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Report

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fMRI as a Method of Detection of Deception: A Review of Experiences

Key Words: fRMI, fRMI and detection in deception, new method of lie-detection, experimental lie detection

The first thing that individuals in the field of deception detection notice upon observing fMRI research conducted in a lab is how very different the experience is to the real world. In a typical fMRI experiment, a participant will lie in a scanner while performing a particular task (Figure 1).

In the earliest fMRI studies, participants watched patterns of grids, such as checkerboards, while scientists measured the output from the visual cortex. First, an MRI image is taken of the individual's brain which, like a fingerprint, has its own unique shape and size. Later, the voxels containing significant relative brain activity are overlaid on this image.

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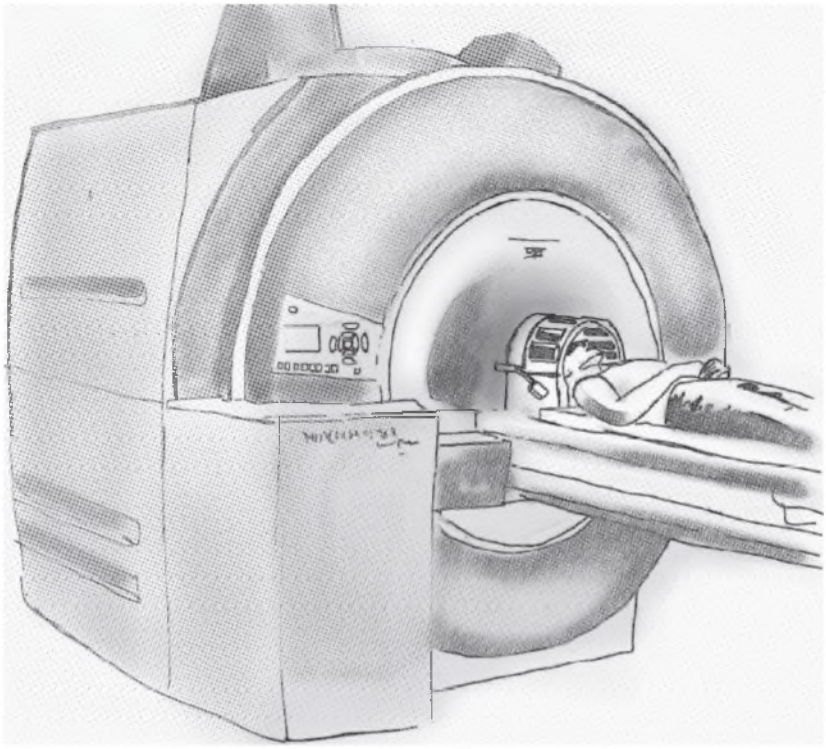


Figure 1: Participant resting on the table of an MRI, coils are placed around the head to measure the MRI signal. In a simple analogy, a camera captures the intensity and color of light to create an image. In an MRI, we use radio waves to excite the molecules in the brain and as the molecules return to rest, the released energy is captured by the MRI coils. Like the intensity and colors in a camera image, the energy from the various molecules in the brain show up with different intensities and contrasts (i.e. colors), creating an image.

Next, a series of low-resolution scans are recorded over time, some during one condition and others during a different condition (see Figure 2). For example, some scans might be taken while an individual is telling a lie, while others might be taken while an individual is telling the truth. The two sets of scans are later compared to see which areas are more active. When a human-being engages in a cognitive activity, such as subtraction, reading, or lying, various parts of the brain become active. Increased mental activity is associated with increased metabolic activity, and that metabolic activity results in an increase in blood flow to the area. The difference in blood flow between conditions is called "relative activity". For example, in order to compare relative activity between lie telling and truth telling, we compare the blood flow measured when a participant tells a lie to the blood flow measured when the same participant tells the truth.

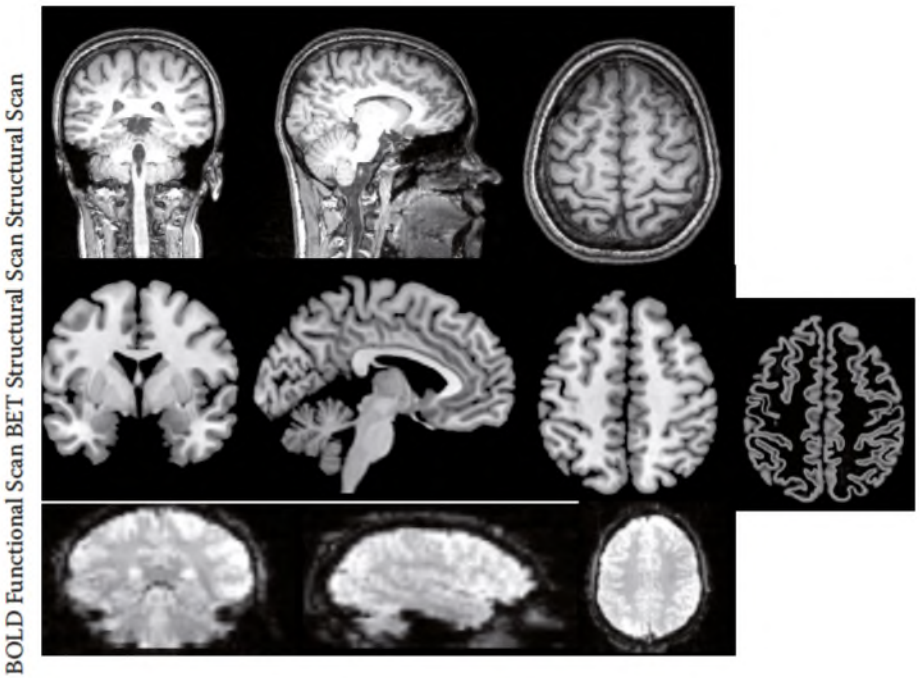


Figure 2. The first row depicts a complete T1 weighted scan. In the second row, the brain region has been extracted (BET) from the original scan. T1 weighted scans, a type of structural MRI, are designed to give the best possible picture of the brain's gray matter (see breakout). The third row shows one volume from a multivolume fMRI scan. Functional scans are made at much lower resolution than structural scans because time is a factor. Unlike a sMRI which can take as long as 12 minutes, an fMRI volume is measured in around 2–3 seconds. A second difference is that the functional BOLD scan is designed to measure blood oxygen.

Anyone who studies or practices in the field of deception detection will be familiar with this conundrum: How do we determine what a lie is? The fMRI offers no solution to the problem. An informal consensus among researchers is that the act of deception is not a unique cortical process, but the summation of many (some interchangeable) processes in the brain. For the purpose of discussing the how these processes might work, I have proposed a simple framework of the order of cognitive processes that occur when an individual hears a question and then responds deceptively (Figure 3).

Every person has a normal resting state, and pattern of physiological reactivity that is unique. Diverse factors such as physical health, emotional state, drug use, intelligence, and familial support systems all help to shape resting executive control. If a question is asked to which the person intends to lie, attention is directed to the question and cognitive resources are allocated. In addition, information is recalled that relates to the question as well as social

decision making information. A decision is made to inhibit the truthful information and present the deceptive information. There is strong evidence that these processes are happening in parallel. For example, it is not always necessary to fully retrieve information from long-term memory before deciding to inhibit it and respond deceptively.

