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Interrogational Neuroimaging: The Missing Element in Counter-Terrorism

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ABSTRACT: Following the September 2001 terrorist attacks in New York, governments have waged a global campaign against terrorists groups in order to ensure national security. A crucial part of this campaign has been intelligence gathering with different methods of interrogation in order to extract allegedly necessary information from suspected terrorists. Similarly, it is not surprising that intelligence personnel have started recognizing that neuroimaging technologies—in particular, functional Magnetic Resonance Imaging (fMRI) addresses this fundamental lack within the realm of scientific scrutiny. The current research introduces a first step towards developing a novel experimental interrogation paradigm that aims to apply a number of reliable and practical applications of fMRI within a rule of law and human rights framework. This prototype is applied in such a way that implications of interrogative methodologies will become a reality for mining of knowledge from potential suspects. The ultimate goal of our innovative methodology is the implementation of fMRI in real life situations that may serve the cause of human rights by providing an innocent person the means to scientifically prove his/her innocence. This truth verification tool has potential to replace torture and aggressive existing interrogation strategies. However, we discuss that there are still human rights and privacy concerns that must be addressed prior to moving this technology to real-world application. Similarly, this paper will recommend best practices and guidelines to address scientific, social, ethical, privacy and general public concerns. The future of law enforcement agencies may very well be under construction with this new line of attack that could revolutionize police work and likely to provide significant benefits to society.

KEYWORDS: fMRI, Interrogation, Counter-terrorism, Human rights, Law enforcement.

1 INTRODUCTION

The fear about investigating suspects has reached new heights and put pressures upon the law enforcement agencies for reliable interrogative methodologies to find out whereabouts of terrorist groups and a prior knowledge of their practices. Towards this end, efforts are invested for centuries by investigators, intelligence officers and psychiatrists to accurately identify perpetrator [1]. Methodologies include torture, polygraph and tools like PSE (Psychological Stress Evaluator), VSA (Voice Stress Analysis), EEG (Electroencephalography) and SVA (Statement Validity Analysis'). Unfortunately, none of these techniques have yielded optimal results and are not entirely suitable for detecting deception and concealed information in the brain of the suspect [2].

According to [3] "Every generation has attempted to develop objective and reproducible methods to discover the truth". Similarly, it is not surprising that security officials have started turning to neuroimaging technologies such as fMRI - a part of a growing trend of technological innovation. It has an emerging potential to revolutionize the investigatory landscape and rapidly coming to the forefront in today's heightened level of security [4] [5] [6] [7]. Proponents of this brain scanning technology argue that arena where fMRI is perhaps most likely to be employed in the future is counterterrorism efforts - from identifying potential terrorists to obtained intelligence information [4] [6] [8]. The brain never lies, and if the information is stored in the individual brain, fMRI can objectively detected this record regardless of the honesty or dishonesty of the subject [10] [11] [12] [13]. This paper is also focusing on the use of fMRI in interrogation room context. It may play a vital role in combating terrorism and assessing the veracity of investigation responses in criminal justice system.

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We argue that this tool has a potential to provide a number of applications ranging from lie detection and to reveal recognition in the brain [14]. This work proposes a methodology in interrogation framework and applies the scientific procedure of fMRI analysis to determine objectively whether or not the person is aware with the information contained in the probes. These stages are: Examination, Interviewing and Scanning that will be applied on the dynamics of the pre-Incident and post incident phase of terrorist related activity. The ultimate goal of our innovative methodology is the implementation of fMRI in real life situations. That will enable intelligence operatives to detect suspicious behavior indicators to provide real-time decision support.

This paper recommends that our methodology will emerge as more promising practice as various researches have reported reliability and reasonably high accuracy rates for fMRI studies. However, critics of brain scanning have leveled several different concerns regarding possibility that counterterrorism agencies may deploy this technology prematurely [15] [16. This research will counter these claims by arguing that because of the reliability and novelty of the physiological parameters being measured; it would be a human rights violation to deny access to fMRI scanning. This technology has potential to replace torture and aggressive existing interrogation strategies. However, we discuss that there are still human rights and privacy concerns that must be addressed.

The prevention of inappropriate application of this technology in counterterrorism context is as important as highlighting its potential usefulness. Similarly, this paper will recommend best practices and guidelines to address scientific, social, ethical, privacy and general public concerns. This research will not discuss the legal issues; instead the focus will be on addressing the research challenges and related issues to elucidate our methodology. We argue that law enforcement agencies and neuroscientists who are engaged in interrogation process must be held to account for their actions. Specially, if the public trust in the integrity of these professions is being seriously compromised or violated international human rights laws. Our efficient internal measures will also propose an elite interrogation unit and a call for greater partnership between major stake holders to engage the general public. It is a major step forward in the action to our defense needs and essential to the national security. The objective of this research is to break old orthodoxies that have confined our mission on war on terrorism.

2 THE ART OF INTERROGATION IN THE WAR ON TERROR: GETTING INSIDE THE TERRORIST MIND

Interrogation is the interview of a suspect to uncover tiny bits of the truth to collect evidence that can be used as evidence at the trial [17]. However, the objective of interrogation in counterterrorism context is to reveal information concerning threats to national security [18]. The benefits of interrogation can be enormous such as preserve important institutions, protect our own population, prevention of a nuclear explosion, maintain civic order and stability etc. [19]. Poor performance in the interrogation function results in the loss of these benefits and can also impose other costs [19]. This process is different from a conversation and the suspect being interrogated is often not willing to divulge information or comfortable with this practice [20]. This procedure can take different forms, but all methods have a similar aim to control the individual in such a way that provides the information being asked for [21]. Interrogations officers are trained to extract this information with different methods. However, it is reasonable to assume that terrorists (guilty suspects) enter examination room with different counter-interrogation strategies [22].

