ratings of help. Even if they do not, the results can be analyzed to determine which pain AUs recruit the most human assistance. This might give insight to possible differences between perception of chronic and acute pain, since some AUs may be correlated more highly with one type of pain than another.

Previous studies of eye-movements indicate that we employ different patterns of fixation for different facial expressions. For example, when human observers view smiling faces they more often fixate on the corners of the eyes (Williams et al. 2001). Apparently we subconsciously check for evidence of a "duchenne," or genuine, smile which causes crinkling of the folds around the eye. A merely social smile lacks these crinkles. As with the smiling face, we may also have evolved to subconsciously fixate on certain key features when viewing a face in pain. Results from eye-movement studies can reveal which features we fixate on initially and which most frequently, when viewing expressions of pain.

Although studies of eye movements reveal much about patterns of looking, they are not an infallible guide to the distribution of attention (Ballard et al. 1995; Hayhoe et al. 1998; Zelinsky 1997). A complementary approach is the flicker task from the field of change blindness (Rensink et al. 1995; 1997; Simons & Levin 1997). Although change blindness is traditionally used to investigate attention to scenes, recent studies show the flicker technique can be used to study attention to faces, and that faces engage specific endogenous, that is, meaning-driven, mechanisms of attention (Davies & Hoffman 2002). The flicker technique involves a brief presentation of one image (about 100–1,000 milliseconds), a blank screen (about 100 milliseconds), and then the same image again with one small change to the image. This sequence cycles until the observer detects the change, and surprisingly, it often takes a long time. One reason is that the blank screen prevents motion from directing attention to the change. As a result, observers must build descriptions of items in the scene one by one, store these in visual short term memory, and then compare these descriptions with descriptions built from the second image (Rensink 2000a; 2000b; 2000c). Items whose changes are better detected are items that are likely to have received more attention. In comparing change blindness results for pain and other expressions we may find differential patterns of attention, which may indicate different evolved mechanisms for processing, and ultimately perceiving, specific expressions.

By investigating human performance in the perception and detection of pain, we can learn more about subconscious processes that influence how we fixate on, react to, and interpret expressions of pain. By comparing these results to those for other facial expressions we can more clearly define the key attributes that make pain a unique facial expression for which we have evolved specific mechanisms of perception and action.

ACKNOWLEDGMENT
This material is based upon work supported by the National Science Foundation under Grant No. 0090833.

Pain, evolution, and the placebo response

Dylan Evans

Department of Mechanical Engineering, University of Bath, Bath BA2 7AY, United Kingdom. **d.evans@bath.ac.uk** **http://www.dylan.org.uk**

Abstract: Williams argues that humans have evolved special purpose adaptations for eliciting medical attention from others, such as a specific facial expression of pain. She also recognises that such adaptations would almost certainly have coevolved with adaptations for providing and *responding* to medical care. The placebo response may be one such adaptation, and any evolutionary account of pain must also address this important phenomenon.

Williams argues that among the evolved human facial expressions there is a distinct facial expression of pain. The function of this state, she claims, is to elicit social assistance of a medical kind. The plausibility of this claim depends on how long medical care has been in existence.

Unfortunately, we are extremely ignorant about the exact age of medicine. It must have originated after the human lineage had already diverged from that of the chimpanzees, because chimpanzees do not practise medicine, if by medicine we mean the provision of special care to a sick individual *by others.* Primatologists have observed many cases in which chimpanzees take care of *themselves* when ill or injured, sometimes in quite elaborate ways, such as consuming plants with medicinal properties or dabbing leaves on bloody wounds, but they have never seen one chimp provide this sort of medical assistance to another. Chimpanzees do spend long hours picking the ticks off each other's backs, which could, perhaps, be regarded as a kind of preventive medicine, but *therapeutic* medicine seems to lie outside their behavioural repertoire.

Archaeological evidence of ancient medical practices does not appear until relatively late. Ancient texts from Mesopotamia and Egypt provide written evidence that sophisticated medical practices were well established by 1,700 BC (Porter 1997), but evidence of the existence of medicine prior to the advent of writing is much harder to come by. One rare example is the existence of skulls with small holes surrounded by calluses that indicate that trepanning was being performed in places as far apart as France and the Pacific by 5,000 BC. This is an operation which involves cutting a small hole in the skull and scraping away portions of the cranium. If such a complex operation was being performed 7,000 years ago, it is a fair bet that more primitive forms of medicine were being practised earlier, but how much earlier is hard to say.