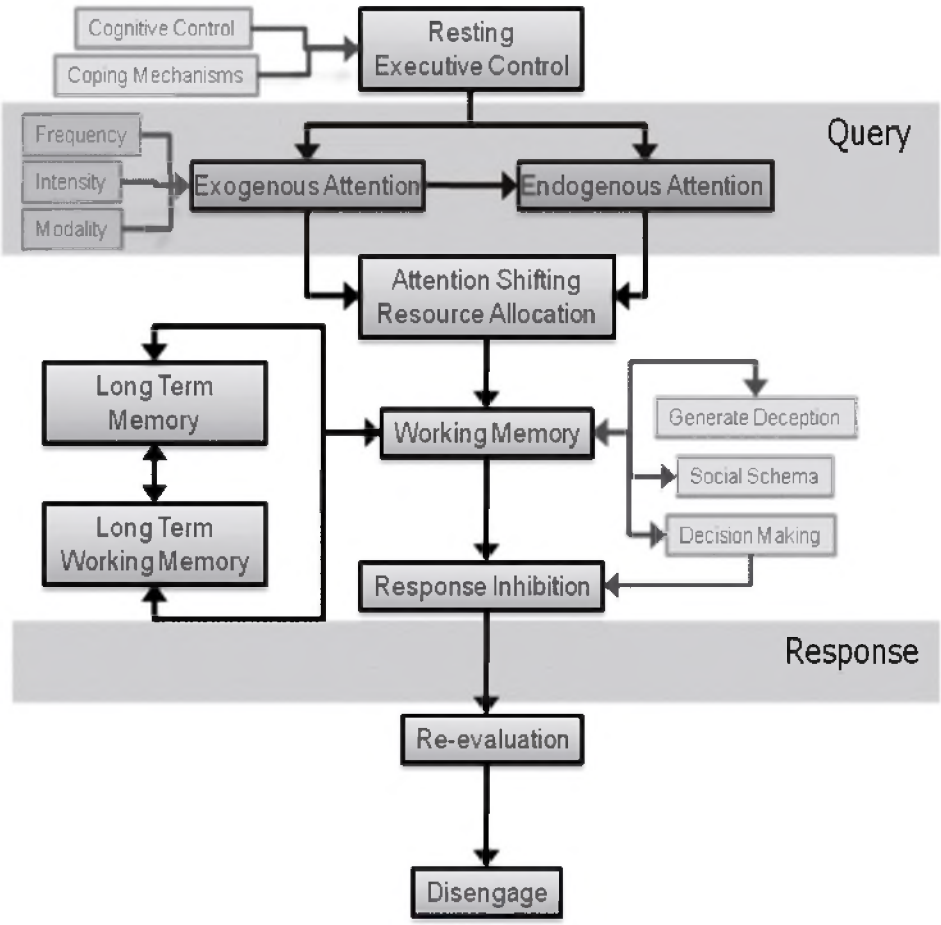


Figure 3. A cognitive framework for organizing studies of the processes involved in deception.

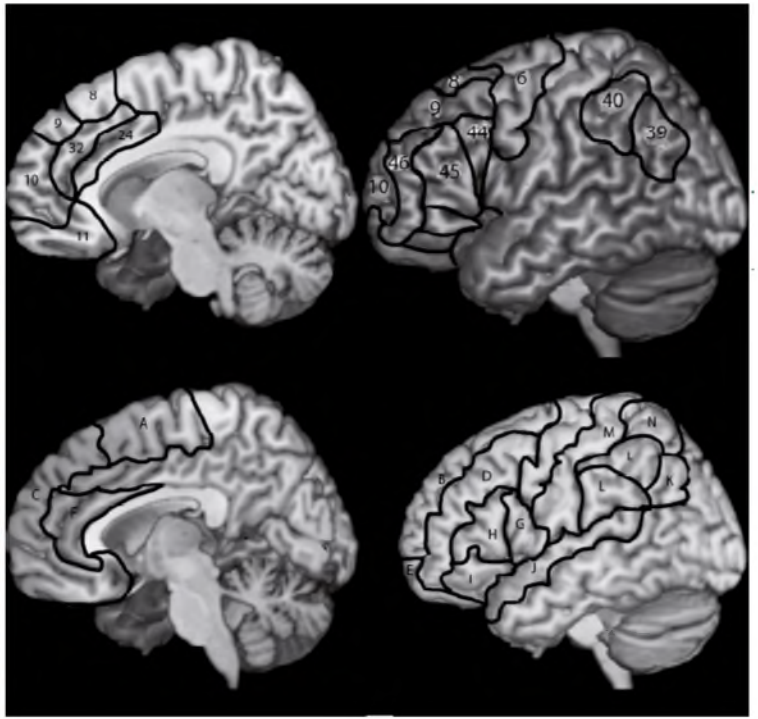
Studying Deception with an MRI

As any examiner will note, the polygraph is not a tool for detecting deception, *per se*. The polygraph is a tool for measuring physiological responses. In the same way, a fMRI scan does not measure the brain activity unique to deception. While there is no one region of the brain that is directly associated with deception, there does seem to be a core set of cognitive processes that are associated with the processes involved in lie-telling. However, these processes are also associated with two levels of difficulty. Similar to the construction of a polygraph examination, a fMRI test must be constructed with attention to detail.

What has fMRI told us about deception?

Three papers have reviewed the data from fMRI studies of deception (Bhatt et al., 2009; Christ et al., 2009; Vendemia et al., 2009). Before discussing the studies, a quick note about anatomical names (see Figure 4). Neuroscientists have different preferences for naming cortical anatomy. The field is in a period of rapid growth, and we are learning previously unknown information about the brain. Naming conventions will continue to change as the breadth of our knowledge expands and our ability to map the brain improves. Some researchers have a preference for using Brodmann's Areas which represent numbered regions of the brain divided by the type of neurons in the region and their interconnections. Other researchers prefer a strictly anatomical name which is based soley on the structures of the brain. The third group has developed a merging of these naming systems to best represent what we know of the function of the underlying cortex. If you read literature about deception, you will most like see the structures in Figure 4.

Each of the reviews have focussed on the major studies in the field, and come to similar conclusions. The paradigms included modifed versions of the guilty knowledge task, lying about recently acquired knowledge, prepared or spontaneous lyies about past experiences, and lies about recent actions. Christ identified regional brain activity common across the studies in a meta-analysis, and then compared them to areas of the brain associated with three cognitive processes: 1) working memory, 2) inhibitory control, and 3) task switching. These three processes are most consistently reported throughout the deception literature and are supported by measures of reaction time, pupilommetry, galvanic skin response, and brain wave recordings obtained



Brodmann Areas	Anatomical Names	Special Regions of Interest
6	Supplementary Motor Area (A)	
6, 8	Superior Frontal Gyrus (B)	
9, 10	Medial Frontal Cortex (C)	
9, 10, 46	Middle Frontal Gyrus (D)	Dorsolateral Prefrontal Cortex
10, 11, 47	Orbital Frontal Cortex	Ventromedial Prefrontal Cortex
11,12	Orbital Gyri (E)	
24, 32	Anterior Cingulate Gyrus (F)	
	Inferior Gyrus	
44	Pars Opercularis (G)	Broca's Area
45	Pars Triangularis (H)	Broca's Area
47	Pars Orbitalis (I)	Ventral Lateral Prefrontal Cortex
22	Superior Temporal Lobe (J)	Wernicke's Area
39	Angular Gyrus (K)	Wernicke's Area
40	Supramarginal Gyrus (L)	Wernicke's Area

Figure 4. Medial and Lateral aspects of the cortex labeled in the top row by Brodmann's Areas and in the bottom based on Anatomical Landmarks. Both naming conventions are used in the literature. These regions are the predominant regions discussed in studies of deception.

through event-related potentials (ERP). However, for reasons I will explain later the meta-analytic approach is not ideal with the research that has been conducted thus far.

