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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

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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

List of Entries

- Ackerman-Schoendorf Parent Evaluation of Custody Test (ASPECT)
- Adjudicative Competence of Youth
- Adult Attachment Interview (AAI)
- Aggravating and Mitigating Circumstances, Evaluation of in Capital Cases
- Aggravating and Mitigating Circumstances in Capital Trials, Effects on Jurors
- Alcohol Intoxication. *See* Substance Abuse and Intimate Partner Violence; Substance Use Disorders
- Alcohol Intoxication, Impact on Eyewitness Memory
- Alibi Witnesses
- Alternative Dispute Resolution
- AMBER Alert System
- American Bar Association Resolution on Mental Disability and the Death Penalty
- Americans with Disabilities Act (ADA)
- Amicus Curiae Briefs
- Antisocial Personality Disorder
- Appearance-Change Instruction in Lineups
- Automatism

- Bail-Setting Decisions
- Battered Woman Syndrome
- Battered Woman Syndrome, Testimony on
- Behavior Analysis Interview
- Bias Crime

- Capacity to Consent to Treatment
- Capacity to Consent to Treatment Instrument (CCTI)
- Capacity to Waive *Miranda* Rights
- Capacity to Waive Rights
- Capital Mitigation
- Capital Punishment. *See* Death Penalty
- Checklist for Competency for Execution Evaluations
- Chicago Jury Project
- Child Abuse Potential (CAP) Inventory
- Child Custody Evaluations
- Child Maltreatment
- Children's Testimony
- Children's Testimony, Evaluation by Juries
- Child Sexual Abuse
- Civil Commitment
- Classification of Violence Risk (COVR)
- Clothing Bias in Identification Procedures
- Cognitive Interview
- Community Corrections
- Competence Assessment for Standing Trial for Defendants With Mental Retardation (CAST*MR)
- Competency, Foundational and Decisional
- Competency, Restoration of
- Competency Assessment Instrument (CAI)
- Competency for Execution
- Competency Screening Test (CST)
- Competency to Be Sentenced
- Competency to Confess
- Competency to Stand Trial
- Competency to Waive Appeals
- Competency to Waive Counsel (Proceed Pro Se)
- Complex Evidence in Litigation
- Computer-Assisted Lineups
- Conditional Release Programs
- Conduct Disorder
- Confession Evidence
- Confidence in Identifications
- Confidence in Identifications, Malleability
- Conflict Tactics Scale (CTS)
- Conformity in Eyewitness Reports
- Consent to Clinical Research
- Coping Strategies of Adult Sexual Assault Victims
- Criminal Behavior, Theories of
- Criminal Responsibility, Assessment of

- Criminal Responsibility, Defenses and Standards
 Crisis and Hostage Negotiation
 Critical Incidents
 Cross-Race Effect in Eyewitness Identification
 CSI Effect
 Cybercrime

 Damage Awards
 Danger Assessment Instrument (DA)
 Death Penalty
 Death Qualification of Juries
 Delusions
 Detection of Deception: Cognitive Load
 Detection of Deception: Event-Related Potentials
 Detection of Deception: Magnetic Resonance Imaging (MRI)
 Detection of Deception: Nonverbal Cues
 Detection of Deception: Reality Monitoring
 Detection of Deception: Use of Evidence in
 Detection of Deception by Detection “Wizards”
 Detection of Deception in Adults
 Detection of Deception in Children
 Detection of Deception in High-Stakes Liars
 Developing Comprehensive Theories of
 Eyewitness Identification. *See* WITNESS Model
 Diminished Capacity
 Diplomates in Forensic Psychology
 Disability and Workers’ Compensation Claims,
 Assessment of
 Disparate Treatment and Disparate Impact
 Evaluations
 Dissociative Identity Disorder
 Divorce and Child Custody
 Doctoral Programs in Psychology and Law
 Domestic Violence. *See* Intimate Partner Violence
 Domestic Violence Courts
 Domestic Violence Screening Instrument (DVSI)
 Double-Blind Lineup Administration
 Drug Courts
 “Dynamite Charge”

 Elder Abuse
 Elderly Defendants
 Elderly Eyewitnesses
 End-of-Life Issues
 Estimator and System Variables in Eyewitness
 Identification

 Ethical Guidelines and Principles
 Ethnic Differences in Psychopathy
 Evaluation of Competence to Stand Trial–Revised
 (ECST–R)
 Expert Psychological Testimony
 Expert Psychological Testimony, Admissibility
 Standards
 Expert Psychological Testimony, Forms of
 Expert Psychological Testimony on Eyewitness
 Identification
 Expert Testimony, Qualifications of Experts
 Exposure Time and Eyewitness Memory
 Extreme Emotional Disturbance
 Eyewitness Descriptions, Accuracy of
 Eyewitness Identification: Effect of Disguises and
 Appearance Changes
 Eyewitness Identification: Field Studies
 Eyewitness Identification: General Acceptance
 in the Scientific Community
 Eyewitness Memory
 Eyewitness Memory, Lay Beliefs About

