in his physiological state. And he judges that the dog and the snake are dangerous. So, this group of theories predicts that John's fear is fear of the dog and fear of the snake. Call this problem 'the connection problem'.

Damasio, who takes emotions to be physiological changes, has proposed a solution to the connection problem that rests on the idea of a 'somatic marker' mechanism. A somatic marker mechanism is a mechanism that underlies the interaction between cognitive representations of the external world and cognitive representations of the internal world. Our cognitive representations of physiological changes enable us to evaluate external perceptual stimuli. For example, if an external stimulus causes a fear response, we can use this cognitive representation of our body state to evaluate the external stimulus as dangerous and act appropriately in response to this stimulus. Somatic markers are associations between stimuli and emotions. The brain links physiological changes with the stimulus that produced it. For example, the brain links the visually presented dog with the fear response produced. The two inputs produce new representations that encode both visual information and the physiological change produced by it. This association between the body change and the visual image is stored in working memory. Somatic markers enable us to be steered towards certain options and react appropriately to potential longer term rewards, instead of responding to the immediate situation around us.

However, this sort of response to the connection problem is problematic. On Damasio's view, we have the physiological change in body state (which is the emotion of fear) before we evaluate the external stimulus as dangerous. Hence, it follows that, in the envisaged scenario, we fear both the angry dog and the threatening snake. But if we experience the snake as causing our fear response but do not experience the dog as causing any relevant response, then the natural thing to say is that we fear the snake, not the dog.

5. The Perceived-Response Theory

An adequate theory of emotions must respond to both the problem of emotional responses to fiction and the connection problem. I propose that emotions are mixed modal perceptions of somatic and mental responses to sensorily presented external stimuli. In previous work I have defended a theory of this kind which I called 'perceived response theory'. On this theory, emotions are perceptions of somatic or mental responses of a particular kind to an external object (e.g. an aggressive-looking person). Suppose I see an aggressive-looking person

approaching. The visual image activates sympathetic nervous system activation, which in turn gives rise to changes in my body state by acting on the muscles and hormonal levels. This change in body state then activates nerve cells in the brain. This causes a fear response.

On the view I propose emotions are not a representation of a change in a physiological state, nor a representation of features of an external object or event, but rather a perception of an object or event causing a physiological response. For example, a state of fear may be a perception of an aggressive-looking person causing the muscles to tense up, the heart to pound, and the breath to shorten. Emotions are therefore perceptual representations of body changes that occur in response to sensorily presented external stimuli. So, I disagree with Damasio that emotions are somatic reactions to changes in the world. Emotions are not somatic reactions. Rather, they are mental representations of the impact of the world on our bodies. They are not body states but intentional mental states.

The perceived-response theory does not require that the individual actually have any bodily or mental responses to an external stimulus or that the object exists as perceived or exists at all. A Matrix person living her life in virtual reality can have a perceptual experience as of a snake causing her heart to pound even if computer processes in super-computers caused her visual sensations of a snake and the pounding of a heart. Nor does the proposed theory require that the object that triggers the emotional response be real objects. The state of pity I am in when I read about Anna Karenina's suffering is a representation of the thought of Anna Karenina's suffering causing a pity response in my body or mind.

The perceived-response theory thus solves both the connection problem and the problem of emotional responses to fictions. It also explains the phenomenon of emotional conditioning (or dispositional emotions). If an event has triggered a negative response in me in the past, a similar kind of event will be more likely to trigger a negative response in me in the future. The perceived-response theory explains this phenomenon. Perceptual content can be stored in working memory. As emotions are perceptions, the perceived-response theory predicts that emotional content can be stored in working memory. When stored in working memory they play the role of Damasio's somatic markers. They can help us in the rapid selection of a course of action when presented with several choices. If we have experienced emotional pain in the past in response to a bad break-up or childhood abandonment, a similar future situation will be more likely to trigger an automatic negative reaction. Stored emotions, like Damasio's somatic markers, help create emotional responses to future situations and thus help us act appropriately.

6. Assessing Emotions in Terms of Rationality and Irrationality

The perceived-response theory also allows for an assessment of emotions in terms of rationality and irrationality. Like actions and beliefs, emotions can be assessed for rationality and irrationality. Fear, for example, is irrational when the fear is not grounded in actual risk of a significant magnitude.

According to Ronald de Sousa, emotions are irrational (or what he calls "unsuccessful") when the emotional response does not fit the perceived object or event (de Sousa 2004: 72). Fear of flying is an example of this. If flying elicits fear, then the fear response does not fit the object or event. So the fear is irrational (or unsuccessful). Lack of rationality can also reside in a

response to a misperception of the object of the emotion despite proper fit. If a child perceives a piece of satin as a bit of Satan and responds with trembling, the trembling fits the perceived object but the response is a response to a misperception of the object and hence is irrational despite perhaps being perfectly reasonable from the child's point of view.

For an emotion to be rational, it does not suffice that the object is perceived correctly and that the response fits the object. The response must also have arisen in response to features the object actually has. If a drug makes you fear a dangerous person, there are good reasons to fear the person as he is dangerous, but because the fear didn't arise in response to the threatening nature of the object, it is not rational.

This type of emotion ontology can be used in specifying when having an emotion is a mental disorder. On one influential model of disorders, a 'disorder' is defined as follows (Culver and Gert 1982: 81).

> A person has a disorder (or malady) if and only if she has a condition, other than her rational beliefs, emotions and desires, such that she is suffering, or at increased risk of suffering, an evil (death, pain, disability, loss of freedom or opportunity, or loss of pleasure) in the absence of a distinct sustaining cause.

Distinct sustaining causes are meant to exclude internal mechanisms. For example, a chemical imbalance may be a sustaining cause of irrational emotions but having irrational emotions because of a chemical imbalance may still be a mental disorder. Given this definition, possessing an irrational emotion that leads to suffering, or increased risk of suffering, an evil is a mental disorder. For example, fear of flying that prevents an individual from visiting family or pursuing a career is a mental disorder, officially classified as a phobia.

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