The honesty of reports offered by suspects concerning their doubtful activities and relations with the specific organizations must all be assessed to inform and guide decision making process. The aim is to also establish accurate connections between characteristics of the terrorism related activity and features of the terrorists (e.g. bomb making knowledge, terrorist training). For instance, a suspect may leave traces of permanent feature of criminal on the crime scene, such as fingerprints and DNA [23]. Similarly, members of a terrorist cell share a particular body of information and the revealing of such knowledge could help in the identification of a suspect. The other fundamental task is to keep the number of both false-negative and false-positive errors as low as possible to conclude the decision [24]. This conclusion may hold important consequences for the subject (e.g., continued custody versus release). Law enforcement agencies have attempted for centuries to determine the accuracy of statements and truth with different interrogative methodologies [25]. Torture is one of the traditional investigating methods used by police officers to orchestrate another possible future attacks [26].

3 TORTURE AND ETHICS IN THE WAR ON TERROR: NO PAIN, NO GAIN?

Security agencies sometimes characterize torture as an indispensable interrogation technique for gathering strategic intelligence [26]. However, torture is obsolete, or at least obsolescent. Over the past few decades the tools of psychological and physical torture have been also refined [27]. Furthermore, the consequences of coercion techniques are numerous, not just for individual victim or suspect but also for the world as whole [26]. Several international human rights bodies have also

highlighted the risk of discrimination in this methods presented by the investigators [28]. This process undermines fair procedures that would otherwise safeguard against miscarriages of justice [29]. Torture also offends ethical concerns and skirts the rule of law that shocks the conscience and violates international and domestic laws [30]. These practices may weaken state's long struggle against terrorism, undermine the legitimacy of its action and eventually limit the government's ability to act [30].

Adapting a quotation from the classic book Front-Line Intelligence the interrogators' purpose is to "facilitate the accomplishment of the mission, and to save lives. When they fail, all the wrong people are hurt1." It is necessary that there should be a standard that keeps interrogators' away from gray areas that might be considered as torture [31]. Police officers are now trying to obtained information without leaving a physical trace of the trauma of torture [32]. The goal is to determine the innovative technologies and reliable methods to shape future interrogation policies [33].

4 PROVIDING NEW TOOLS TO FIGHT TERRORISTS: IS THIS A COMPREHENSIVE RESPONSE TO TERRORISM?

Novel interrogation technologies often bring with them new opportunities to influence criminal justice system. Few technologies, however, have captured the imagination of law enforcement agencies, policy makers, and the general public, like Polygraph. However, this technique has failed. Polygraph relies on physiological manifestations of anxiety and measures changes in skin conductance, respiration and heart rate to detect deception and makes it intrinsically susceptible to producing erroneous results [34]. This technology is not effective when the subject has learned to suppress these manifestations or when suspect is a sociopath [35]. In addition, serious doubts can be raised when questions and answers are translated to and from the suspect's native language [36]. Other technique such as PSE was invented for the detection of emotional stress in the voice to identify deception with infrasonic frequency modulation that varies between 5 Hz and 20 Hz [37]. It is controlled by the central nervous system and disappears during emotional stress of the suspect. However, the popularity of the PSE was declined as this method is criticized as invalidate. Experimental research also failed to found its validity in various studies and today it is rarely used [37].

SVA is another tool based on the analysis of statements made by suspects to specify what he/she did or what he/she saw is investigated [38]. This technique assumes that false statements differ from true ones in both quality and content, and considered to be a highly effective as a police interrogation technique. However, critics argue that this method is theoretically vague with little or no empirical evidence in its favor. It encourages interrogators to presume a subject as deceptive and affirm a presumption of guilt before the interrogation process even starts [38]. The SCAN (Scientific Content Analysis) is also a technique used to recognize deception assumes that suspects will use more deviations in pronoun usage [39]. For instance, replacing I with you and use many unnecessary connectors, such as 'after I left', and 'and then' [33]. Unfortunately, there is no scientific evidence on the validity of the SCAN and it is not especially effective beyond its ability to generate admissions in interrogations [33] [39].

Thus, scientifically sound studies have concluded that above technologies and methods are too inaccurate to be used in practical settings and alternative methods ought to be investigated [35] [37] [38]. These strategies are geared toward getting subjects to comply and talk. It may lead innocent subject to make incriminatory testimony against his own self-interest and possibly resulting in conviction and incarceration [33] [39] [40]. By and large, such tactics have been shown to be unreliable and counterproductive.

5 WHAT IS NEEDED TO START TO WIN THE WAR ON TERROR: DEFINING THE PROBLEM?

The treatment of prisoners at Abu Ghraib and at Guantanamo Bay have shocked the public and provoked the collective conscience of the society [41] [42]. Civil society, theologians and scholars have condemned the harsh and traditional methods used by the Intelligence operatives that include both physical and psychological torture [42] [43]. The law enforcement agencies need to know whether any pragmatic technique of obtaining information actually works to avoid the creation of more enemies and maintaining the integrity of the state [41]. However, there has been no objective interrogation method and scientific way to discriminate between truthful and deceptive statements [44]. It is also very difficult to uncover concealed information in terrorist's mind with above tools. The objective of the criminal justice system is implement

[1] *Front-line intelligence / [by Stedman Chandler and Robert W. Robb]. (Washington, D.C. : U.S. Marine Corps, 1986)*

technologies that can identify the line of attack as we can better prepare ourselves to extend our defenses and protect the nation [45]. However, this article supports the possible uses of fMRI, based on their current validity and the availability of peer-reviewed public data. This tool may prove to be an effective deterrent for extremists and avoiding the prosecution of innocent subjects, thus, freeing up governmental resources [46]

6 FUNCTIONAL MRI AS A COUNTERINSURGENCY STRATEGY: TOWARDS A NEW MANIFESTO IN FIGHT AGAINST TERROR

The functional MRI is widely known and accepted in the scientific community as it does have a significant amount of scientific research behind its claims and validity. There have been hundreds of articles published and studies conducted on it over the past two decades. An fMRI is an increasingly popular psychiatric neuro-imaging technique that was developed in the 1990s and has since become the preferred method for studying the functional anatomy of the human brain [34]. This is a hybrid technique that provides real time and ultra-high resolution, computer-generated models of brain activity [47]. It produces a series of ultra-high resolution structural scans of the brain, which expose brain activity [27]. This technique relies on the fact that cerebral blood flow and neuronal activation are coupled. It involves placing the subject in a donut-shaped magnetic technology, which can identify subtle changes in electromagnetic fields [36]. The subject must remain still during the scanning process. During scanning, when an area of the brain is in use, blood flow to that region also increases [36]. Thus, its responses associated with neuronal activation correlated with cognitive tasks and various behavioral functions [48]. This is how this machine detects this physiological change due to the blood oxygen-level-dependent, or BOLD, effect. The changes are represented onto a three-dimensional, computer-generated image of the person's brain [36].