In block design fMRI studies of deception, researchers have associated activations in the caudate (Lee et al., 2002), cerebellum (Ganis et al., 2003), cingulate (Mohamed, Faro, Gordon, Platek, Ahmad, & Williams, 2006; Ganis et al., 2003; Kozel et al., 2004; Lee et al., 2002), cuneus (Ganis et al., 2003), fusiform/parahippocampal area (Ganis et al., 2003; Kozel et al., 2004), precental gyrus (Ganis et al., 2003), ventrolateral prefrontal cortex (Mohamed et al., 2006; Spence et al., 2001), medial prefrontal cortex (Ganis et al., 2003; Langleben et al., 2002; Spence et al., 2001), prefrontal cortex (Mohamed et al., 2006; Ganis et al., 2003; Kozel et al., 2004; Lee et al., 2002), left frontal (Ganis et al., 2003; Langleben et al., 2002; Spence et al., 2001), left inferior parietal (Langleben et al., 2002), (Lee et al., 2002; Spence et al., 2001), and temporal, (Mohamed et al., 2006; Kozel et al., 2004; Lee et al., 2002; Stelmack, Houlihan, Doucet, & Belisle, 1994b) regions with the act of deception.

Table 1 lists fMRI studies in which participants engaged in deceptive behavior or observed deceptive behavior, and the specifics of each paradigm. It is clear that these studies differ on how participants were "motivated" to deceive, the types of lies they were asked to tell, the type information about which they lied, and the type of polygraph scenario they attempted to parallel.

Table 1. A comparison of paradigms investigating deception

Author	Paradigm Description	Lie Type
Bhatt et al., 2009	Participants responded to grayscale images of faces presented in lineups	Facial recognition
Ganis et al., 2003	Recorded work/vacation scenarios, after 1-week delay generated alternate scenarios and memorized them.	Memorized and Spontaneous
German et al., 2004	Observers indicated whether real or acted clips revealed completed acts.	Observation only
Grezes et al., 2004	Observers indicated whether actors actually lifted heavy boxes or pretended to lift heavy boxes.	Observation only
Kozel et al., 2004a	For a reward, participants lied and told the truth regarding objects under which $50 was hidden.	Concealed information
Kozel et al., 2004b	For a reward, participants, lied and told the truth regarding an object under which $50 was hidden.	Concealed information
Kozel et al., 2005	For a reward, participants, lied and told the truth regarding an object under which $50 was hidden.	Concealed information
Langleben et a., 2002	Deception to cards in a concealed information test	Concealed information

Langleben et al., 2005	For a reward participants were instructed to (lie) deny possession of one playing card and (truth) acknowledge the possession of a different playing card.	Directed lie about objects in possession
Lee et al., 2002	For a reward, participants lied in a card playing scenario	Concealed information
Lee et al, 2002	For an imaginary reward, participants faked amnesia to digits and autobiographical information	Simulated amnesia digits and autobiographic memory
Mohamed et al., 2006	Participants responded to previously recorded questions in a concealed information test	
Nunez et al., 2005	Subjects instructed to give truthful or „false" answers (blocked) to a series of yes/no questions that also varied in autobiographical content	Autobiographical Memory
Phan et al., 2005	For a reward, participants lied in a card playing scenario	Concealed information
Spence et al., 2005	Participants were told to lie and tell the truth to events that happened earlier in the day	Directed lie to episodic memory
Spence et al., 2001	Participants were told to lie and tell the truth to events that happened earlier in the day	Directed lie to episodic memory

Even given these differences, activations in certain regions could be anticipated based on the underlying processes engaged in each study. For example, the studies by Kozel et al. (2004, 2004b, 2005), Langleben et al. (2002), and Phan et al. (2005) each used a risk-taking scenario in which participants would receive a monetary reward if they "fooled" the examiner, but no reward if they failed to "fool" the examiner. Given this condition, activation could be anticipated in the orbitofrontal cortex, a region of the frontal cortex that has been implicated in the integration of motivational stimuli when guiding response selection (Schoenbaum, Takahashi, Liu, & McDannald, 2011). Only Kozel identified activation in this region.

John Gabrieli and other fMRI researchers argue that the anterior prefrontal cortex, or Brodmann's Area 10, is involved in the act of deception (Gabrieli, July 14, 2005). Ramnani and Owen (2004) argue that this area is activated when an individual must make simultaneous considerations of multiple relations. When an individual deceives, these multiple relations may occur between situational context, goal-driven behavior, divergence of the deceptive information from truthful information, and a variety of internal states. Given the generalist nature of these "simultaneous considerations," it is no surprise that several researchers have identified activation in this region during the

act of deception (Bhatt et al., 2009; Ganis et al., 2003; Lee et al., 2002; Mohamed et al., 2006; Vendemia, & Buzan, 2004a;).

However, the most widely reported region of activation is the anterior cingulate (Vendemia, & Buzan, 2004b; Spence et al., 2001). This activation is broken down into two main areas, the ventral anterior cingulate and the dorsal anterior cingulate. Some researchers believe that this area is involved in conflict resolution, while others believe that it is involved in attention shifting and resource allocation processes. It is possible that the more ventral regions are involved in conflict resolution, while the more dorsal area is involved in attention shifting. It is theoretically probable that the act of deception involves both processes.

Bhatt's (2009) review of the brain regions activated in fMRI studies noted that the group activations reported in the studies were quite varied (activation between truthful groups and deceptive groups). Vendemia et al., (2009) evaluated the intersubject variability between the studies finding that the general differences in brain activation between participants was greater than that between truthful and deceptive responding. At first the variability seems overwhelming, but this variability is exactly what research with the fMRI is designed to identify.

The polygraph is a reliable measure of autonomic nervous system responses, and it is very robust. Any variety of test formats produce similar results, even though the formats measure different aspects of cognition, attention, and emotion. The reason the tests are robust is that autonomic system responses result from the combination of cognitive processes. Very similar patterns of results can be the results of different combinations of cognitive processes. For example, the guilty knowledge ("concealed information") test depends on the presentation of the infrequent "relevant" item among high frequency irrelevant items. Extensive research with the infrequent/frequent paradigm with other measures of cortical activity suggest that "the expectation of the infrequent stimulus" drives the autonomic system activity. When the anticipated infrequent stimulus occurs and the rare information is recognized a particular brainwave, the oddball P300, occurs (Allen & Iacono, 1997; Allen et al., 1992; Farwell & Donchin, 1991; Rosenfeld et al., 1999). Particular cognitive functions associated with the identification of the infrequent stimulus include attention resource allocation (Comerchero & Polich, 1999), and the consequential updating of information held in working memory (Donchin & Coles, 1988; Ruchkin et al., 1990).

During probable lie format exams, in which relevant questions are embedded in between pairs of "probably lie" questions that are then intermingled with irrelevant questions, waveforms associated with recall of information

(N4) and switching between high and low difficulty conditions occur (Meek, Phillips, Boswell, & Vendemia, 2013; Schillaci & Vendemia, 2014; Vendemia, Schillaci, Buzan, Green, & Meek, 2009).

Using fMRI, along with other technologies and techniques, we can begin to parcel the specific cortical activity that occurs during the act of deception. The task is far from simple, and the studies conducted thus far are rife with errors in test construction. They repeat errors that occurred in the early 1990's with the first studies of brain wave measures of deception which repeated errors in the first designs of polygraph tests. In addition to errors in design, fMRI tests are susceptible to a variety of errors.

Problems with fMRI studies of Deception

Noise related to people. Within subject noise can occur any time a subject moves inside the MRI scanner. Respiratory and cardiac artifacts can also create within subject noise during scans, as can attentional modulation, changes in cognitive strategy, drugs and medications, anxiety, and countermeasures. Factors related to within subject noise are also consistently present in between subject noise. Whenever a difference occurs between participants that is not related to the task, it enters into a class of error called between subject noise. Variability in how the brain's anatomy, differences in hemoglobin concentrations, cytoarchitectonic variability (how the different parts of the brain are connected during development), and variability in venous drainage patterns are all factors of between subjects noise. Other factors such as how much information a person can maintain at any given moment in time, working memory, are also considered between subject noise if the experimenter has not considered them.

An example of the impact of such a variable can be observed in a study in which we tested the verbal memory in 19 participants who then performed a deception task in the fMRI.