We know, then, that medicine – the provision of special care to the sick by others – must have originated some time between five million years ago and 10,000 years ago. Of course, that is a very large time window. It is so large, in fact, as to leave us ignorant on the vital question of whether or not there has been enough time for natural selection to shape specific adaptations for medical care. If medicine originated towards the beginning of this window, shortly after the hominid lineage branched off from that of the chimpanzees, then there would certainly have been time for the human brain to have developed special purpose mechanisms for eliciting, providing, and responding to medical help. If, however, medicine only started towards the end of this time window, when our ancestors were already fully human, then there would not have been time for any such special-purpose medical adaptations to have evolved.

Still, even if we are ignorant on this point, we can still explore each of the alternatives. The first possibility is that medicine is a few million years old, and that humans have evolved special psychological and physiological mechanisms that are for eliciting, providing, and responding to the provision of medical attention. Williams concentrates on adaptations for eliciting medical care, in particular, on the facial expression of pain, but she also points out that such adaptations would almost certainly have coevolved with adaptations for providing and *responding* to medical care.

Williams draws on the work of the late Patrick Wall, particularly on his claim that pain is a "need state," like hunger and thirst (Wall 1999b). Need states are terminated by specific consummatory acts; hunger by eating, thirst by drinking, and so on. Pain, presumably, is no different. Withdrawing one's hand rapidly from a hot stove is a consummatory act that terminates one sort of pain; keeping a sprained ankle still is a consummatory act that terminates another. Crucial to Wall's argument, however, is that pain can sometimes be terminated simply by care and attention from others. It is this addition of a purely social event to the list of various consummatory acts relevant to pain that makes human pain such an evolutionary novelty.

Wall's claim about the relevance of social support to pain relief is supported by studies that have investigated the anti-inflammatory effects of fake ultrasound (Hashish et al. 1986; 1988). One of these studies found that the placebo response was only triggered when the fake ultrasound was applied by *someone else*. When exactly the same physical stimulus was applied by the patients to their own faces, the swelling was not reduced. This suggests that the mere provision of social support can be sufficient to trigger the placebo response. Perhaps this is the result of natural selection wiring up the pain generating circuits in the brain to inputs from the neural regions that are sensitive to social support. Of course, this presupposes that medical care has been a feature of our environment for long enough to enable such evolutionary change to take place.

If Wall's theory is right, and natural selection has designed specific brain circuits to feed information about the social environment into the circuits that generate pain, such circuits must confer some evolutionary advantage on those who have them. It is hard, however, to see what this advantage might be. As Williams points out, pain is a vital protective mechanism, and those who lack the capacity for pain do not survive very long. What possible advantage could there be in having a mechanism that shuts down pain when medical care is provided? Surely it would be better to make the sensation of pain autonomous, independent of such social factors?

Or would it? There are costs as well as benefits associated with pain (Humphrey 2000). In particular, high levels of pain can actually slow down the healing process. When you are alone, the protective value of pain might outweigh the disadvantage of slowing down the healing process, but when others are taking care of you, the cost-benefit ratio may change. In particular, when others can protect you, pain might not be so vital. In effect, medical care might allow the patient to offload the protective function of pain onto others: Self-defence is unnecessary when other people are around to do the defending for you. If this is true, then a person whose brain was capable of shutting down pain when it detected the presence of medical help might actually have an advantage over someone whose brain lacked this capacity (Evans 2003).

What is pain facial expression for?

Nico H. Frijda

Department of Psychology, Amsterdam University, 1018 WB Amsterdam, The Netherlands. **pn_Frijda@macmail.psy.uva.nl**

Abstract: A functional interpretation of facial expressions of pain is welcome. Facial expressions of pain may be useful not only for communication, such as inviting help. They may also be of direct use, as parts of writhing pain behavior patterns, serving to get rid of pain stimuli and/or to suppress pain sensations by something akin to hyperstimulation analgesia.