The introduction of fMRI is considered to be technologically superior to any another comparable imaging method such as PET (Positron Emission Tomography) [5]. In contrast with PET, functional Magnetic Resonance Imaging does not need the injection of radioactive labels into the subject. Secondly, fMRI has better temporal resolution (down to 2 to 3 seconds with rapid event-related) and superior spatial resolution (down to 1 mm3) than PET [49]. According to the director of the fMRI Research Center at Columbia University, this novel technology really opening the black box as it signifies a "quantum leap" over any previous technology for imaging the brain [49]. An fMRI has already had a major impact on neuroscience and in clinical settings. It has been applied ranging from language comprehension to treatment of neurological impairment disease, psychiatric illness, aesthetic judgment and justification of cognitive enhancing drugs in educational settings [14]. With these rapid developments many researchers claimed this technology to be useful outside the laboratory settings. For instance, economics contexts, investing personality traits, mental illness, religious extremism, racial prejudice, suicidal thoughts aggressive or violent tendencies and lie detection [14].

Proponents of this neuro-imaging technology hailed this machine as a next truth meter [6]. They conclude that because of the novelty of the physiological parameters being measured, this technology may be more accurate than other traditional methods [34]. According to Spence, this ground breaking research proves that fMRI has the potential to reduce the number of miscarriages of justice and capacity to address the question of guilt versus innocence. Since the first publication by [50] on deception detection by fMRI, various papers and studies [8] [12] [51] [52] have reported different experiments in which subjects were asked to respond deceptively in some blocks and truthfully in others. In these two studies, subjects were instructed to say yes when the truth is no and vice versa [50] [53]. In another study, the task paradigm included spontaneous lies [54], for instance, the subject was instructed to say Chicago when the truthful answer is Seattle. Similarly [51] [52] studies were included feigning memory impairment tasks. In addition, lying about having a play card [4] [10] [11] [55] and lying about having fired a gun [12] revealed that particular spots in the brain's prefrontal cortex become more active when a subject is suppressing the truth or lying. In some of the other experimental tasks, subjects were motivated by monetary incentives as they were told that they would double their reward money if they were able to deceive the fMRI machine. For example, lying about having taken a ring or a watch [56] and lying about the place of hidden money [57] [58].

In above studies, subjects were asked to conceal their information by lying and press buttons to respond 'no' or 'yes' to specific questions. Though the answers varied from trial to trial but it was possible to determine brain activity in response to specific pieces of information. In spite of different paradigms employed in the laboratory settings and the content of the questions, brain activation was compared in response to deceptive answers to truthful ones. It proved that lying involve more efforts than truth and expose that specific brain areas respond strongly in generating deceptive responses. As with lying, several brain regions show significant increases and light up on during scanning when a person sees a familiar object or image or during deception compared to truth telling [59]. For instance, dorsolateral prefrontal cortex (DLPFC), anterior cingulate cortex (ACC), ventroletral (VLPFC) and left and right cerebral hemispheres increases activity when people tell lies [16] [55]. Similarly, during the interrogation phase, if a suspect is asked a question, the information to which is unknown then the specific regions of the brain is unusually active and it is presumed that suspect is lying; if, however, the same areas are no

more active it may presumed that subject is telling the truth [59]. Thus, this technology has potential to reveal recognition regardless of whether the suspect speaks or attempts to conceal the recognition.

In above experiments, this technology has been claimed to be 80 - 90% accurate by the researchers. Apart from above laboratory experiments, Sean Spence, who has pioneered the use of this groundbreaking technology, carried out a real-life experiment in 2008 [6]. He investigated the potential innocence of a woman who had been convicted of intentional inducing illness in a child (and later was sentenced to four years in prison, see [6]). Brain imaging technologies has also captured the attention of legal system to influence criminal justice system. For instance, in September 2008, a court in India allowed to use brain scan images in a criminal case. Aditi Sharma was convicted by a court for the murder of her former fiancé, Udit Bharati [60]. However, for the first time, a brain scan was used as evidence of a criminal defendant's guilt. This case marked the dawn of a new era for the use of brain scan technology in criminal prosecution. The court found that the brain scan proved that Aditi Sharma had experimental knowledge of having murdered Udit Bharati herself [60].

A variety of recent advances in neurological research and the development of this new technology claims to be a more accurately deception revealing tool for screening. It can be effective in distinguishing truth tellers from liars and to determine hidden conscious states of an individual, with accuracy greater than chance [7]. Thus, unlike polygraph—which detects a person's emotional response to deception—fMRI measures person's decision to lie, as subjects cannot control their cerebral activity to avoid detection [27]. Thus fMRI can be used as a tool warranted in interrogation techniques in this era of terrorism that is creating an all-pervasive fear. This technology can be considered as a magic bullet in the war on terror [6] [7]. Not only has this neuro-imaging technology taken the attention of scientific communities and law enforcement agencies but it has also attracted interest of corporate world [61]. Two private firms: No Lie MRI and Cephos Corp trying to make the dream of perfect truth verification into a reality and have begun marketing since 2006. They offer high-tech lie detection services based on research comparing neuronal activation patterns [36].

7 FUNCTIONAL MRI: A NEW WAY FORWARD IN THE CRIMINAL JUSTICE SYSTEM

This technique has emerged as more promising technology that aims to directly reveal if a suspect's brain displays particular responses: Specially, when it is deal with specific information that could only be known to the criminal or terrorist. This tool has potential to directly reveal deception and read out the contents of suspects' mind, including their intentions and memories to reveal recognition. Ruben Gur, a neuropsychologist at the University of Pennsylvania, states that fMRI scans can reveal cognitive tasks when a subject recognizes a familiar picture, face or place, no matter how hard he or she tries to conceal it [62]. This cognitive analysis technology could function as a hyper-accurate lie detector that is nearly impossible to deceive [8] [56]. For instance, an interrogator could present a suspect with images of terrorist leaders, potential targets, or specific information that could generate neural responses if the subject were known with that pictured information [56]. This scientific technique provides intelligence operatives to focus their investigations on the suspects who actually commit terrorism and to determine if he or she has been to any specific place before. If a person was in any terrorist training camp, you can actually determine that [12] [46].

