

# Commentary: The Future of Forensic Functional Brain Imaging

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In "Functional MRI Lie Detection: Too Good to be True?" in this issue of *The Journal*, Joseph Simpson reviews the merits and the limitations of using fMRI to detect deception. After presenting the gaps in experimental data that stand in the way of translating the laboratory proof of concept to a field application, Simpson surveys the legal, regulatory and ethics concerns facing fMRI, should it emerge as a technologically robust method of lie detection. In our commentary, we update and interpret the data described by Simpson, from the points of view of an experimental scientist and a forensic clinician. We conclude that the current research funding and literature are prematurely skewed toward discussion of existing findings, rather than generation of new fMRI data on deception and related topics such as mind-reading, consciousness, morality, and criminal responsibility. We propose that further progress in brain imaging research may foster the emergence of a new discipline of forensic MRI.

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In his article, "Functional MRI Lie Detection: Too Good to be True?,"<sup>1</sup> Joseph Simpson reviews and comments on the emerging field of functional magnetic resonance imaging (fMRI)-based lie detection. In the past few years, experts from many relevant disciplines have written reviews,<sup>2–14</sup> journal articles,<sup>15,16</sup> and books<sup>17–19</sup> that set accuracy and originality standards that are a challenge for the new entrants.

Rome did not fall because it was weak; it fell because it became weaker than the barbarians at its gates. The polygraph did not become more or less accurate in the past decade. Rather, it failed to keep up with the neuroscientists. There were warnings. In 1988, the year of the Federal Employment Polygraph Protection Act (FEPPA), Rosenfeld<sup>20</sup> reported using the P-300 component of the electroencephalogram (EEG) to detect deception. A few years later, Farwell<sup>21–23</sup> commercialized the technology. Farwell is still in business (Brain Fingerprinting Laboratories, Inc., Seattle, WA). Simpson repeats<sup>24</sup> the important question: should fMRI be regulated under the FPPA?

The reader would benefit from an in-depth look into this matter. Both fMRI and EEG are measures of central nervous system activity that have been proposed as an alternative to polygraph. Neither has been shown to be clinically valid. Is regulating fMRI, but not EEG, under the FEPPA, reasonable and defensible? Are the images generated by fMRI particularly dangerous to the impressionable juries and human resource directors? Probably not, since the new 128-lead EEG systems could be used to generate equally impressive images of brain activity. Or is this special treatment a badge of recognition of fMRI's true potential?

Simpson's survey omits many recent contributions to the field.<sup>5–8,10,25–27</sup> Of particular interest is work by Abe *et al.*<sup>28</sup> on the activity of the limbic system during deception. Considering the role of emotion in polygraphy, the absence of limbic activation from most reported fMRI patterns of deception is intriguing and may be construed as a proof of the fundamental difference between the peripheral and central nervous system correlates of deception.<sup>6</sup> Equally important to consider is the continuous progress in fMRI research of executive functions, memory, and real-time fMRI that is critical to the future of applied forensic fMRI, including lie detection.<sup>29–32</sup> In his review, Simpson does not distinguish between the researchers of deception and the merchants of fMRI-based lie detection. While the overwhelming majority of the former are recognized

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scientists, it would be interesting to know more about the latter. The uneasy alliances between this industry and academia, brokered by university technology commercialization departments,<sup>16</sup> are yet another topic that we wish Simpson had shed some light on.

Regarding Simpson's assumption that "...there do not appear to have been any instances of the use of fMRI lie detection in a legal or employment setting" (Ref. 1, p 492) we note that Harvey Nathan was tested by No Lie MRI, Inc. in an insurance fraud case in 2007. A brief review of an ABC television description of Mr. Nathan's case<sup>33</sup> suggests that the goal of Mr. Nathan's investigation was to prove his innocence, rather than guilt. In all published fMRI lie-detection studies, presence of deception was guaranteed by experimental design. Was the test, given to Mr. Nathan by No Lie MRI, Inc., appropriate for a situation in which deception could be absent? Mr. Nathan's case highlights several interesting points we wish Simpson had elaborated on. First, does absence of deception prove innocence? That would depend on the tests' false negative rate.<sup>3</sup> Second, is the same combination of specificity, sensitivity, and prevalence appropriate for civil, criminal, and nonlegal (e.g., insurance) cases? Specificity that is not high enough to prove innocence positively in a civil case may still be sufficient to raise reasonable doubt in a criminal case. Defending Mr. Nathan's fMRI study in court would require normative data that, to the best of our knowledge, is not yet available in the peer-reviewed literature. Without such data, truth verification with fMRI could degenerate into a brisk trade in false-negative fMRI findings. In his last neuroscience-related paragraph, Simpson may have confounded two fundamentally different applications of fMRI for information gathering: mind reading and lie detection.<sup>5,34</sup> While lie detection implies a query and a deceptive response, mind-reading requires neither. Mind-reading with fMRI is scientifically more challenging and even less developed than lie detection, yet it is of great interest and relevance to forensic psychiatry. Despite the multitude of technical challenges, we believe that fMRI is a powerful technology that may, together with the more established structural MRI, form a discipline of forensic MRI in the foreseeable future.

Simpson quotes an ethicist's concern that "At the most basic level is the question of whether a precise definition of lying even exists" (Ref. 1, p 495). The

answer to this is; "Yes, they do exist." As there are multiple types of lying,<sup>35</sup> so are there multiple definitions, relevant to a particular domain of culture, science, or law.<sup>36-39</sup> It is sufficient for biological researchers of deception to commit, *a priori*, to a specific definition of deception and incorporate it in the model they use to produce deception in their experiments.<sup>3,39</sup> Whether the model of deception used in a particular research study or a case is externally valid is up to the peer review process or the courts.

Simpson's article provides a comprehensive list of the critical knowledge gaps that include the effects of countermeasures, motivation, and demographics on the relevance of fMRI to real-world deception. For an experimental scientist, items on this list have one common thread: studies that would fill these gaps will require larger samples than those provided in any prior fMRI study of deception. Yes, the gaps between a proof of concept, a prototype, and a fieldworthy test have to be filled with research subjects, and thus with much more funding. The fMRI lie-detection technology is at a stage of development similar to a Phase 2 Food and Drug Administration registration trial of a new medication. Phase 3 trials are now due. In the pharmaceutical industry, Phase 3 trials cost hundreds of millions of dollars. Commercial lie-detection interests have neither the technical nor the financial muscle of their pharmaceutical colleagues. The total private investment in fMRI-based lie detection research so far can be estimated to be a few million U.S. dollars. The official government investment is even smaller. Larger sums may have been spent in relative obscurity by groups closely affiliated with the Department of Defense. One example is a \$5,000,000 U.S. Congress earmark in the 2004 and 2005 Defense spending bill to fund research on "advanced technologies for deception detection" at the University of South Carolina at Columbia, SC.<sup>40</sup> Such a method of funding research has been criticized,<sup>17</sup> because of the potential conflicts of interest.

Despite the relative dearth of fMRI and other biological data on deception, there is a proliferation of scholarly reviews on the subject that threatens to suffocate this emerging field of study. Extending this imbalance, the funding for the elaboration of the ethics and legal dimensions of neuroscience-based lie detection equals or exceeds that provided to acquire new data. An example is McArthur Foundation's \$10,000,000 Law and Neuroscience Project,<sup>41</sup> seemingly dedicated to discussion rather than gener-

ation of pertinent experimental data. We believe that independent, competitive, and distributed research funding, similar to the one administered by the National Institutes of Health, is necessary to generate the independent data we need to tell whether lie detection with fMRI is “too good to be true.”

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