 Facial Composites
 False Confessions
 False Memories
 Financial Capacity
 Financial Capacity Instrument (FCI)
 Fingerprint Evidence, Evaluation of
 Fitness-for-Duty Evaluations
 Fitness Interview Test–Revised (FIT–R)
 Forced Confabulation
 Forcible Medication
 Forensic Assessment

 Georgia Court Competence Test (GCCT)
 Grisso’s Instruments for Assessing
 Understanding and Appreciation
 of *Miranda* Rights
 Guardianship
 Gudjonsson Suggestibility Scales
 Guilty but Mentally Ill Verdict

 Hallucinations
 Hare Psychopathy Checklist–Revised
 (2nd edition) (PCL–R)
 Hare Psychopathy Checklist: Screening Version
 (PCL:SV)

- Hare Psychopathy Checklist: Youth Version (PCL:YV)
- Hate Crime. *See* Bias Crime
- HCR-20 for Violence Risk Assessment
- Hearsay Testimony
- Homicide, Psychology of
- Hopkins Competency Assessment Test (HCAT)
- Hypnosis and Eyewitness Memory
- Identification Tests, Best Practices in
- Inadmissible Evidence, Impact on Juries
- Insanity Defense, Juries and
- Insanity Defense Reform Act (IDRA)
- Institutionalization and Deinstitutionalization
- Instructions to the Witness
- Interdisciplinary Fitness Interview (IFI)
- Interrogation of Suspects
- Intimate Partner Violence
- Involuntary Commitment. *See* Civil Commitment; Outpatient Commitment, Involuntary
- Jail Screening Assessment Tool (JSAT)
- Judges' Nonverbal Behavior
- Juries and Eyewitnesses
- Juries and Joined Trials
- Juries and Judges' Instructions
- Jury Administration Reforms
- Jury Competence
- Jury Decisions Versus Judges' Decisions
- Jury Deliberation
- Jury Nullification
- Jury Questionnaires
- Jury Reforms
- Jury Selection
- Jury Size and Decision Rule
- Jury Understanding of Judges' Instructions in Capital Cases
- Juvenile Boot Camps
- Juvenile Offenders
- Juvenile Offenders, Risk Factors
- Juvenile Psychopathy
- Juveniles and the Death Penalty
- Legal Authoritarianism
- Legal Negotiation
- Legal Socialization
- Leniency Bias
- Lineup Filler Selection
- Lineup Size and Bias
- Litigation Stress
- MacArthur Competence Assessment Tool for Clinical Research (MacCAT-CR)
- MacArthur Competence Assessment Tool for Criminal Adjudication (MacCAT-CA)
- MacArthur Competence Assessment Tool for Treatment (MacCAT-T)
- MacArthur Violence Risk Assessment Study
- Malingering
- Malingering Probability Scale
- Mandated Community Treatment
- Massachusetts Youth Screening Instrument-Version 2 (MAYSI-2)
- Master's Programs in Psychology and Law
- Media Violence and Behavior
- Megan's Laws. *See* Sex Offender Community Notification (Megan's Laws)
- Mens Rea and Actus Reus
- Mental Health Courts
- Mental Health Law
- Mental Health Needs of Juvenile Offenders
- Mental Illness and the Death Penalty
- Mental Retardation and the Death Penalty
- Mild Traumatic Brain Injury, Assessment of
- Miller Forensic Assessment of Symptoms Test (M-FAST)
- Millon Clinical Multiaxial Inventory-III (MCMI-III)
- Minnesota Multiphasic Personality Inventory-2 (MMPI-2)
- Minnesota Multiphasic Personality Inventory-2 (MMPI-2) Validity Scales
- Minnesota Sex Offender Screening Tool-Revised (MnSOST-R)
- M'Naghten Standard
- Mood Disorders
- Moral Disengagement and Execution
- Motions to Suppress Eyewitness Identification
- Mug Shots
- Multiple Personality Disorder. *See* Dissociative Identity Disorder
- Neil v. Biggers* Criteria for Evaluating Eyewitness Identification
- Novaco Anger Scale

x Encyclopedia of Psychology and Law

- Obscenity
 Optimality Hypothesis in Eyewitness Identification
 Outpatient Commitment, Involuntary