On the other side, an information absent will provide support for the claims of innocence that individual is not guilty of committing any crime and has no knowledge specific to any particular group [6]. The imaging results can be used against the suspect at trial and prevent future tragedies. Thus, this machine is capable of witnessing the brain in action by tracing the way blood flowed and takes pictures that highlight specific areas of the brain activated during certain tasks. Similarly, the primary goal of the current research is to develop a novel experimental paradigm with fMRI based interrogation techniques. The purpose is to maximize the likelihood of a true confession of a terrorist activity.

8 OUR METHODOLOGY: APPLYING THE CONCEPT TO LAW ENFORCEMENT

One of the most important aspects of security agencies is the prevention of terrorist attacks with a prior knowledge of terrorist practices and mindsets regarding preparation and implementation of attacks – so called Pre-Incident Phase. Secondly, to establish accurate and reliable connections between features of the terrorist attacks the one hand and features of the perpetrator or witnesses related to the terrorist activity on the other - Post-Incident Phase. Our research is also focusing on the dynamics of the pre-Incident and post incident phase of terrorist attacks. Examples of the knowledge of these phases include weapons details, information regarding specific locations, time, key personnel, source of funding, recognition of false identities for group members, acquisition of supplies, the deployment of assets and other related information. The future of law enforcement may very well be under construction with this new approach that is becoming a reality for mining of knowledge from potential terrorists to assess potential threats rapidly. This methodology proposes three paradigm of using fMRI in interrogation process. These phases are: Examination, Interviewing and Scanning.

8.1 EXAMINATION

This process is research-intensive as it consists of the designee that will determine the significant features of terrorist activity. The interrogator must be careful to select stimuli in such a manner that a subject who is innocent would find them as equally plausible as the irrelevant chosen. Thus, no physiological response is expected on fMRI. However, this information must be present in the brain of suspected terrorist. The probes selected in terrorist related activities must be included the landscape that the terrorist ran through while planning or committing the act. Interrogator must formulate the actual event of terrorist related activity with the features and background information in two ways. Firstly, about known terrorists whose suspicious activities or relation with terrorist organization is reasonably certain because of the evidence available. Secondly, the suspects whose guilt is doubtful or uncertain because of lack of essential evidences or because of weaknesses in the available facts. It is important to note that some suspects cannot be placed precisely in either of these two groups.

The accuracy of interrogator's efforts to classify a suspect depends upon their experience, ability, availability and accuracy of the information [63]. For instance, the questioning must be designed to develop a detailed account of the suspect's activities before, during, and after the action was committed [2]. Information that is certainly known to interrogator and if suggest the suspect's activities, then these details should be used in formulating questions to determine her/his reactions and to test whether the suspect is inclined to lie. An inaccurate classification may lead to an unsuccessful interrogation or innocent person can be punished [2]. Specially, if the questioning technique based on the original classification is not skillfully modified or changed during the examination.

8.2 INTERVIEWING

Once this information has been collected and probes are prepared, interrogation officer must interview the suspect prior to the fMRI scanning process. This procedure is necessary to determine exactly what the person knows, why he/she has knowledge of certain information relevant to the examination. This phase is also useful to find out about subject's innocence and non-suspicious explanation [2]. Moreover, questioner also observes the verbal and non-verbal behavioral symptoms of deception in the subject [2]. When evidence is weak, interviewer must proceed cautiously by different questions or pictures. The purpose is to place the suspect in a position where he/she will be forced to alter facts that are definitely known to him. It will lead the potential terrorist to believe that answers are already known to the police officer. However, when evidences are strong and when suspect whose relation with the radical organization is reasonably certain, interviewer should assume an air of confidence. He should stress the evidence to analyze the relation of the suspect with terrorists and strive with WHY the suspect committed a terrorist activity rather than IF the suspect committed the terrorism. This process would also help interrogators to remove those stimuli that are significant, not related and independent of the suspicious activity at issue. This process may serve as baseline for security officials. It will ensure that person informed about the targets that will be shown to him in fMRI machine will render a scientific conclusion regarding guilt or innocence.

8.3 SCANNING

After the interviewing, the investigator must select stimuli that is collected through interview process (known to the suspect) to apply the scientific procedure of fMRI. This phase is a scale moving from overt conscious evaluation of stimuli accompanied by response selection of the subject, to unconscious perception constructing meaningful and measurable brain activity [64]. Test administrator must also select irrelevant targets and placed a subject in MRI scanner to analyze scanning parameters by showing a series of words and picture to detect recognition. For example, for the deception task, different types of questions can be visually displayed to the subject with control questions because of the different imaging site. The button-press paradigm will be used to investigate brain activity associated with deception. This task would be designed in a way that the subject would consciously evaluate the stimuli presented and decide whether to press "yes" or "no (i.e. "Yes, I know him" or "No, I do not know him").

The subject is told to press one button to confirm a fact and another button to deny the information as each image is shown. The subject will click a pad button to advance to the next stimuli to keep his/her attention on the scanning test itself. Interviewer must present each question in a way that it is easy to identify the category of the stimuli (e.g., one of the following is the terrorist weapon…) to observe a subject's neural response with. Investigator may also present a suspect with pictures of potential terrorist targets, suspected terrorists, recognition of key people or places and watches movies (e.g. a digital reconstruction of the terrorist scene). These images would generate certain neural responses if the suspect were already familiar or to reveal different information (such as, where a suspect had been or what he/she had seen with another suspect). Thus counterterrorism agencies would be able to distinguish whether the subject was lying based on the BOLD

signal change associated with the response to a particular question [10]. The subject's response can be classified by complex mathematical algorithms recently created by various researchers that are able to analyze imaging data of deception [10].