All were scans collected at 3T with Siemens Magnetom Trio System using T2* weighted echoplanar images sensitive to blood oxygen levels were acquired during the functional scans (gradient echo; *TR* = 2490 ms; *TE* = 30 ms; image matrix = 64 X 64; in-plane resolution = 208 X 208 mm; slice thickness = 3.2 mm). Voxel-wise analysis was carried out using flexible hemodynamic response function (HRF) modeling, allowing HRF to vary spatially and between subjects. (Woolrich 2004). Analysis was carried out using FEAT (FMRI Expert Analysis Tool) Version 5.63, part of FSL (FMRIB's Software Library, www.fmrib.ox.ac.uk/fsl). Time-series statistical analysis was car-

ried out using FILM with local autocorrelation correction (Woolrich 2001). Z (Gaussianised T/F) statistic images were thresholded using clusters determined by Z>2.3 and a (corrected) cluster significance threshold of P=0.05 (Worsley 1992). Registration to high resolution and/or standard images was carried out using FLIRT (Jenkinson 2001, 2002).

Participants with lower scores on verbal working memory had greater relative activation in the left middle frontal gyrus while responding deceptively than those with higher scores (Figure 5). The finding is critical as the left middle frontal gyrus is a common finding in fMRI studies of deception. If participants who have poor working memory skills show greater activation in deception relative to truth telling than any study that reports left frontal middle activation without accounting for the effect verbal working memory is potentially confounded.

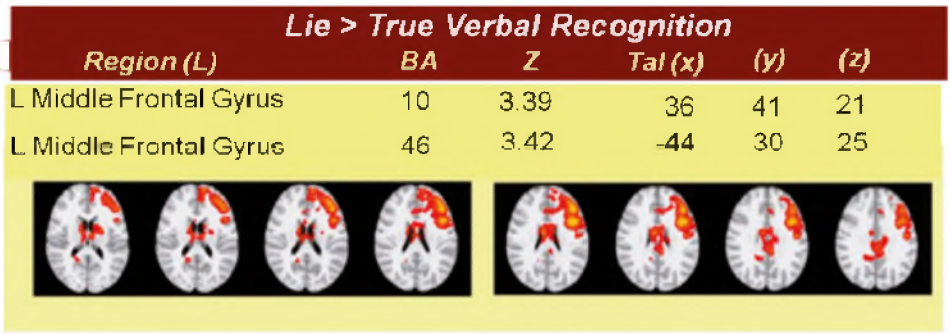


Figure 5. Greater relative left middle frontal gyrus activation in participants with lower working memory scores than those with higher working memory scores when they respond deceptively as compared to truthfully.

Paradigm Noise. Issues with between paradigm noise arise from inconsistent definitions of types of deception being used in paradigms, differences in stimuli presented (rate, number, and type), differences in the type of memory involved, and differences in reward/punishment scenarios. We studied a very simple aspect of stimulus presentation in the fMRI by having participants respond deceptively on different percentages of the trials.

Participants were 89 undergraduate college students (61 females, Mean age = 20.9 yrs, SD = 3.45). Ethnicity breakdown : 78% Caucasian, 8% African-American, 3% Asian, 2% Hispanic, 3% identified as Other, 5% did not report. An event-related paradigm was implemented with 200 trials of the two-stimulus type being presented. Participants were randomly assigned to one of three conditions, 20% Lie (N = 15), 50% Lie (N = 21), or 80% Lie (N=21).

These N's represent the final numbers, as participants were thrown out for too much motion or accuracies below 85% before analyses.
As can be seen in Figure 6 relative activity in the anterior cingulate and parietal cortex was significantly greater when participants responded on 50% of the trials as compared to 20% of the trials. Activity in the anterior cingulate is the primary finding in fMRI studies of deception. The effect of this small paradigm manipulation has crucial implications. First, it is critical to know what is the mechanism causes anterior cingulate action. Second researchers must be clear about how frequently participants told lies; of the previous research studies reviewed for this paper several did not contain enough information to determine how often their participants told lies. Of those papers in which the information was available the participants were deceptive on 10% to 80% of trials.

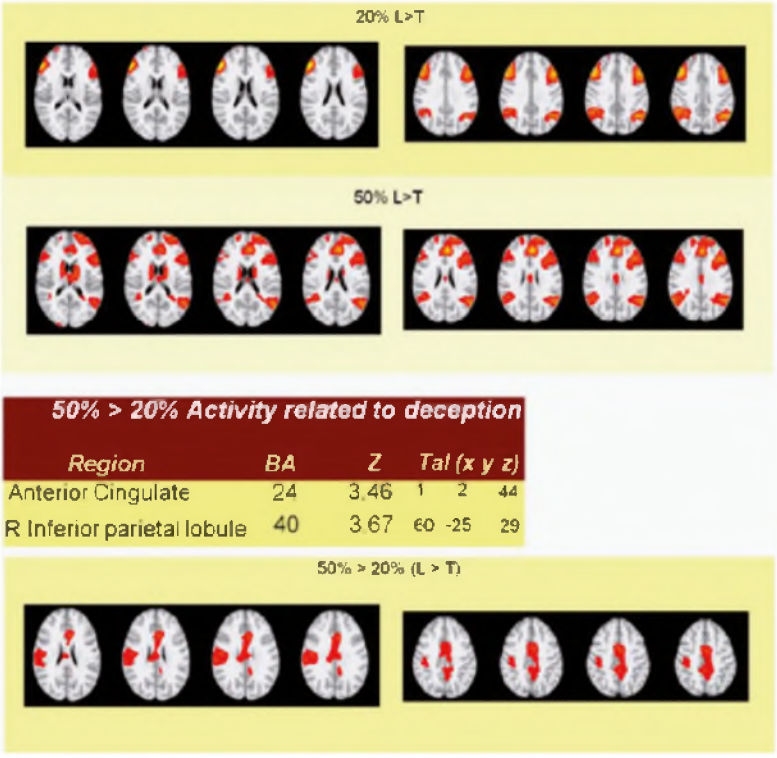


Figure 6. Patterns of relative brain activation when participants respond deceptively as compared to truthfully. In the top panel, participants responded deceptively on 20% of the trials. In the second panel participants responded deceptively on 50% of the trials. The bottom panels shows the specific regions that were activated more in the 50% condition than in the 20% condition.

Validity of Stimuli. Deception paradigms are based on the assumption that the only difference between stimulation "questions" is the participant's truthful, deceptive, or unknown response. A substantial body of scientific evidence points to several confounding factors within the question set designs of existing paradigms (Phillips, Meek, & Vendemia, 2011). Unfortunately, a systematic approach to question design based on known linguistic and cognitive principles has not been developed (Phillips & Vendemia, 2008). The validity of test stimuli should be investigated thoroughly by basic researchers, rather than applied researchers, and then tested for generalizability and disseminated to the field.

Analytical Assumptions. fMRI is a multivariate signal which means that the brain functions as a system with different areas of activation being interdependent on one another. The problem of multivariate signal detection can be easily resolved by requiring that researchers utilize multivariate approaches for data analysis or reduction. In some cases a univariate approach can be justified, and for those, researchers should be able to provide such justification. All levels of research, from basic validity testing to field testing, should meet this criterion.

Methodological Confounds. Researchers should be familiarized with the literature of deception before they begin constructing paradigms. Methodological confounds can enter the test scenario at any level of research or field design. A mechanism should be put into place to allow feedback between basic and applied researchers to communicate possible sources of confounds. In addition, a mechanism should be put into place that allows field examiners to communicate to appropriate applied researchers when the field applications provide unexpected results.

Unity of Construct Assumption. A basic research program that focuses on the identification of models of deception and of underlying dimensions of deception should exist. This program is a fundamental part of establishing the validity of the measures.

Construct Validity. An ongoing basic research program that focuses on the identification of a valid model of deceptive behavior at the central nervous system should exist. If a valid model can be identified with central nervous system measures, then test designs can be formulated based on those measures and translated to other sensor systems for experimental testing.

