DETECTION OF DECEPTION: MAGNETIC RESONANCE IMAGING (MRI)

Traditional means of lie detection, such as the polygraph, rely on measurements of peripheral nervous system (PNS) activity. Recent advances in noninvasive brain imaging techniques, such as functional magnetic resonance imaging (fMRI), have aroused public and academic interest in developing a viable alternative. This entry briefly explains the technique of MRI and its application in the detection of deception.

How MRI Works

An MRI scanner is a powerful superconducting electromagnet with a central bore large enough to accommodate a human body. This magnet generates a magnetic field perpendicular to the plane of the central bore. It is equipped with electromagnetic gradient coils that produce weaker, rapidly changing magnetic fields. These magnetic “pulses” cause the hydrogen nuclei in the body to resonate and emit radiofrequency signals used to create tomographic images with a spatial resolution of less than a millimeter that can be reconstructed into a three-dimensional image. Blood oxygenation level–dependent (BOLD) fMRI is an enhanced technology that measures regional changes in the levels of oxygenated hemoglobin and reflects regional brain activity with a time resolution of seconds. The small effect size of the BOLD fMRI signal associated with most cognitive phenomena (<2%) requires a scanner field strength of at least 1.5 T and multiple repetitions of each stimulus class to achieve a meaningful signal-to-noise ratio. Compared with psychophysiological recordings, fMRI measures of lie detection have theoretical advantages of proximity to the source of deception (central nervous system, CNS). Although fMRI is a less direct measure of CNS activity than electroencephalography, the significantly better spatial resolution of fMRI may lead to higher test specificity.

Use of MRI in Detecting Deception

Initial fMRI studies demonstrated prefrontal- and parietal-lobe differences between lies and truth on a multi-subject average level. These data linked the classic Augustinian definition of lying (“To have a thought, and, by words or other means of expression, to convey another one”) with the concept of deception as a cognitive process involving working memory and behavioral control and led to a moral conclusion that truth is the basic state of the human mind. Second-generation studies, using 3-T scanners and sophisticated logistic regression and machine-learning methods of data analysis, showed the feasibility of discriminating lies and truth in single subjects. These studies support the critical role of the inferior frontal and posterior parietal cortex in deception and estimate the potential accuracy of the approach to be 76% to 90%. An important conclusion of these studies is that lie and truth patterns are, at least partially, task specific. These findings paved the road for clinical trials of the technique and spurred an increasingly emotional debate on the ethical, legal, and procedural issues surrounding the future applications of this technology. Critics emphasize both insufficient data and potential privacy violations, the latter leading to the term cognitive freedom and a new discipline of “neuroethics.” Proponents of fMRI advocate its noninvasive nature, the objectivity of fMRI data analysis, and the fact that fMRI requires a fully cooperative and conscious subject, making coercive use impossible. Potential forensic and medical applications of this technology differ in the degree of accuracy they would require, as well as in ethical and practical dimensions. For example, an fMRI test requested by a criminal defendant to create a “reasonable doubt” in a criminal trial may require a lower accuracy threshold than routine screening of thousands of suspects, most of whom are unlikely to be the perpetrator of an offense of interest. Diagnosing malingering is the most immediate potential medical application, but other applications, such as the differentiation of denial and deception during psychotherapy, are conceivable.

Further studies are necessary to determine the clinical utility of fMRI for forensic and medical lie detection. Myriad questions related to the effects of risk, medications, medical and psychiatric disorders, CMs, age, gender, and language remain to be answered. Performance of the technology in “real-life” situations needs to be examined in clinical trials. Furthermore, both experimental and applied lie detection should not be confused with attempts to use fMRI for “mind reading.” Whereas lie detection is focused on the brief and singular act of deception, mind reading would capitalize on the patterns of brain activity in response to sensory probes. Such probes could invoke highly variable sequential and parallel cascades of memory retrieval and language
preparation. Harnessing such probes to applied information gathering would pose a computational and validation hurdle far beyond those faced by fMRI-based lie detection. Finally, a controlled clinical comparison between the polygraph and fMRI characterization of deception is unavailable at the time of this writing. The development of a technology using both PNS and CNS measures, either simultaneously or sequentially, may have clinical utility. To avoid unreliable data and inappropriate application, it is imperative that the multidisciplinary research on the neurobiology of deception is funded, conducted, and published by peer-reviewed public and academic organizations that adhere to the standards of responsible research practices.

Although one cannot predict which combination of behavioral probe and brain-imaging technology will ultimately become the method of choice in applied lie-and-truth discrimination, the prevailing demand and scientific progress are likely to produce a clinical application of fMRI-based studies of deception in the near future.

Daniel D. Langleben and Melissa Y. De Jesus

See also Detection of Deception: Cognitive Load; Detection of Deception: Event-Related Potentials; Detection of Deception in Adults; Detection of Deception in High-Stakes Liars; Malingering; Polygraph and Polygraph Techniques; Psychotic Disorders

Further Readings


Detection of Deception: Nonverbal Cues

Trying to find a tell-tale sign of deceit (a “Pinocchio’s nose”) in human nonverbal behavior has been the subject of much effort, and many suggestions have been put forward. In lay people’s thinking and in police interrogation manuals alike, one can find numerous ideas about detecting deceit from nonverbal behaviors such as eye contact or gestures. The scientific research shows, however, that overall only a few nonverbal behaviors are associated with deception. Under certain conditions, such as time to prepare the lie, special motivation to convincingly tell a lie, and when the lie is about concealing a transgression, there seem to be some nonverbal behaviors that may distinguish liars from truth tellers.

Research on beliefs about deception shows that presumed experts (e.g., police officers) and lay people (e.g., college students) have very similar beliefs. They mostly indicate nonverbal signs of deception, especially a decrease in eye contact, when lying. Furthermore, presumed experts and lay people alike believe that an association exists between deception and an increase in body movements.

Scientific Study of Nonverbal Behaviors

To find out about potential nonverbal correlates of deception, psychologists and other researchers conduct experiments. They instruct some people to lie and/or tell the truth (the lies are most often “constructed” for the sake of the experiment) and videotape the telling of truths and lies in interviews or mock interrogations. (If the focus is on the speech-related variables, audiotapes are of course sufficient.) Then, these videotapes are closely analyzed, and the frequency and/or duration of a list of nonverbal behaviors are scored. The scored behaviors are then summarized for truths and lies separately, and if statistical comparisons show significant differences, researchers conclude that there are systematic nonverbal signs of deceit and truthfulness. A great number of such studies have been published. In this entry, findings from several meta-analyses and research overviews are summarized.

Included in the concept nonverbal behavior are body movements (e.g., gestures and leg movement), facial indicators (e.g., eye contact, smiling), and speech behaviors (sometimes called paraverbal behaviors; e.g., response latency and pitch of voice).

Theoretical Approaches

Why would the nonverbal behavior of a liar give him or her away? Scientists usually suggest three different
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