These responses can be recorded with a software tool such as E-Prime (Psychology Software Tools, Inc. Pittsburgh, PA) and a custom built apparatus such as MRA Incorporated, Washington, PA . Functional MRI analysis can be carried out with different software such as using SPM (Statistical Parametric Mapping software, Welcome Department of Cognitive Neurology, London, UK), BV (BrainVoyager), AFNI (Analysis of Functional NeuroImages), PLS (Partial Least Square), FSL (FMRIB Software Library), AIR (Automated Image Registration) or MIPAV (Medical Image Processing, Analysis, and Visualization).

Security agencies must ensure that subjects are examined medically to ensure that they are safe to enter the MR environment and all the necessary actions are taken. The exclusion criteria that are generally preferred for an MRI Investigation must be used (e.g., claustrophobia, not MR-compatible Transplants, Pacemaker, Insulin pump, Middle ear implants, cardiorespiratory and orthopedic disorders and neuropsychological or sensory impairments, etc.). Usually the subjects in the MRI scanner have an emergency ball in one of their hands with which they can signal at all times that they want to stop the scanning. Subjects should be immediately taken out of the scanner after pressing this ball or at any other sign of emergency, claustrophobia or discomfort. The finding of information present or information absent will recommend a scientific determination of whether the suspect has knowledge of the probe stimuli tested or not. Difference in brain responses among individuals can be used as a baseline for comparison. The results of fMRI analysis will educate law enforcement agencies and judiciary in rendering their verdict about the subject [35].

9 FUNCTIONAL MRI: STRENGTHENING THE CRIMINAL JUSTICE SYSTEM AGAINST TERRORISM

This development will lead to speculations about the development of this neuro-imaging technology that could directly examine the terrorist's memories, intentions and its mind. Interrogators will be able to confidently say that the fMRI told us this detainee lied about X or that he recognizes terrorist Y or fMRI picked him out as a terrorist. This confidence that intelligence operatives will have in this neuroscience technique will be based on aura of infallibility, scientific validity and objectivity [64]. Secondly, the uncritical acceptance of stimulus recognition and lie-detection will be recognized in light of the graphic images that functional MRI is capable of producing. Thirdly, there will be no similar chilling effect like polygraph - when fMRI will be used in high-pressure environments as a part of counterterrorism operations [64]. For instance, the mistreatment of detainees in Abu Ghraib and Guantanamo Bay is arguably the result of worst excesses confidence in the reliability of devices like polygraph.

Researchers are skeptical of claims that an fMRI have potential to identify innocent subject from abuse at the hands of intelligence operatives. However, those who doubt the deployment of this machine in scenarios for good or ill should judge the statement from a United States intelligence officer. Who explained how he and his team "once put a suspects hand on the Xerox machine, turned it on, and told him it was a truth detector and would administer a massive shock if he lied" [64]. Interestingly, the result was positive and the subject "was bluffed into a good confession" [64]. Similarly, such kind of output is also more likely to achieve successfully by functional MRI and we can expect that this tool will successfully be applied in interrogation context with a high degree of confidence [64].

This technology is of course expensive requires extensive support facilities and highly trained staff. However, this mechanism may therefore be most useful in national security scenarios due to the security clearance and complexity of this equipment. This machine is hard to cheat unlike polygraph. It is very easy to deceive polygraphs with a simple internet search that can reveal many ways how to mislead the interviewer. One former polygrapher charges $59.95 for his manual plus DVD offering information on beating this device [65].

10 NEURO-TECHNOLOGY AND NATIONAL SECURITY CONCERNS: REMOVING OBSTACLES TO INVESTIGATING TERRORISM

Although above arguments and studies reported reliability and reasonably high accuracy rates for fMRI studies, there are still significant concerns must be addressed prior to moving this technology to real-world application [14]. In addition to the scientific challenges, advances in fMRI identify numerous social, legal and general public concerns to the process of and the science behind it [65]. Some state that this tool isn't reliable enough to be used outside of a laboratory setting [67]. Thus, these challenges require further investigations to assess its relevance capabilities to national security.

According to some critics, variation in experimental design, situational variables, subject characteristics and the preliminary nature of the existing data are the key scientific challenges in fMRI studies [15] [35]. Large numbers of replicate scans under extremely controlled conditions are needed to accommodate for interscan and intersubject variability [15] [35].

However proponents counter that certain methods and techniques have been developed to overcome for the inbuilt physical limits of fMRI machine [59]. Though, the only feasible technique of increasing the subject's signal is by repeating the scanning several times in order to reach a level where the signal can be heard over the noise and to get the meaningful data [59]. Secondly, critics explore that so far fMRI studies have been conducted in artificial laboratory environments with small numbers of normal (drug free, non-criminal) volunteers to maximize positive results. The criminals and experienced liars were not included and their effects on interrogation are unknown as none of the protocol studies applied to the actual criminal investigations [36].

Other common line of criticism deals with the mental capacity of subjects to record information either during the alleged commission of the terrorism or prior to the fMRI scanning itself. For instance, what if suspect is under extreme emotional distress, under the influence of narcotics or intoxicated or so forth? [65]. According to William Iacono "we don't know enough of how memories are formed during crimes." However, such a criticism is unfounded, as the human brain is always recording information regarding of whether we realize it [68].

Next, various opponents criticize that suspect could attempt to be deliberately deceptive and it is possible for well-prepared terrorist to cheat the fMRI [19]. However, supporters of this technology suggest that fMRI scanning is different from other lie detection tests and it is hard to beat this neuroscience technology [6]. The responses are evaluated by the neural activity and the presence of certain information in their brain suspect not merely for their truth or falsity. Self-deception will have no effect on fMRI testing. A terrorist or a criminal who has convinced himself that he is not guilty; he/she still has recorded information and knows the salient feature of the crime [68]. Thus, our suggested method can measure a brain response at the moment of recognition or if suspect lie. It is equally effective if this test is given to hardened terrorist or pathological liar. A number of opponents claim that fMRI scanning is based on bias [69]. Interrogator could potentially impact the analysis result through the decision process in choosing the specific stimulus [71]. However, [70] has responded that bias is impossible to insert in fMRI scanning process because its responses associated with neuronal activation. The determination of information present or absent is directly revealed by suspect's brain displays made by the fMRI machine and not by the interrogator.