Conclusions

fMRI has the potential for yielding the most specific measures of deceptive behaviors of any technology; however, that potential is significantly hampered by a lack of specificity in the current research applications. A major problem with the current set of research protocols is that researchers are often guided by unidimensional theoretical assumptions, without any consideration of confounding factors. This is particularly problematic because the reported studies are highly confounded by variables known to affect peripheral system measures (and therefore CNS measures as well).
Researchers need to be familiar with neuroscientific processes in the human brain to conduct adequate studies with this technology. Of critical importance is a familiarity with those processes known to affect other dependent measures of deception. Test construction within this arena is of paramount importance. Researchers need to have experience with the broad set of results and techniques in the field of credibility assessment, and to revisit questions many times before reaching conclusions.

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British Experiences of Polygraph Testing Sexual Offenders an Update

Key Words: sex offenders, polygraph examination of sex offenders, treating and supervising sex offenders

Introduction

Just two years ago, in April 2012 (Wilcox and Gray) published a paper in this journal on the then current application of polygraphy with sexual offenders in the UK. At the request of the Journal Editor, this paper represents an update of developments in this area.

Background

The previous article was published prior to Gannon et al's (2012) government commissioned review of the most comprehensive British trial of polygraph

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testing of convicted sexual offenders to date (Gannon et al, 2014). As suggested, based on informal information gathered from Probation Officers involved in the trial (Wilcox and Gray, 2012), Gannon's research findings gave indications of significant benefits to employing polygraph for the purposes of monitoring offence-related issues among convicted offenders. These mandatory polygraph trials involved 599 sexual offenders released on licence from seven probation trusts and ended on 31 March 2012 (Draft Offender Management Act, 2007; Commencement No. 6).

Polygraph testing was used principally to determine the offenders' compliance with specific licence conditions, for example, restricting the offender from visiting places, people, etc. where risk of reoffending was considered to be greater. Recorded data concerning polygraph administration and associated disclosures (Gannon et al, 2012) was employed to impact on case management decisions concerning risk, appropriate levels of supervision, and, at times, judgements as to whether an offender should be recalled to prison due to breaches in licence conditions. Such actions were not directly determined by whether the offender passed or failed the polygraph. Rather, polygraph results and disclosures influenced the case management process and often gave rise to more intensive investigations of the behaviours of the offenders concerned by their supervising probation officer or other individuals directly involved in their monitoring, treatment or assessment. Where additional information indicated a failure to comply with licence conditions or gave indications of increased risk to the public, the offender could, and was at various times, recalled or subjected to more stringent supervision conditions.

While the original study undertaken by Grubin (2010) involved voluntary polygraph testing in 10 UK probation trusts, the further evaluation enforced mandatory testing through the powers of the Offender Management Act (2007), allowing polygraph testing to be used, as deemed appropriate, in the management of sex offenders on licence in England and Wales. Though the magnitude of sexual disclosures reported by Gannon et al (2012) was notably less than that described by Grubin (2010), the directionality was the same, as was the perceived benefit of including polygraph testing in the overall community monitoring offender management package, as compared with excluding this tool from the overall supervision plan.

Broadly, the evaluation of the polygraph pilot conducted by Gannon and colleagues (2012) found that sex offenders on licence who were required to take periodic polygraph examinations were more than twice as likely to make significant disclosures as those in the comparison group who were not required to undertake polygraph examinations. This had a substantial impact on mobilising probation resources and associated agencies to enhance community

safety. The study concluded that polygraph testing appeared to increase preventative action among professionals by enabling them to gain more information for greater effectiveness in managing the offenders' behaviour and safeguarding the public.

Current Status

In the recent parliamentary sixth report (Draft Offender Management Act 2007; Commencement No. 6, 2013), it was indicated that an expansion of this scheme is intended by the UK's Ministry of Justice (MOJ), with the aim of targeting those individuals who pose the greatest risk of reoffending or who give greatest cause for concern to the supervising agencies involved in case management. The MOJ has advised that this would involve approximately 25% of sex offenders in the UK who are on licence. The MOJ estimated that this would necessitate that about 750 sexual offenders should receive polygraph examinations yearly. The MOJ also suggested that a capacity to assess an additional 200 offenders, in circumstances where such action was deemed necessary, would also be included in the overall provision plan. There is a recognition that the capacity to undertake this task, involving these numbers, does not as yet exist within the United Kingdom.

At the time that this pilot was being undertaken, a legal challenge was mounted, alleging that mandating polygraph testing within an offender's licence conditions was a violation of his human rights, citing Article 8 of the European Convention on Human Rights (ECHR, 1950). Opponents argued that this action was not proportionate and could not be justified on the basis that it was in the public's interests. However, this legal argument was not accepted by the Court and, in keeping with the spirit of proportionality and responsible ethical practice in the use of the polygraph (Wilcox, 2013), the planned national rollout would be targeted to sex offenders presenting with the most substantial risk concerns. From 6 January 2014, drawing from the Offender Management Act (2007), the parliament affirmed that polygraph use would be extended across England and Wales in the management of the most serious sexual offenders.

Making provision for polygraph testing on this scale, has proven to be challenging. Initially, plans had been made to privatise lie detector testing for sex offenders, though this decision was reversed when G4S and Serco, two of the government's largest private providers of national security services, became the subject of investigations and what has been described as "outsourcing scandals" within the current services they provide to the UK government

(Peachey, 2014). As a result, the UK government has opted to train its own polygraph examiners and the tendering process for training future examiners has only just been concluded. As yet, it is unclear what impact this will have upon the introduction of mandatory polygraph testing on a large scale in the UK, though it appears that this will only influence the timescales and not the government's basic plan.

As noted previously (Wilcox and Gray, 2012), the Hertfordshire police completed a successful pilot polygraph scheme, significantly reducing investigation time and often providing additional information relating to other unreported offences among suspected sex offenders who volunteered in advance of bringing charges (Travis, 2013). Further development of polygraph use in this area remains under discussion, as the results of this trial have been positively connoted. Relatedly, on this basis, police in Scotland have considered the use of the polygraph with sex offenders (Robertson, 2013) based on their investigation of the English pilot programmes referenced above. Unsurprisingly, the Association of Chief Police Officers (ACPO) in Scotland described reviewing these programmes 'with interest' while simultaneously recognising 'challenges' that any such scheme would have to address in relation to public acceptance.

Polygraph testing is also beginning to be employed in conjunction with psychological testing and incorporated into formal comprehensive reports in care and family proceedings as well as in relation to Sexual Offences Prevention Orders (SOPOs) and Risk of Sexual Harm Orders (RSHOs) where evaluating the behaviours and interests of individuals that impact on community and family safeguarding is considered a key concern (Donathy and Wilcox, 2013). In particular, the polygraph appears to be an important assistive tool in working with non-offending partners, within the context of family proceedings. The authors note that partners who have been groomed over extensive periods of time and particularly subject to the expressed views and opinions of their often convicted partner, benefit greatly from the employment of polygraph examination to obtain greater details about sexual convictions, such that they can achieve greater objectivity in judging the reported offending behaviour of their partner. Through viewing the DVD of the polygraph examination, non-offending partners can personally observe clear indications of inconsistency in the offender's self-reporting, to take into account and more objectively form their own future views about their partner and their family's safety.

Summary

The introduction of polygraph with sex offenders in the UK has been a slow process undertaken with considerable care and planning (Grubin, 2002; Grubin, 2006; Wilcox, 2009; Wilcox and Sosnowski, 2005; Wilcox, Sosnowski and Middleton, 1999). While its use continues to be controversial, the polygraph's benefits with regard to eliciting disclosures that have significant public protection impact has been difficult to refute in spite of its many vocal adversaries. For this reason, the polygraph appears to be set to continue to be rolled out and employed to supervise, treat and assess sexual offenders in the UK and to make an important ongoing safeguarding contribution.

