

worldwide elimination of nuclear weapons can be made strictly on the basis of human threats to global security. Extraterrestrial dangers need not be considered.

Thomas Graham, Jr., served as special representative of the

president for arms control in the 1990s and now chairs Thorium Power Ltd., which develops proliferation-resistant reactor fuel. Russell L. Schweickart, a former astronaut who flew on Apollo 9, heads the B612 Foundation, which champions the testing of spacecraft designs that can deflect NEOs.

Skeptic

Adam's Maxim and Spinoza's Conjecture

Belief, disbelief and uncertainty generate different neural pathways in the brain

BY MICHAEL SHERMER



During an early episode of the über-pyrotechnic television series *MythBusters*, Adam Savage was busted by the camera crew for misremembering his predictions of the probability of an axle being ripped out of a car, à la *American Graffiti*. When confronted with the unmistakable video evidence of his error, Adam sardonically rejoined: “I reject your reality and substitute my own.”

Skepticism is the fine art and technical science of understanding why rejecting everyone else’s reality and substituting your own almost always results in a failed belief system. Where in the brain do such belief processes unfold? To find out, neuroscientists Sam Harris, Sameer A. Sheth and Mark S. Cohen employed functional magnetic resonance imaging to scan the brains of 14 adults at the University of California, Los Angeles, Brain Mapping Center. The researchers presented the subjects with a series of statements designed to be plainly true, false or undecidable. In response, the volunteers were to press a button indicating their belief, disbelief or uncertainty. For example:

Mathematical:

- (2 + 6) + 8 = 16.
- 62 can be evenly divided by 9.
- 1.2⁵⁷ = 32608.5153.

Factual:

- Most people have 10 fingers and 10 toes.
- Eagles are common pets.
- The Dow Jones Industrial Average rose 1.2% last Tuesday.

Ethical:

- It is bad to take pleasure at another’s suffering.
- Children should have no rights until they can vote.
- It is better to lie to a child than to an adult.

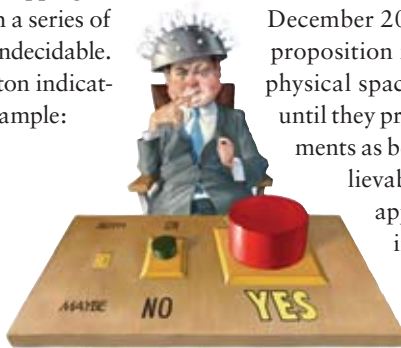
The findings were revealing. First, there were significant reaction time differences in evaluating statements; responses to belief statements were significantly shorter than responses to both disbelief and uncertainty statements (but no difference was detected between disbelief and uncertainty statements). Second, contrast-

ing belief and disbelief in the brain scans yielded a spike in neural activity in the ventromedial prefrontal cortex, associated with decision making and learning in the context of rewards. Third, contrasting disbelief and belief showed increased brain response in the left inferior frontal gyrus, the anterior insula and the dorsal anterior cingulate, all associated with responses to negative stimuli, pain perception and disgust. Finally, contrasting uncertainty with both belief and disbelief revealed elevated neural action in the anterior cingulate cortex, a region associated with conflict resolution.

What do these results tell us? “Several psychological studies appear to support [17th-century Dutch philosopher Benedict] Spinoza’s conjecture that the mere comprehension of a statement entails the tacit acceptance of its being true, whereas disbelief requires a subsequent process of rejection,” report Harris and his collaborators on the study in their paper, published in the December 2007 *Annals of Neurology*. “Understanding a proposition may be analogous to perceiving an object in physical space: We seem to accept appearances as reality until they prove otherwise.” So subjects assessed true statements as believable faster than they judged them as unbelievable or undecidable. Further, because the brain appears to process false or uncertain statements in regions linked to pain and disgust, especially in judging tastes and odors, this study gives new meaning to a claim passing the “taste test” or the “smell test.”

As for the neural correlates of belief and skepticism, the ventromedial prefrontal cortex is instrumental in linking higher-order cognitive factual evaluations with lower-order emotional response associations, and it does so in evaluating all types of claims. Thus, the assessment of the ethical statements showed a similar pattern of neural activation, as did the evaluation of the mathematical and factual statements. People with damage in this area have a difficult time feeling an emotional difference between good and bad decisions, and they are susceptible to confabulation—mixing true and false memories and conflating reality with fantasy.