Furthermore, critics of fMRI points out that this technique is not reliable enough to be used as a lie detector in interrogation course of action. It could lead to further abuse of prisoners and human rights violations in the form of torture. It may also allow interrogators to believe more justified in using whatever painful method they use in investigations to extract the information they are looking for [19]. However, advocates strongly recommend that fMRI has potential to minimize the torture dilemma by monitoring involuntary responses and indicating when such fabrications occur. [6] also counter this argument and saying that, pain would appear to be a necessary condition for any kind of physical torture in interrogation but functional MRI is not painful and uncomfortable. It certainly not represents any physical or mental torture and no foreseeable direct health risks associated with its use [27]. The only possible pain that this scan could inflict is to keep the individual motionless. The subject's head is immobilized with foam pillows while inside this machine as suspect's movement could compromise the quality of the scan result. These restraints would almost certainly not inflict to even uncooperative subject and anything near the level of pain that would rise to torture. This practice is contradictory to so-called stress positions that international tribunals have considered to be a torture (for instance, subject being hung by the legs or arms). In fMRI machine, the individual is required only to remain lying down for an extended period that has no relation to the extreme stress positions [10] [12].

It can be concluded that the suspect's body is not physically compromised by this piece of equipment as fMRI is passive, in the sense that it does not enter the body. Now the concern is only with the mental, rather than physical intrusion. Various critics have highlighted that this technology erode the right of fundamental liberty interest in private thoughts. However, [72] is rejecting this assessment and says that this tool does not provide any precise conclusion about a person's thought or what a person is thinking. It can only show a difference across time, across location and across tasks. An fMRI is very good at discovering when brain tissues are active during different cognitive tasks. Thus, regardless of the technological particulars of this tool, it is strongly suggested that fMRI does not violate the right to internal mental privacy [72]. It must be regarded as intruding upon the fundamental liberty interest in private thoughts. Though it can be argued that, a claustrophobic subject might undergo mental suffering in the scanner. However, this distress must have been the result of the use of mind-altering substances or procedures. This psychological condition inherent in the subject is probably not sufficiently severe to rise to the level of torture such as threatened dismemberment or castration. It is also important to note that this scanning cannot be operated on an unconscious person - unlike blood tests, so some form of considerable restraint will be required to ensure that an unwilling suspect remains virtually motionless [27].

Despite the subject's mental condition, he/she would almost certainly not suffer prolonged mental harm because of fMRI, and certainly not constitute torture under any International Human Rights Law [27]. One other objection to the fMRI as a lie

detection raises worrying questions regarding civil liberties [69]. However, we argue that it would be a human rights violation to deny access to fMRI scanning as it serves the cause of human rights and provide scientific means to prove subject's innocence. The potential forensic uses of fMRI also reflect the fact that outrage attending the news about Abu Ghraib and Guantanamo Bay would have been different if prisoners had been examined by fMRI instead of hooded, naked, sexually posed by hostile interrogation. The images featured provoked shock and anger in the society and turned into emblems of degradation and humiliation [26]. Being lying in the fMRI scanner is neither the moral equivalent of being deprived of sleep for 36 hours in a cold torture cell nor legal equivalent of being forced to strip naked and simulate sex with another prisoner.

Opponents also argue that use of this novel method as reliable lie detection will raise different unanswered legal questions [69]. These controversies can be elevated under legal regimes and the international law about privacy and government power. However, science always moves forward, not backward. Hank Greely, Professor of Law at Stanford Law School support this theme and saying that fMRI evidence is certain to be accepted by the courts in future [60]. "The easier, the cheaper, the more pleasant a technique is, the more likely it is to be used in the legal system [60]." [73] also state that, "courts usually seem willing to consider brain imaging evidence under the same standards that they apply to other scientific evidence".

Putting aside all the arguments, but more to the point, how much precision could be increased for fMRI? How accurate should it be to be widely accepted in legal and security settings? Scientists are unable to accurately predict how much the error rate might be reduced? It is also unclear that whether this technology needs to reduce the error rate from 10 percent to something comparable with the billions-to-one accuracy (such as DNA) - will be useful or not? However, given the mechanics of the scientific research involved, it is difficult to conceive of this claim as the legal system has also issues concerning unreliability and repeatability in many procedures [36]. For example, fingerprints experts have sometime claimed perfect accuracy, but a number of pragmatic studies have revealed misidentification rates of about 5% [74].

Critics have also argued against the effort and length of time that would be requisite to acquire an adequate number of probes in interrogation and also in judicial process [27]. However, this problem can be solved by putting more logistic support and by offering more trained staff to the interrogation process to run the fMRI scan and analyze the results effectively. Finally, one of the most common concerns of fMRI scanning may involve the portability of this tool (weighing 20,000 lbs or so). For example, what if intelligence community wants to carry out fMRI scanning on a large number of people or if subjects live in tribal areas, such as Afghanistan? However, we argue that Mobile MRI is the counter strategy that can be used to rebut this objection. Mobile MRI is housed in a highly specialized trailer and a great way to have access to this equipment. It is useful to have access to this facility if a hospital's or imaging center's MRI is not currently functional or not available. This unit adheres to the same strict procedures a fixed MRI unit at imaging center must meet. There is no cause for concern by the subjects if this unit is used for MRI imaging.

Advantages of mobile MRI systems are shorter installation times, lower initial investment and rapid response. Similarly, mobile fMRI will be particularly useful if government has to scan a number of people in remote areas. This service may allow law enforcement agencies to carry out identity checks on suspects in large public occasions and sporting events that could be targeted by the terrorist attacks. It is also useful to access crucial data in challenging environments such as national border control areas military and nuclear power plant zones. However, security officials must make absolutely certain that they are scanning only when they suspect an individual of an offence and can't establish his identity. This action will reduce the number of errors and will rapidly improve security reaction times. Furthermore, fMRI mobile scanning could help police performance with decrease the number of arrest significantly and hasten the speed of criminal investigations.

