Behavior

Patrick Young reports from San Francisco at the meeting of the American Association for the Advancement of Science

The nature and nurture of emotions

When members of the Minangkabau culture in Western Sumatra, Indonesia, voluntarily make facial expressions of fear, anger, sadness or disgust, they experience the same basic physiological changes and the same emotional feelings as Americans, two California psychologists report. The researchers suggest this means the physiological changes accompanying certain emotions are genetically — rather than culturally — determined.

"Our assumption is these [physiological reactions] are biologically based and hard-wired," says Paul Ekman of the University of California, San Francisco (UCSF). "Culture may magnify or diminish emotional reactions, but will neither eliminate nor replace them."

Ekman and Robert W. Levenson of the University of California, Berkeley, report what they describe as the first cross-cultural study of how facial expression relates to the physiology of emotion. Psychologists have long debated the role of nature and nurture in emotion, but "there has been little debate whether changes in the autonomic nervous system are universal," Ekman says.

In 1983, Ekman, Levenson and Wallace V. Friesen of UCSF discovered that when Americans make facial expressions voluntarily, this generates involuntary autonomic nervous system activity (SN: 9/17/83, p.182). Simulating an expression of anger or sadness increases the heart rate; forming an expression of disgust lowers it.

With the assistance of anthropologist Karl G. Heider of the University of South Carolina in Columbia, who is conducting his own long-term study of emotions in Indonesia, Ekman and Levenson asked 46 Minangkabau males, ages 17 to 28, to make specific facial expressions and recorded their physiological responses, including heart rate, skin temperature, and speed and depth of breathing. Previous studies of people from nine different cultures had established that all nine associated the same expressions with specific emotions.

"The magnitude of the [physiological] changes is smaller for Sumatrans than for Americans," Levenson says, but the pattern of changes in fear, anger, sadness and disgust for the two cultures proved the same.

The researchers asked the young men to imagine some emotional experience — something disgusting, for example — and quizzed them about their feeling at the peak of their image. "We have found it isn't just the look on the face, but the feelings inside that people share," Ekman says. "It is the first evidence of the universality of autonomic nervous system pattern."

The study also indicates that culture strongly influences whether and how people talk about or show their emotions, and even what produces an emotional response. For instance, Ekman notes, "what is perceived as a threat may vary from culture to culture."

Negatives of negative support

In a long-term, ongoing study of the effects of chronic stress, psychologist Janice K. Kiecolt-Glaser and her co-workers at Ohio State University in Columbus are studying a group of people caring for parents or spouses with Alzheimer's disease. Earlier, they reported these caregivers had weaker immune systems, more depression and more infectious illnesses than a matched control group (SN: 9/12/87, p.168). Now Kiecolt-Glaser says the quality of support these caregivers receive from family and friends also affects the immune system.

"In general, positive support appears to be a positive thing," she says. But "negative or upsetting support," such as criticism of how they cared for a relative, proved unhealthy to those who got it. "We find they have the poorest immune function among our subjects," Kiecolt-Glaser says.

Biology

Rick Weiss reports from San Francisco at the meeting of the American Association for the Advancement of Science

The revolution will not be fertilized

Since the first application of genetic engineering to crop plants just six years ago, scientists have hoed a remarkably long row. Gene splicing has cut years off the usual seven-year period plant breeders need to create new crops with old-fashioned crosses. It has made plants resistant to insects and herbicides, and it promises enhanced nutrition and seed survival. But researchers note several scientific and economic weeds not yet plowed under in the otherwise fertile fields of agricultural biotechnology.

Cost to the farmer is one concern. By one estimate, high-tech alfalfa seed, genetically engineered so the adult plant will fix high quantities of nitrogen while resisting the onslaught of insects and microbes, might run farmers $12 per pound — a six-fold increase above current costs. U.S. farmers might accept that as a reasonable investment, because seed accounts for less than 10 percent of their total costs. The affordability of such seeds for Third World farmers appears less certain. Still, some analysts claim that biotechnology's "upfront" costs to poor farmers are significantly lower than those associated with the two previous revolutions in agriculture: mechanization and the advent of nitrogen-based fertilizers.

Also, some scientists express concern about the implications of increasingly splicing the genes for certain insecticides into plants. An insecticide called Bt is one case in point. For years, farmers have sprayed Bt to protect their crops against leaf-eating caterpillars. Its short residual time in soil has minimized the "selection pressure" that might lead to the evolution of Bt-resistant bugs. But resistance might develop much more rapidly, some say, once Bt or similar chemicals are more commonly engineered into plant cells and thus become more persistent in the environment.

Perhaps the biggest challenge facing plant genetic engineers is to find more efficient ways to transfer genes into plant cells — particularly into cereal crops, which have so far resisted all attempts at high-tech genetic transformation. Researchers have used microinjection needles, lasers and electrical shocks in their attempts to send bits of desirable DNA into plant cells. Sometimes the DNA fails to enter the cells. At other times it may enter a cell but then doesn't become spliced into the cell's native DNA. And even if the new DNA is incorporated into the old, it may fail to function properly or it may destroy too much of the cell's protective membranes on the way in.

Winston J. Brill of Agracetus, a Middleton, Wis.-based biotechnology company, describes an "electrical-discharge particle accelerator" developed by Agracetus to blast DNA-coated gold particles into plant cells. Within the food-processor-sized device, a 20,000-kilovolt spark explodes a drop of water suspended between two electrodes. The explosion sends a volley of the 1-micron-diameter gold spheres into plant cells at just the right velocity to penetrate but not seriously damage them. Once the new DNA has worked its way into the old, scientists cultivate the gene-altered cells into full-grown plants. Later they harvest seeds from these plants, from which they grow new generations of the DNA-enhanced crop.

This technique, which resembles others in principle, has proved successful in corn, soybeans and cotton, Brill says. And it appears to have applications for gene transfer in animals as well. Researchers recently used the device to blast missing genes into the bodies of living nematodes — tiny, worm-like, soil-dwelling organisms that are favorite experimental subjects for geneticists.

At first, says Brill, "we had nematode soup." Researchers had to make a few adjustments. But now, he says, nematodes missing a gene needed for motility are able to "walk" again after getting a blast of golden buckshot coated with copies of their missing gene.