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Value of Content-Based Deception Detection Methods

Key Words: detection of deception, content-based methods, CBCA, Reality Monitoring

Literature abounds with examples of various methods serving detection of deception in testimonies. They can be divided both according to the methods used depending on the tactics of witness interrogation (Gruza, 2009) and the psychological model of analysing testimony veracity (Marten, 2012). Functioning currently is also a division of methods of detecting deception based on the channel of communication analysed (Vrij, 2008): methods based on the analysis of the so-called non-verbal and vocal detection of deception (DePaulo *et al.*, 2003), methods based on psychophysiological analyses (polygraph, EEG, fMRI, and thermography examinations), and methods that analyse the contents of the testimony (e.g. Content Based Criteria Analysis – CBCA,

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Steller, Köhnken, 1989; Reality Monitoring – RM, Sporer, 2004; Aberdeen Report Judgement Scale – ARJS, Sporer, Breuer, 2009). The last set of tools seems to be most interesting for the potential of an extensive application in judiciary practice, and relative easiness and low cost of application, coupled with powerful theoretical grounds (Wojciechowski, 2012).

In the past, studies related to the last group of the methods focused mostly on seeking an answer to the question whether it is possible to find elements proving that witness testimony was consciously falsified in its content, and what elements these are. Today, it is rather assumed that the above is possible, and psychologists' efforts aim at building a classification of such elements mostly in the form of the so-called veracity criteria, whose presence in a testimony proves its sincerity. The methods that are based on analysing testimony content are often called verbal veracity assessment tools (Vrij, 2005), as they analyse the contents of the witnesses' statements, with omission of vocal (e.g. pitch of the voice, pauses in the utterance, etc.) and non-verbal (gestures, leg movements, etc.) hints.

What is usually used as theoretical grounds for the existence of content-based methods is the so-called Undeutsch hypothesis: the assumption that a testimony based on the witness's personal experience differs in form and content (qualitatively and quantitatively) from deceptive or insincere testimonies, and that the motivation of the liar is different than that of a person telling the truth, which translates into the contents of the testimony (Arntzten, 1989).

It is also noted that, according to the Reality Monitoring model (Johnson, Raye, 1981), memories of actual events differ in content and quality from representations and false memories. True memories about actual, personal experiences mirror the processes of perception that take place during their acquisition, while the ones based on representations contain more inference and cognitive processes. It was empirically proved that memories of experiences contain more stimuli data (visual detail, sounds, tastes, physical sensations), and contextual and emotional information than false memories (Johnson and Raye, 1981). Basically, the model explains how true memories "mix" in memory with fabricated events (or implied memories). Nevertheless, researchers adapted it to the needs of building a tool for discovering deceptive statements (Sporer, 2004, Alonso-Quecuty, 1992).

Currently, psychological literature distinguishes at least a number of systems of assessing testimonies and several dozens of criteria of veracity (see e.g.: Arntzten, 1989; Adams, 1996; Dando, Bull, 2011; Akehurst, Köhnken, Hoefer,

2001). The system that is perhaps most frequently used in the judicial practice is the Content Based Criteria Analysis – CBCA (e.g. Vrij, 2005, Köhnken, Steller, 1989). It is a tool that makes up a part of a larger procedure known as Statement Validity Analysis (SVA). It consists of 19 criteria concerning the semantic features of the contents of a testimony which, following the hypotheses, emerge more frequently in sincere testimonies (i.e. of events the person actually witnessed) than in deceptive (concerning invented events). These criteria include "logical structure" (criterion 1), "lots of details" (criterion 3), and "description of interactions" (criterion 5). It is assumed that in true testimonies, these criteria are present with greater intensity than in false ones. In other words, in sincere testimonies, people trained in the use of the CBCA method should confirm the existence of a logical structure of the utterance more often, diagnose a greater number of details, and discover the existence of utterances or parts of conversations quoted in the original form more often than in false testimonies.

Another system to be fairly well described in literature is Reality Monitoring (RM), based on a model quoted above (Johnson, Rye, 1981). The tool consists of 8 or 7 (see: Sporer, 2004;Vrij, 2008; Sporer, 1997) or 43 criteria (SMCQ, Sporer, Kuepper, 1995) divided into eight sections, and including, for example "visual details", "spatial details", "emotion" (Sporer, 1997).

Studies using content-based methods traditionally include three indicators: total accuracy rate, accuracy rate in diagnosing true statements (colloquially speaking: the capacity of a tool for revealing true statements as true), and the accuracy rate in pointing to false statements. These indicators differ in scientific studies (both experimental and practical), yet studies prove that the total accuracy rate of the CBCA usually oscillates between 55% (Granhag, Strömwall, Landström, 2006) and 100% (Esplin, Boychuk, Raskin, 1988), and in the case of the RM – between 61% (Sporer, Sharman, 2006) and 82% (Stromwall, Granhag, 2005). Falling back on the literature concerning matters of deception, Vrij (2008) sets the average accuracy rate of CBCA at 70.81%, and that of RM – at 68.8%. This allows to notice that the distribution of results concerning the accuracy rate of content-based methods is significant, and amounts nearly to 50%, depending on the experiment. Therefore, a question where such a difference originates arises: what variables influence the efficiency of content-based methods, and in consequence – differences between the studies.

An important question concerning the calculation of accuracy rate of content-based tools must be emphasised here. Analysis of sincerity conducted

with such a tool is usually performed in two phases. In the first, the coder of CBCA, RM, or other method is looking for the criteria of veracity in a given statement, and later assigns to them point-based values. Usually, a 0 if the given criterion is absent, 1 – if it is present in low intensity, and 2 if it is very clearly present. A five-point (e.g. Godert *et al.*, 2005) and a seven-point (e.g. Bradford, 2006) scale can also be used. To perform the calculation of the accuracy rate of a given method at this stage, some researchers employ statistical analyses (i.e. Multiple Discriminant Analysis) comparing the numbers of points acquired in truthful statements to the sums of points scored by false testimonies. It must, however, be strongly emphasised that the method does not apply in judicial practice, as courts experts do not have at their disposal multiple true and false statements, on whose grounds they could run statistical analyses. Everyday situations include also the second phase of the analysis: using a given tool, the coder must independently assess whether he or she believes the statements to be true or false. It is worth mentioning that content-based tools do not have objectively set limits defining the number of points above which a statement or testimony is true. According to the theory, the only thing that can be ascertained with such a tool is the fact that the greater the number of the points, the greater the probability that the testimony is true. The coder (court expert in practice) must himself or herself make the decision whether – on the power of own experience, the veracity criteria found, and knowledge of the tool – the testimony in their opinion is false or true. Some published studies measure the accuracy rate of a tool on the grounds of the coders' own true – false assessments made after conducting CBCA or RM analysis. The differences between this indicator of accuracy rate and the first one (i.e. calculated from the significance of the difference between the number of points acquired in true and false statements) may be significant and differ even by several persent for the same testimonies and the same coder (Dukała, Sporer, Polczyk, in print). The reason for such a status quo can most probably be the fact that while making the final decision whether testimony is true or false, coders working on content analysis do not follow the number of diagnosed criteria but rather their subjective weights.

Thus, one of the variables that influence differences in the efficiency of content-based tools of detecting deception in testimonies is the method of calculating the accuracy rate of the tool. Besides the above, researchers point to the existence of variables related to the persons of the witness and the interrogator, and the event itself. It is generally believed that these are usually such variables that have an impact on the quality of the statements made (Vrij, 2005). For if a statement is sparing, short, forced, and/or contains a very

small number of details, it is far more difficult to ascertain the presence of criteria of its veracity, which may disrupt CBCA and RM analyses. In turn, if a statement is extensive, and the free utterance of the witness is complex and rich, there is a greater probability for the criteria of veracity two emerge, which has an impact on the accuracy rate of content-based methods.