The potential of fMRI in attempt to transfer this technology outside the research context poses several challenges in the context of national security. However, apart from many challenges, critiques have to bear in mind that functional MRI is just two decades old. Scientists reviewing the ability of photography 20 years before could not visualize the idea that one day this device would be able to determine images of planets orbiting other planets and resolve images less than a fraction of a second long at micrometer scales – which has now been done [75]. According to Vanderbilt's Frank Tong, "If brain scans were admissible in court, and became popular enough, then even if they were not mandatory they would become in a sense obligatory. Because if you didn't voluntarily undergo it, then there would be the question, `Why didn't you take the test? '

Secondly, for decades, polygraph has been widely used in interrogation by law enforcement agencies and has long been rife in the courtroom despite their flaws. Even supporters of this device confess a 10 percent failure rate [76]. Brandon L. Garrett, the law professor of the University of Virginia analyzed 200 cases in his published study in which innocent people were wrongly convicted by the courts. He found that in 55 percent of these cases, courts had been presented with faulty forensic evidence such as DNA and polygraph [77].

Further pointed out that fMRI is ethically acceptable in the market to the same extent as traditional polygraphs. If suspects are permitted to undergo a traditional polygraph examination, the argument is equally strong concerning fMRI scans as it is superior to the polygraph in accuracy and reliability [78]. The involuntary information extract from subject's mind should be considered as fundamental liberty interest. This right must be "deeply rooted in this Nation's history and tradition" and "implicit in the concept of ordered liberty". In the eyes of society and international law, fMRI based interrogation would be less objectionable than interrogation based on torture and physical beatings of naked hooded bodies. By contrast, fMRI is less invasive and harmful that can be legally defended by law and by the society [27]. However, this is true that ethical conflicts and criticism often arise when clinical technology is used for non-clinical purposes. There is a need to build an elite interrogation unit and a call for a greater partnership to employ policies and to counter above threats.

11 DEVELOP THE NEW ELITE INTELLIGENCE UNIT: A NEW ALLIANCE ARCHITECTURE

It is vital to establish an elite interrogation unit that must be filled with skilled intelligence professionals, neuroscientists, neuro-ethicists and other qualified individuals who must be knowledgeable about the application of fMRI and understand the limitations. The unit members must continue to uphold principles of medical ethics and the development of interrogation strategies must be addressed to protect public interest. For instance, involvement of neuroscientists in this unit for intelligence gathering is necessary as they can perform physical and mental assessment of subjects to provide medical care and to disclose the limit of access to the medical record. Secondly, the role of neuro-ethicists in the panel is essential to inform policy discussions about setting up the necessary infrastructure to protect the privacy of suspects. Thirdly, this elite interrogation panel will be helpful to inform the general public about the ethical, legal and social implications of this technology and permissible interpretations of test results without contributing to technology hype.

12 A NATIONAL STRATEGY & COALITION IS NEEDED TO GUIDE OUR PREPAREDNESS EFFORTS

Advances in fMRI have necessitated discussions on the ways this neuroscience tools could be used as a weapon in the war on terror. However, among the many challenges to this application, a central one is the partnership between major stakeholders. The primary reason is of course a lack of neuroscience expertise and the frequent unwillingness of the scientific community itself to engage and in dialogue with high levels of government level. Secondly, to work against political agenda that promotes that tools like fMRI perceived as wrong, misguided or even dangerous for general public. These people are those whose finances or status depends on the old means of doing things, and this group of people often resists progress because they see it as a threat for their own ways. To work against the resistance to fMRI application requires the full commitment and engagement of experts that resides only within the scientific community [79]. We recommend that a four-way partnership is needed between intelligence officials, neuroscientists, neuro-ethicists and policy makers to serve the national security interests. This goal can only be achieved by the concerted efforts, imaginative thinking, planning, coordination and participation of each of these groups.

13 EVIDENCE-BASED POLICIES AND GUIDELINES: A RELIABLE RESPONSE TO PUBLIC CONCERNS

This paper recommends that investigators involved in screening process must be made aware of the issues raised by fMRI to develop best practices and efficient internal measures. Neuroscientists may contribute in developing effective interrogation strategies for general training purposes for investigators that must be humane and respect the rights of individuals. Secondly, training of interrogators is one of the major challenges for the implementation of this technology. This training is necessary for the evaluation of interrogation centers to appropriately protect subjects while allowing for scanning. Thus, only trained experts will be required to evaluate subjects and conduct the scan. Furthermore, this education will help to establish proactive and defensive knowledge of scientific and technological capabilities of fMRI analyses. More important, it will assist new elite interrogation unit to identify what systems, methods, or processes of interrogation are best to protect the nation's security. This guidance will also address the ethico-legal and social issues and the vulnerabilities they exploit. The principal benefit of this training is to obtain knowledge from suspects that will increase investigator's understanding of terrorist adversaries and may assist them in developing potential countermeasures [80].

Thirdly, Neuroscientists are ethically obligated to report to the appropriate authorities when they have reason to believe that interrogation is coercive and violating human rights. They must ensure that if experts do not detect any abnormal behavior, the subject is not harmed. However, if an abnormality is detected, the results of the scan should be analyzed by other highly trained neuroscientists and possibly rectified. Fourthly, it is also important that professionals involved in interrogation will be required to acquire security clearances. This shield will make it impossible for them to share the findings with colleagues in unclassified settings. Fifthly, the "Certificate of Confidentiality and Privacy" issued by the new elite

interrogation unit can provide additional protection and can make a difference in the interrogational context. This certificate will allow the members who have access records to refuse to disclose identifying information at the civil, criminal, legislative, federal, state, or local level if the subject is not guilty. Disclosure of sensitive information could have adverse consequences on innocent person's reputation, employability as well as financial standing. The revelation of such knowledge could reasonably lead to social stigmatization or discrimination. This credential is necessary to protect data relating to persons' sexual attitudes, genetic information, use of alcohol, drugs and other different practices and preferences. This document will particularly encourage subjects (e.g., in employee screening) to participate in scanning process. In sum up, the Certificate of Confidentiality and Privacy will ensure that informed consent is appropriate, risks are minimized and protections are adequate [80].