Williams defends the position that facial expression of pain belongs to pain behaviors generally, and is in some way functional in dealing with the pain. This position has proven fruitful for the study of facial expressions generally (Frijda & Tcherkassof 1997).

Since Darwin, facial expressions are viewed as functional primarily because they communicate information on the subject's state to onlookers, who may come to the subject's assistance or fulfill his or her desires. For Darwin, facial expressions were, in part, serviceable habits that survived in evolution because of the benefit for survival that their communicative value brought. It is along the same lines that Williams interprets the use of facial expression of pain.

However, there is no reason to assume that the serviceable habits have entirely lost their original significance. In fact, some of Darwin's interpretations are based on contemporary, as well as on ancient, advantages. He interpreted the obliquely drawn eyebrows of fear as a consequence of protecting the eyes under threat, and at the same time keeping them open in order to keep seeing the threat. There is no reason why this mechanism would not be operative in fear expressions in humans today, even if the automatism also occurs when the habits are of no use, such as when listening to a fearful story.

Some facial expressions are obviously functional in this sense. One example is the protective startle response; another is the facial aspect of the orienting reflex that includes one element of the standard facial expression of surprise, namely, eye-widening. Eye-widening in orienting and surprise probably broadens the available visual field, and may also facilitate eye movements.

Facial expressions of pain may well have a utility that is quite distinct from their communicative value. Facial expressions of pain are part of more encompassing pain behaviors such as stretching and throwing the head backwards, or contracting, drawing in the shoulders, and bending the head and torso. They accompany overall tensing of the limbs, clenching the fists, or other spasmodic movements. All these behaviors can be plausibly seen as part of an overall behavioral pattern of writhing or squirming. Facial expressions of pain appear to be part of a rather elementary pain response of writhing, which would seem to serve the function of getting rid of the painful stimulus. It might also serve to diminish the pain sensation by diverting attention or by suppressing the pain sensations. Clenching one's teeth illustrates that latter function, as does digging one's nails into one's palms.

The facial contortions of a person in pain would seem to contribute little to the escape or suppressive functions of body contortions and tensing elsewhere in the body. However, there are muscular synergies that induce movements that are of no use. A distinct example is given by facial expressions accompanying muscular effort; the expressions strongly resemble those of pain. Take the faces made when pulling a rope or lifting a heavily laden spade; or that facial expression of no obvious communicative value: the facial expression of efforts made during bowel movements. All this corresponds more to Darwin's third principle, that of the irradiation of nerve-force, but it is still serviceable as part of exerting force, given a certain crudeness of motor control.

Darwin implied that pain behaviors with such a function would only be retained in evolution when they were actually of use. I am not sure that current evolution theory requires the merely useless action dispositions to spontaneously disappear. But even so, is there evidence – other than everyday self-observation or illusion – that the mentioned pain behaviors are indeed of direct use by increasing pain thresholds? There may well be. It would be consonant with the gate-control theory of pain, and with the research on hyperstimulation analgesia (Melzack 1973); but whether this includes systematic research on the effects of muscular effort, wriggling, and facial pain expressions, I do not know.

It would be useful to know whether facial expressions of pain differ from facial expressions of muscular effort, and not merely from other expressions of emotion. If they do, it would strengthen the hypothesis of communication function; if not, it would strengthen a hypothesis of direct use.

In any case, this possibility of direct uses of facial expressions only adds to the plausibility of Williams' general point: that facial expressions of pain have a nonoperant, evolutionary origin.

Intention and authenticity in the facial expression of pain

Mitchell S. Green

Department of Philosophy, University of Virginia, Charlottesville, VA 22904-4780. **msg6m@virginia.edu** **www.darwin.clas.virginia.edu/~msg6m**

Abstract: Williams and the many studies she considers appear to assume that voluntary amplification in facial expression of pain implies dissimulation. In fact, the behavioral ecology model of pain expression is consistent with amplification when subjects in pain are in the presence of others disposed to render aid, and that amplification may well be voluntary.

Block et al. (1980) and Flor et al. (1995) show that subjects exhibit an increase in pain behavior in the presence of solicitous others, such as family members, and healthcare professionals. It may be