 Parens Patriae Doctrine
 Parent-Child Relationship Inventory (PCRI)
 Parenting Satisfaction Scale (PSS)
 Parenting Stress Index (PSI)
 Parole Decisions
 Patient's Rights
 Pedophilia
 Personal Injury and Emotional Distress
 Personality Disorders
 Plea Bargaining
 Police as Eyewitnesses
 Police Decision Making
 Police Decision Making and Domestic Violence
 Police Interaction With Mentally Ill Individuals
 Police Occupational Socialization
 Police Psychologists
 Police Psychology
 Police Selection
 Police Stress
 Police Training and Evaluation
 Police Use of Force
 Polygraph and Polygraph Techniques
 Popout Effect in Eyewitness Identification
 Pornography, Effects of Exposure to
 Postdoctoral Residencies in Forensic Psychology
 Postevent Information and Eyewitness Memory
 Posttraumatic Stress Disorder (PTSD)
 Presence of Counsel Safeguard and Eyewitness Identification
 Presentence Evaluations
 Pretrial Publicity, Impact on Juries
 Prison Overcrowding
 Probation Decisions
 Procedural Justice
 Profiling
 Prosecutorial Misconduct
 Proxy Decision Making
 Psychiatric Advance Directives
 Psychological Autopsies
 Psychological Inventory of Criminal Thinking Styles
 Psychopathic Personality Inventory (PPI)
 Psychopathy
 Psychopathy, Treatment of
 Psychopathy Checklist–Revised. *See* Hare
 Psychopathy Checklist–Revised (2nd edition) (PCL–R)
 Psychopathy Checklist: Screening Version. *See* Hare
 Psychopathy Checklist: Screening Version (PCL:SV)
 Psychopathy Checklist: Youth Version. *See* Hare
 Psychopathy Checklist: Youth Version (PCL:YV)
 Psychotic Disorders
 Public Opinion About Crime
 Public Opinion About Sentencing and Incarceration
 Public Opinion About the Courts
 Public Opinion About the Polygraph

 Race, Impact on Juries
 Racial Bias and the Death Penalty
 Rape Trauma Syndrome
 Rapid Risk Assessment for Sexual Offense
 Recidivism (RRASOR)
 Reconstructive Memory
 Reid Technique for Interrogations
 Religion and the Death Penalty
 Repeated Recall
 Reporting Crimes and Victimization
 Repressed and Recovered Memories
 Response Latency in Eyewitness Identification
 Retention Interval and Eyewitness Memory
 Return-to-Work Evaluations
 Risk Assessment Approaches
 Risk-Sophistication-Treatment Inventory (RSTI)
 Rogers Criminal Responsibility Assessment
 Scales (R–CRAS)

 Scientific Jury Selection
 Sentencing Decisions
 Sentencing Diversion Programs
 Serial Killers
 Sex Offender Assessment
 Sex Offender Civil Commitment
 Sex Offender Community Notification (Megan's Laws)
 Sex Offender Needs Assessment Rating (SONAR)
 Sex Offender Recidivism
 Sex Offender Risk Appraisal Guide (SORAG)
 Sex Offender Treatment
 Sex Offender Typologies

- Sexual Harassment
 Sexual Harassment, Jury Evaluation of
 Sexual Violence Risk–20 (SVR–20)
 Short-Term Assessment of Risk and
 Treatability (START)
 Showups
 Simultaneous and Sequential Lineup Presentation
 Source Monitoring and Eyewitness Memory
 Spousal Assault Risk Assessment (SARA)
 STABLE–2007 and ACUTE–2007 Instruments
 Stalking
 Stanford Prison Experiment
 Statement Validity Assessment (SVA)
 STATIC–99 and STATIC–2002 Instruments
 Statistical Information, Impact on Juries
 “Stealing Thunder”
 Story Model for Juror Decision Making
 Stress and Eyewitness Memory
 Structured Assessment of Violence Risk in
 Youth (SAVRY)
 Structured Interview of Reported Symptoms (SIRS)
 Substance Abuse and Intimate Partner Violence
 Substance Abuse Treatment
 Substance Use Disorders
 Suicide Assessment and Prevention in Prisons
 Suicide Assessment Manual for Inmates (SAMI)
 Suicide by Cop
 Supermax Prisons
- Tender Years Doctrine
 Termination of Parental Rights
 Terrorism
 Testamentary Capacity
- Test of Memory Malingering (TOMM)
 Therapeutic Communities for Treatment of
 Substance Abuse
 Therapeutic Jurisprudence
 Training of Eyewitnesses
 Transfer to Adult Court. *See* Waiver to Criminal
 Court
 Translated Testimony
 Treatment and Release of Insanity Acquittees
 Trial Consultant Training
 Trial Consulting
- Unconscious Transference
 Uniform Child Custody Evaluation System (UCCES)
 U.S. Supreme Court
- Validity Indicator Profile (VIP)
 Verbal Overshadowing and Eyewitness Identification
 Victim Impact Statements
 Victimization
 Victim-Offender Mediation With Juvenile Offenders
 Victim Participation in the Criminal Justice System
 Videotaping Confessions
 Violence Risk Appraisal Guide (VRAG)
 Violence Risk Assessment
 Voice Recognition
 Voir Dire
- Waiver to Criminal Court
 Weapon Focus
 WITNESS Model
 Witness Preparation
 Wrongful Conviction