

# Editorial

## A Picture Is Worth a Thousand Dollars

Brain images are the scientific icon of our age, replacing Bohr's planetary atom as the symbol of science. Many businesses have realized that brain images make their products or services appear to be especially scientific and cutting edge, whether they are selling to high-level corporate executives or the viewers of TV infomercials. Of course, brain imaging is increasingly able to deliver practically useful information about people and their thought processes, so one cannot assume that all claims are bogus. Society is currently being challenged to sort out which of the new applications of brain imaging perform as claimed, which are immature but promising, and which are snake oil.

Cognitive neuroscientists must take the lead in evaluating these new applications and informing the public about them. Our task is not simply to be the "bad science" police but to participate in a variety of ways as citizen-scientists with knowledge and skills that are relevant to society's needs. This includes provoking discussion with businesses concerning the evidence for their claims, which their nonexpert customers cannot do for themselves, and educating the public about the prospects and the limitations of brain imaging.

Unrealistic, financially motivated claims about functional brain imaging can have a negative impact on society at large and on our field. If too much is promised and not delivered, funders may become wary of cognitive neuroscience and skeptical about its genuine potential. Bad advice given to businesses concerning marketing and personnel selection could lead to expensive mistakes, and bad advice given to governments concerning security screening and interrogation could lead to far worse. Yet imaging is being offered for these applications now, with scant evidence of validity.

One example of unfounded claims based on brain imaging comes from the firm FKF Applied Research, whose Web site boasts a client list of Fortune 500 companies. Among their projects is a study of political campaigns, and their advice to American presidential candidates appeared in the *New York Times* last winter (Iacoboni et al., 2007). The authors made extensive use of what Poldrack (2006) has called reverse inference. For example, anterior cingulate activation in response to pictures of one candidate was taken to indicate voters' conflicted feelings, whereas for another candidate insular activation was taken as a sign that he evoked feelings of disgust. Such inferences ignore the fact that many mental states can be associated with activation in a given area, the ACC and the insula included (Aron et al., 2007; Farah, 2007; see also Iacoboni, 2008; Poldrack, 2008).

Another profitable but unproven application of brain imaging is as an aid to diagnosis for psychiatric disorders such as depression, anxiety, attention deficit hyperactivity disorder, and autism. Definitive diagnoses are not always possible in psychiatry, especially in pediatric psychiatry, and companies such as the Amen Clinics and Brain Matters are profiting by suggesting that they have a more scientific basis for diagnosis than conventional psychiatry. Tens of thousands of individuals, many of them children, have been exposed to the radiation of two SPECT scans and paid thousands of dollars out of pocket (because insurers will not pay) against the advice of many experts including the American Psychiatric Association's Council on Children, Adolescents and their Families (2005). The Amen Clinics are now marketing their services outside the medical arena, advising couples with marital problems and even "prescreening" couples. Dr. Amen has suggested routine brain imaging of presidential candidates, given that "the brain is involved in everything humans do: how we think, how we feel, how we get along with others, how we negotiate, how we pay attention in meetings and how we turn away the advances of White House interns or decide to invade a country based on contradictory intelligence" (Amen, 2007).

Laboratory fMRI research on deception has been prematurely commercialized by companies such as Cephos and No Lie MRI, which are offering their services to individuals, companies, and governments. Their Web sites emphasize the attributes of science and objectivity and of course feature brain images prominently along with claims such as "the technology used by No Lie MRI represents the first and only direct measure of truth verification and lie detection in human history!" Although published research on the kinds of methods used by these companies documents impressively high levels of accuracy approaching 90% under laboratory conditions (Davatzikos et al., 2005), this is not sufficient accuracy for high-stakes decision making nor will this performance necessarily generalize to real-world situations.

As cognitive neuroscientists, we have many opportunities in the course of our careers to help society sort the valid from the invalid applications of brain imaging. For those of us in academics, teaching is a powerful means to inoculate our students against brain imaging overclaim, and such teaching can even carry over to influence the friends, family, and future coworkers of our students. Lectures or discussion sections analyzing the validity political neuromarketing, psychiatric diagnosis, lie detection, and other applications of brain imaging are likely to grab the interest of undergraduates and to be remembered after

the end of the semester. If you notice a distortion or a misunderstanding of brain imaging in the media, writing to the editor and the reporter will encourage better coverage in the future, and if your letter is published it will reach a wider audience. Blogging and posting reactions to blogs, especially at business, policy, and education sites frequented by nonneuroscientists, are other ways to raise awareness. A final strategy for improving the quality of applied cognitive neuroscience is to get more good scientists involved with it. Many applications of brain imaging are intellectually challenging as well as potentially useful and profitable and could make good dissertation topics, grant proposals, or sabbatical projects. For basic science researchers, the occasional excursion out of the ivory tower can be bracing.

It is a sign of our field's progress that we are in a position even to attempt to apply brain imaging commercially. Our growing understanding of the brain's cognitive and affective processes and our ability to correlate brain images with psychological processes, in individual subjects and even for individual stimuli or trial types, bode well for real-world applications. However, whether from genuine misunderstanding or cynical opportunism, some entrepreneurs are making unrealistic claims about the current capabilities of brain imaging. As cognitive neuroscientists, we have a responsibility to stay informed about this work and to speak up when we see our science being misrepresented.—*Martha J. Farah*

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<http://www.noliemri.com>  
<http://www.cephoscorp.com>

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