Sixthly, in case of suspicious employee screening (e.g., Nuclear power plant), employee's right must be protected by Article 8 of the European Convention on the Protection of Human Rights and Article 12 of the Universal Declaration of Human Rights. The interrogation process must implement the United Nations International Labour Organisation (ILO) code of practice on the Protection of Workers' Personal Data (1996) as well as European Union Guidelines 95/46 and 97/66 on data protection. The access to the results should be restricted for interrogators in order to prevent the misuse of these preliminary data. It is important that counterterrorism agencies must ensure the safety of the subjects through the systematic monitoring of the international law and human rights – including the United Nations Conventions Against Torture, the International Covenant on Civil and Political Rights, and the Universal Declaration of Human Rights. The state must also consider the nuances of the Geneva Conventions as applied to suspected terrorists. Finally, uniformed personnel's and medical experts who are engaged in interrogation panel using fMRI must be held to account for their actions if they have violated human rights laws. Innocent subjects or victim of this technology must be offered compensations, health care services and a formal apology to address ethical violations caused by this technology or by the professionals. A comprehensive federal investigation is required if the public trust in the ethical integrity of the security and medical profession being seriously compromised. If interrogators dismiss a subject for failing an fMRI scan test, they must be able to justify the action against him/her under the influence of a Human Rights Act, such as the European Convention on Human Rights (ECHR) or the UK Human Rights Act 1998 [80].

Innovation in technology has been a key driver of change - the defense and security arenas are no exception [87] [88]. Similarly, members of elite interrogation unit should be well aware of current knowledge, novel literature, latest technologies, valuable processes and services about fMRI scanning for the purpose of developing image analysis to improve investigating methods. It is a major step forward in the action to our national interests that will continue to play a key role in the effectiveness of fMRI as a counterterrorism tool. We also recommend that government must push promising research on fMRI as they could meet our defense needs through collaboration with research sectors and universities to ensure a strong research base in this area. This action must be vibrant, inventive and innovative that looks most promising in interrogational neuroimaging. Investigators and neuroscientists must grasp the opportunities and adapt them quickly and effectively as this benefit is critical to our security and sovereignty [80].

14 THE COSTS AND BENEFITS OF INTERROGATIONAL NEUROIMAGING IN THE STRUGGLE AGAINST TERRORISM

Detecting deception and intelligence gathering from human resources is increasingly important to protect vital national security interests. We argued that fMRI has a potential to detect the neuro-circuitry involved in deception. This technology can support state's struggle against terrorism by understanding the brain basis of deception, so that the means for dealing with terrorists are developed in a timely manner. However, in a democracy, the legitimacy of state's action is important to maintain support for what the government does in the war on terror with in rule of law to protect public interest [80]. Knowledge is power, and certainly advance security measure government could take is to ensure that general public is aware of its benefits and threats. In this regard, it is important to pay explicit attention on adopting fMRI with cost and benefit analysis. Thus, the decision might be improved with great understanding and confidence that it is widely believed to be the right thing to do.

Firstly, apart from the challenges we described above, fMRI has several other disadvantages as a tool for lie deception. For instance, it is time-consuming and expensive process [81]. Secondly, fMRI need a separate control room (magnetically shielded) filled with computers, power supplies and data storage devices that require a significant capital investment from state [82]. Thirdly, the noise level during examination is uncomfortably high that needs protective ear coverings for subject. Fourthly, a relatively minor head or body motion during the scan can spoil the analysis [82]. Unfortunately, these movements could be effective countermeasures for resistant terrorist. In addition to these challenges there are also some safety hazards associated with this scanning. People with claustrophobia and pregnant women are generally not scanned for obtaining information [19].

On the other side, the use of vulnerable populations (such as prisoners) for the new interrogation techniques has a long and disturbing history filled with misguided unethical experimentation. Those who designed, control, monitor and supervised these alleged practices – whether security officials or health professionals claims to be in the service of national security objectives. Though, sometime this practice faces conflict with the interests of those whom they are monitoring such as suspects of crime. However, given the attacks on 9/11 in New York and those in 2004 in Madrid and London in 2005, the public is well aware of a heightened threat of terrorism to national security. As a result, the public has generally accepted the government's new steps, new tools and new ways of thinking to fight terrorism [83]. Nonetheless, this war requires constant vigilance and the commitment of resources on all fronts. For instance, the perpetrators of 9/11 used commercial airplanes as a major weapon. This attack exposed major weaknesses in the existing immigration system and border security. In this regard, air travelers have adjusted to the need for more intensive passenger screening on airport [83]. Incredibly, there is a willingness from general public to provide, iris scan, fingerprints, and other biometric screening methods to acquire secure identification [83].

The cost of liberty is high, but it is a price people always have been, always will be and willing to pay. Public support is a strategic instrument and a vital component and there is a great deal of complacency amongst the public in the war on terror. Similarly, there is a great expectation among scientists and counterterrorism agencies that public will also realize the urgency of the threat and the significance of interrogational neuroimaging application to national defense. We have proposed our novel experimental methodology and guidelines that introduce a first step toward developing reliable and practical interrogation applications. This paradigm will provide counter terrorism agencies with cost effective approaches that could have a profoundly beneficial impact on society. It will allow interrogators to focus their investigations on the suspects who actually commit terrorism. Thus, innocents can be treated with the dignity befitting human beings. It would appear from this research judgment and assessment that fMRI has a greater probability for success to identify recognition and lie detection during interrogation procedure.

We also argued that some of the claims are unfounded such as concerns about privacy, confidentiality and torture. It has potential to truly deliver what its advocates such as cognitive liberty and potential to replace torture and aggressive existing interrogation strategies that inevitably violate the core human rights obligations. The goal is to create an environment where neither torture nor coercive interrogation is permissible. Thus, implementation of fMRI may render the dark art of interrogation unnecessary in the Global War on Terrorism. Armed with this neuro-imaging technology, investigators will no longer feel the need to torture or use 'torture-lite' interrogation tactics. An fMRI is compatible with human rights law and information can now be achieve without leaving a physical trace of the trauma of torture [13].

More significant, consideration must also be given to the government's purpose in subjecting the suspect to fMRI scan. It is important that state's interest in interrogating high-value terrorists may be justifiable and most likely not to rise to the conscience shocking level and will not injure substantial liberty interest. Whether or not policy makers or civilized society can or should allow brain scanning is a matter that will continue to be debated for years to come. However given only the terrible choice of permitting the death of many innocent people OR scanning an individual ,who can possibly prevent mass causalities, the state have to make sensible decisions what is necessary to save lives.

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