One of such important variables is the age of the interrogated. CBCA was designed to verify the veracity of children's statements in cases related to sexual abuse, hence the presence of some specific criteria (e.g. the criterion 10 "accurately reported details misunderstood", being a criterion concerning especially sexual performance, which a small child does not understand yet can describe them well, if he or she is actually their witness or a victim). Nevertheless, Undeutsch's hypothesis on which CBCA is based concerns general motivation and cognitive mechanisms in the human. Hence, it can be expected that the tool will be efficient both in the case of children and adults. However, some specialists draw the conclusion that if CBCA was designed to cover testimonies of children, the efficiency of the entire tool may be the same in the case of testimonies of children and adults, yet some of the criteria will turn up only and solely in the testimonies of children, and not in those from the adult people (e.g. the criterion 10 mentioned above). Additionally, small children are not fluent in expressing themselves, and building utterances and sentences, which may influence the quality of a testimony, and indirectly – the accuracy rate of the tools.

In turn, RM is based on theories concerning monitoring, i.e. a cognitive process that is developed and mature in adults. As the authors of the Reality Monitoring theory (Johnson, Rye,1981) themselves note, this processes is not yet developed in children, and children relatively frequently happen to confuse events they invented with ones that actually occurred to them. It can, therefore, be assumed that a tool serving verification of sincerity of the testimonies based on the criteria made on the grounds of the theory will have a lower efficiency in the case of children's testimonies than in the case of the ones acquired from adults.

Studies of CBCA accuracy rate suggest that generally the presence of the CBC a criteria is related to the age of the testifying person (Buck, Warren, Betman , Brigham, 2002; Craig, *et al.*, 2000; Hershkowitz, Lamb, Sternberg, Esplin, 1997; Lamers-Winkelmann and Buffing, 1996; Santtila, Roppola, Runtti, Niemi, 2000; Vrij, Akenhurst, Soukara, Bull, 2002). In other words, testimonies of younger children contain fewer CBCA criteria (or criteria are discovered, yet with low intensity) than testimonies of older children and adults. For

example, studies conducted by Buck and the team (Buck *et al.*, 2002) discovered that the presence of no fewer than 13 criteria was correlated with age. Probably this is why CBCA accuracy rate in case of children's testimonies is slightly lower than in the case of adult testimonies (Vrij, 2005), yet only up to a certain age, approximately 9 years (Santilla *et al.*, 2000). This, as a rule, is explained by the fact that younger children still find it difficult to assume the perspective of other people (hence absence of certain criteria, e.g. "pardoning the perpetrator" in their testimonies). Additionally, some researchers (notably Craig, Sheibe, Rasklin, Kircher, Dodd, 1999; Davies, Westcott, Horan, 2000) notice that in the case of younger children, the interrogators usually do not allow free utterances and use large numbers of leading (direct) questions, if not even focused ones. This results in low quality, short testimonies, and sparing input from children, which in turn may have a negative bearing on the efficiency of the CBCA in reference to the testimonies of small children. It must, however, be noted that in some studies, the impact of the age on the accuracy rate CBCA is not present (Akenhurst, Köhnken, Hofer, 2002).

A similar result is acquired when RM analyses is applied. For example, the studies by Otgaar, Candel, Memon, and Almerigogra (2010) did not acquire a satisfying accuracy rate in the use of RM for distinguishing between true and invented statements of young children, although one of the criteria (visual details) was distinctive for the difference between true and false statement well. In turn, other studies allow to draw a conclusion that RM works well only in the case of statements from adults (e.g. Sporer, Kuepper, 1995, Sporer and Sharman, 2006) and older children (Santtila, Roppola, Niemi, 2000; Stromwall, Granhag, 2005). In turn, for example, studies conducted by Roberts and Lamb (2010) ascertained that the older the child, the more RM criteria are present in his or her testimonies, and the effect was far more stronger in the case of true statements, then the false ones. Generally, it can therefore be stated that in the case of very young children, content analyses are hardly efficient in differentiating between true and false testimonies, yet the efficiency grows parallel to the age of the child.

Another important variable is the level of training of the people who use content-based methods. One could expect that the better trained (or having a longer experience) CBCA coder, the better diagnosis of the presence of individual criteria and the more accurate the conclusions drawn from the analyses conducted. In the case of CBCA, the recommended training lasts 3 weeks (Köhnken, 1999) or at least 3 days (Raskin and Esplin, 1992). Unfortunately, published scientific articles contain hardly any information on

the training for RM and CBCA coders. As a rule, researchers disregard the question entirely while describing the method. And yet, as research concerning e.g. efficiency of lie detection methods based on non-verbal signals, not only is the length of training significant, but so are the number of analyses performed earlier in a given method and the number of articles read (see: Vrij, 2008).

In the case of CBCA, there are at least a number of studies comparing the accuracy rate of detecting deception by untrained and trained people applying CBCS. The results of the studies are contradictory. In some studies, the training in applying CBCA helped to increase the accuracy rate of coders compared to an untrained population (Landry & Brigham, 1992; Vrij, Kneller, Mann, 2000; Fiedler & Walka, 1993; Porter, Yuille, Lehman, 2000, Tye *et al.*, 1999), in others, it reduced it (Akehurst *et al.*, 1998), and yet in others no difference in the accuracy rate of finding insincere statements between trained and untrained coders was discovered (Ruby & Brigham, 1998; Santtila *et al.*, 2000). However, attention should be paid to the fact that majority of cases covered by the studies referred to above lasted for 45 minutes (e.g. Landry and Brigham, 1992), 90 minutes (e.g. Ruby and Brigham, 1998) or (a single case) two hours (Akehurst *et al.*, 1998). As Köhnken (2004) noted, such a short time is absolutely insufficient for CBCA coders to be able to learn the method even superficially. Moreover, in most of the studies mentioned above, the training of CBCA coders did not cover an opportunity to practice the skills, and the statements used to analyse veracity were relatively short (e.g. 2 minutes in a study by Ruby and Brigham, 1998). In only one study, an extremely intensive CBCA and RM training was applied, with each coder being given 40 testimonies to assess under the supervision of a specialist and several scientific articles on CBCA and RM to read before the study; Sporer and Bursh, 2003), which significantly increased the accuracy rate of assessments using the methods. On the grounds of these studies and experiments proving zero efficiency rate of CBCA applied by untrained people (e.g. Bradford, 2006), researchers are likely to say that an appropriately long and well-designed training helps to increase the accuracy rate of deception assessments made with the use of CBCA.

As has been mentioned earlier, another very important variable that has an impact on the accuracy rate of content-based methods is the way of conducting the interrogation. Researchers pay attention to the fact that the longer and the freer the expression (free recall) of the witness, the more criteria of veracity can find their way into the testimony. A particular conclusion may be

drawn from here, namely that the less directive the interrogation, the greater freedom of expression the witness is allowed, and the more encouraging to speak the interrogation is on the other hand, the greater the precision of the CBCA and/or RM. For example, Herskowitz, Lamb and Sternberg (1997) realised that if open questions predominate in an interrogation of children, more CBCA criteria are present in sincere testimonies than in a situation where mostly focused questions are asked. A similar effect in the case of testimonies from sexually abused children was obtained by Craig, Sheibe, Rasklin, Kircher and Dodd (1999) who additionally noticed that when open questions were answered, more CBCA criteria emerged in true statements than in false ones (i.e. in the testimonies of children that lied about being sexually abused). In Vrij, Mann, Kristen and Fisher (2007), an accusatory style of interrogation, applied by police officers as a standard practice towards the suspects, significantly decreased the efficiency of both CBCA and RM. In turn, in the studies of Santtila, Roppola, Niemi (2000), a friendly or unfriendly way of interrogating a child influenced the frequency of emergence of CBCA criteria, and consequently – the accuracy rate of the tool.