This research supports Spinoza’s conjecture that most people



have a low tolerance for ambiguity and that belief comes quickly and naturally, whereas skepticism is slow and unnatural. The scientific principle of the null hypothesis—that a claim is untrue unless proved otherwise—runs counter to our natural tendency to accept as true what we can comprehend quickly. Given the chance, most of us would like to invoke Adam’s Maxim because

it is faster and feels better. Thus, it is that we should reward skepticism and disbelief and champion those willing to change their mind in the teeth of new evidence. ■

Michael Shermer is publisher of Skeptic (www.skeptic.com). His new book is The Mind of the Market.

Anti Gravity

Nothing to Sneeze At

And other interesting results from researchers with some operating room

BY STEVE MIRSKY



It’s a problem faced by Yogi Berra, welders and surgeons: How do you sneeze with a mask covering your face? Catchers and welders, however, only have to deal with the unpleasant bounce-back effect. Surgeons need to worry about ejecting multitudinous microbes directly into the gaping

hole they’ve carved in a patient. Not good. And with “uh-oh” being among the worst words a surgeon can say at work (“Where’s my watch?” is also bad, as is the simple and direct “oops”), how best then to avoid an uh-oh following an achoo?

The answer to this and other pressing questions in science and medicine can be found in the year-end issue of the *British Medical Journal*, well known for its unusual array of offbeat articles. (Had the Puritans never left Britain for New England, they might later have fled the *British Medical Journal* to found the *New England Journal of Medicine*.)

First, the case of the surgical sneeze. The accepted wisdom was that the surgeon should in fact sneeze facing the area being operated on—because the mask will redirect the ejecta and send it backward out of the sides of the mask, away from the open wound. But two plastic surgeons from a British hospital checked the literature and found no actual evidence that the masked sneeze did in fact fling the phlegm sideways. They thus phlegmatically set out to test the hypothesis, using high-speed photography and some finely ground pepper to encourage sneezing by masked volunteers.

The result: very little of the blast escapes out the sides, and a bit sneaks out of the bottom, onto the surgeon’s upper chest. Most of the debris appears to stay safely within the doctor’s domain, leaving the patient pristine. Unable to offer any clear direction to surgeons, the authors offer these clear directions: “Surgeons should follow their instincts when sneezing during operations.” One might call such instruction the *gesundheit* of reason.

BMJ also featured a review of commonly held medical myths that showed that the drowsiness commonly induced by the Thanksgiving

meal is probably not a function of the tryptophan in the turkey. That amino acid has been getting a bad rap for years for Uncle Dave’s open-belted couch coma during the second game of the turkey-day NFL doubleheader. But a given weight of turkey actually has the same amount of tryptophan as does chicken and beef, whereas pork and cheese have even more. In reality, any big meal diverts blood, and therefore oxygen, from the brain, inducing sleepiness. And, as the authors point out, “wine may also play a role.”

In a short item entitled “A Day in the Life of a Doctor: The PowerPoint Presentation,” two British physicians reveal that “the main purpose of a PowerPoint presentation is entertainment. Intellectual content is an unwarranted distraction.” They go on to advise that “the more lines of writing that can be coerced onto a slide and the smaller the font, the lower the risk of anyone criticizing any data which has accidentally been included” and that “the number of slides you can show in your allotted time is inversely proportional to the number of awkward questions which can be asked at the end.”

Then there was a study that questioned the efficacy and purpose of the intensive screening of travelers at airports. The researchers, from Harvard University, the Massachusetts Institute of Technology and the Washington University School of Medicine in St. Louis, note that no scientific evaluation has ever been done of the “screening tools currently in place.” They ask the arch yet brief question, “Can you hide anything in your shoes that you cannot hide in your underwear?” And they point out that spending on “airport security (\$9 per passenger) is 1,000 times higher than

for railway security (\$0.01 per passenger), even though the number of attacks on trains is similar to that in planes.” Which, they explain, is “analogous to committing mammography resources to screening only the left breast.” Indeed, whenever I fly and see signs at the airport claiming that the risk of a terrorist attack that day is “high,” I think, “Compared to what?” I don’t say it out loud, of course, because I want to be allowed to board my flight. ■



PHOTOGRAPH BY FLYNN LARSEN; ILLUSTRATION BY MATT COLLINS