In literature on the psychology of witness testimonies, cognitive interview (CI) is frequently mentioned as the most efficient technique and one most recommended for interrogating children and adults. Cognitive interview is based on memory, social, and representational techniques (Fisher, Geiselman, 1992). It is used ever more commonly in the daily work of police and prosecution (Memon, Meisner, Fraser, 2010). A question arises whether the application of the technique of interrogation will have an impact on the efficiency of content based tools for detecting insincere testimonies. Researchers point to two possible relations. First, according to the magnifying glass hypothesis (Hernandez-Fernaud and Alonso-Quecuty, 1997), a cognitive interview may increase the differences between true and false testimonies. These experts point to the fact that because a cognitive interview facilitates drawing details from memory, its application will make the statements of the people telling the truth longer, richer in detail, and more transparent, so that the presence of veracity criteria will increase. In turn, a cognitive interview in no way influences the testimonies of the people who lie, because in their case there are no memories, whose drawing would be facilitated by the cognitive interview. In this way, with the application of the CI the difference between true and false testimonies becomes highly visible, which facilitates the operation of content-based methods.

Another hypothesis (Dukała, Sporer, Polczyk, in print) concerns the representational aspect of cognitive interview techniques. Many elements in such interrogations concern encouraging the witness to imagine the circumstances of the event, involving all senses in reminding, engaging imagination, and reporting the greatest number of details (e.g. probing images, context reinstatement techniques). Such a procedure may help deceptive individuals to build a more probable lie during an interrogation than in the cases when traditional form of interrogation is applied. In this way, the CI may negatively influence the efficiency of content-based techniques.

The results of studies in this area are not coherent. For example, the application of cognitive interview decrease the efficiency of RM in the studies conducted by Bembibre and Higueras (2011), and especially so in the case of testimonies concerning false accusations. Steller and Wellershaus (1996) observed a major drop in CBCA accuracy rate in the case of false testimonies collected with the use of cognitive interview as compared to the testimonies acquired during a standard interrogation. Although the studies conducted by Köhnken, Shimossek, Ashermann, Hoffer (1995) did not corroborate the impact of the manner of interrogation on the general accuracy rate of CBCA, yet it was observed that some CBCA criteria emerge more frequently in true and false statements acquired during a cognitive interview than in ones acquired during a standard interview (SI). Observed in the studies by Landstrom and Garnhag (2005) was the fact that certain RM criteria (temporal, spatial information) emerge more often in false statements acquired in CI than in SI. In turn, no negative impact of CI on the presence of RM criteria was observed in Hernandez-Fernaud and Alonso-Quecuty (1997). The results of the studies quoted above point to the fact that a cognitive interview may have a bearing on the efficiency of content-based techniques, yet this area has not been fully researched yet.

What has additional impact on the efficiency of content-based methods is the number of interrogations. For example, Saykaly (2009) observed that the presence of CBCA criteria decreases and altogether disappears at the third interrogation of a child. Erdmann, Volbert and Bohm (2004) noticed that in the fifth interrogation of a child, only one CBCA criterion (quantity of details) differentiates true statements from false, and additionally some children begin to believe that they witnessed an event that never happened already after the fourth interrogation. Granhag, Stromwall and Landstrom (2006) observed a similar impact on RM in the case of five consecutive inter-

rogations. In turn, Stromwall, Granhag, (2005) observed that the accuracy rate of RM in reference to the testimonies of all the children decrease already after the second interrogation.

One of the variables that have an impact on the efficiency of content-based techniques is the training of the person making the insincere testimony. Researchers pay attention to the fact that a person familiar with the criteria of veracity may include them into their statement while lying, in this way reducing the efficiency of content-based tools. A number of experiments were conducted to verify the claim. It found corroboration both in the case of testimonies of children (Vrij, Akenhurst, Soukara, Bull, 2004; Vrij, Keller, Mann, 2000; Vrij, Akenhurst, Soukara, Bull, 2002) and adults (Caso, Vrij, Mann, De Leo, 2006).

Additionally, experts point to the personality-based variables of a witness that may have an impact on the efficiency of content-based tools. These include fantasy proneness (with people with high fantasy proneness being capable of creating convincing and colourful lies that reduce the efficiency of CBCA; Schellerman-Offermans, Merckelbach, 2010), verbal skills (the higher they are, greater number of CBCA criteria turn up in testimonies independent of their veracity; Santtila, Roppola, Niemi, 2000), social anxiety (decreases the quality of the testimony and reduces the efficiency of both CBCA and RM; Vrij, Akenhurst, Soukara, Bull, 2004), and social adroitness (the presence of this trait in a witness increases the efficiency of the CBCA; Vrij, Akenhurst, Soukara, Bull, 2004). It must, however, be mentioned that studies concerning the links between the personal traits of the witness and the efficiency of content-based methods mentioned above have not been replicated.

Moreover, one should pay attention to the fact that the nature of a memory may influence the efficiency of content-based methods. The researchers strongly emphasise that both CBCA and RM were created to differentiate between sincere and deceptive testimonies, and account for the witness's intentions, as the variables that is responsible for creating differences between these types of statements (e.g. Köhnken, Steller, 1989). These tools may prove inefficient in statements based on suggested or false memories, in whose case, the witness is convinced about their authenticity. The results of studies do not corroborate the hypothesis. For example, Blandon-Gitlin, Pezdek, Lindasy and Hagen (2009) studied the testimonies of people who had a false memory concerning a childhood event (e.g. getting lost in a shopping centre, upsetting a punch vase at a party) developed. Analyses with the use of CBCA and RM distinguished true statements from ones based on false memories,

yet only if the false memory was defined as partial. In Short and Bonder (2010) RM in the 43-criteria version also proved efficient in distinguishing between true and suggested statements, yet the effect was not strong.

Content-based methods of discovering deceptive testimonies gain on popularity both in Poland (Wojciechowski, 2012) and in other European states (Vrij, 2008) due to the easiness of application and relatively high accuracy rate. Their vast advantage is the fact that there are plenty of well-conducted studies concerning the factors that influence the efficiency of these tools, which makes it possible to use them more precisely, and correctly in practice. It is, however, material to remember that certain areas concerning the factors resulting from the analyses using content-based methods (e.g. the personal traits of a witness, and the impact of the manner of interrogation) still require additional studies.

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Report

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Polish Society for Polygraph Examinations was founded

The Polish Society for Polygraph Examinations (Polskie Towarzystwo Badań Poligraficznych – PTBP) was set up on 24th November 2013 by a group of people representing Polish government, the private sector and the academia. The Society operates nationwide. Marcin Gołaszewski (Full Member of the American Polygraph Association) was elected its President, and Professor Jan Widacki (Member of the APA Science & Technology) became the President of Scientific Committee.

The Polish Society for Polygraph Examinations accepts the APA standards of practice and is ready to cooperate on promoting validated techniques and the highest ethical standards within the polygraph profession. The main objective of the Society is to enhance the quality of polygraph examinations in Poland. Other goals include inspiring interest and promoting knowledge of polygraph examinations, supporting exchange of experience and ideas among people interested in the subject.

The Society intends to achieve its objectives by:

a) organising conferences, workshops and training aimed at improving professionals skills of Polish polygraphers
b) encouraging scientific research in the field of psychophysiological detection of deception
c) editorial activity, and

d) support for legislative activity helping to expand the possibilities of applying polygraph in criminal proceedings, employee screening, and as therapeutic assistance.

Moreover, the Society manages a list of recommended polygraph experts in evidentiary examinations. The list is published on the Society's website: www.ptb.pl. In order to obtain a recommendation, an expert is expected to meet specific requirements concerning education and professional experience. The Polish Society for Polygraph Examinations regulates the professional conduct of recommended examiners by requiring strict adherence to a set of standards in training, practice, and ethical issues.

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