

Announcements (2/16/04)

- Electricity Test Today
- Video Library -- <http://svl.arizona.edu>.
- Information on Papers (last week)
- Online syllabus and links:
<http://www.u.arizona.edu/~jallen/Courses.htm>
- Review of 3x5 cards

*Lie Detection: The Problematic
Polygraph Test and Some
Alternatives*



People Sometimes Lie



An Armchair Taxonomy Of Lies

Little Harmless Lies

The Social Graces

All Other Lies

Accusations

about parental habits

about fidelity

about abuse: physical, sexual

Inaccuracies

income

assets

Denials

about parental habits

about fidelity

about abuse

about income

about assets

The Difficulty in Detecting Lying

<u>Observer Group</u>	<u>Accuracy</u>
Secret Service	64.1
Federal Polygraphers	55.7
Robbery Investigators	55.8
Judges	56.7
Psychiatrists	57.6
Special Interest	55.4
College Students	52.8

^achance = 50%

from Eckman & O'Sullivan, 1991

The Polygraph and the American Psyche

Lady 1: [My coworker]'s husband is being sent to polygraph school in Atlanta for three weeks so he can give the polygraph test.

Lady 2: Cool! That's like the test that can read your mind, right?

Conversation overheard in W. Lafayette, Indiana, December, 1990

What we, the American people, are witnessing is the beginning of the end of mankind's search for an honest witness. For the first time in the history of civilization, mankind has the opportunity to prove beyond a reasonable doubt the veracity of his testimony through a generally accepted and scientific (sic) valid examination of his own psyche. God gave us the polygraph.

Michael B. Lynch, in *Polygraph*, The Journal of the American Polygraph Association, 1975

Media Portrayals:

Political Ad

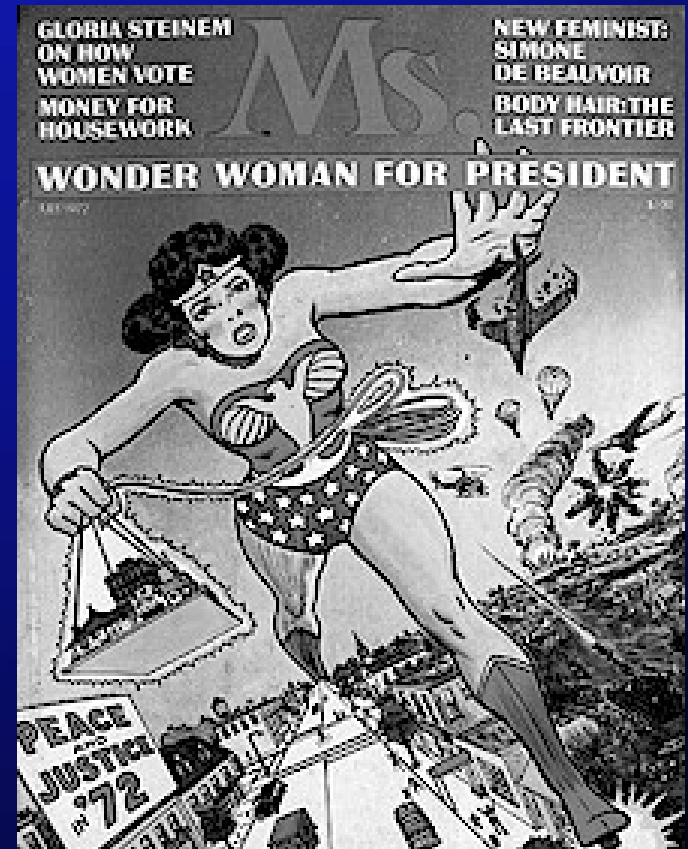
Entertainment

Talk Overview

- ❑ Abbreviated History and Overview of the Conventional Polygraph
- ❑ Limitations to Conventional Polygraphy
- ❑ Overview of alternatives: Assessing recognition
- ❑ What are Event-related Potentials (ERPs)?
- ❑ How can ERPs be used in the detection of deception?
- ❑ The challenges, promise, & limitations
- ❑ Future directions



- Polygraph invented in 1915 by Harvard-trained Ph.D., LL.B. William Moulton Marston
- Claimed it could detect lies by measuring blood pressure
- Not his main claim to fame



Overview -- Import

- ❑ Why important?
 - ❑ Perhaps most widely administered psychological test
 - ❑ Perhaps most lucrative psychological test

- ❑ Long history: ancient Egyptians used masticated rice
 - ❑ If you spit out moist rice -- Truthful
 - ❑ If you spit out dry rice -- Liar
 - ❑ Note the use of early autonomic arousal as psychophysiological measure of a sort...

- ❑ Probably the area where psychophysiology (as a measure, not a science) has most often been thrust into the public eye

Uses (and abuses) of Polygraph Tests

- ❑ Most based on the premise that physiological responding:
 - ❑ differs when one is truthful versus being deceptive, or
 - ❑ Demonstrates a specific physiological “lie response.”

- ❑ Specific Incident Investigations
 - ❑ Criminal Investigations: Defendants, Complainants, Witnesses
 - ❑ Insurance Claims Investigations
 - ❑ Investigating Prison Inmates Accused of Violating Rules
 - ❑ Substantiation of Claims Made in Civil Suits
 - ❑ Paternity Suits

- ❑ Screening Situations
 - ❑ Pre-employment Screening
 - ❑ Screening of Current Employees
 - ❑ Child Custody Cases

- ❑ Federal Polygraph Protection Act (1988)
 - ❑ Prohibits Screening Tests for employment in private sector
 - ❑ Allows tests for those reasonably suspected of involvement in a workplace incident
 - ❑ “Friendly” Tests to the currently employed and to criminal defendants still permitted
 - ❑ Federal Agencies and Police can still use for screening!

Instrumentation and Measures

- ❑ Polygraph examinations involve multi-channel recorders in a flightcase.

- ❑ Typically recorded:
 - ❑ Respiration
 - ❑ Cardiovascular activity (BP, HR)
 - ❑ Skin resistance

- ❑ These measures:
 - ❑ provide an indication of changes in autonomic activity
 - ❑ do *not* index the "lie response"

Conventional Polygraphs

Each instrument comes with a one year warranty on all parts and labor. With each four- or five-pen instrument you will receive the following standard accessories: two pneumo chest assemblies, GSR electrode set, standard Kovacic arm cuff, pump bulb assembly, pens and bottles for each recording module, one extra ink bottle, pen pad, ink filler, ink, tool kit, two rolls of chart paper and an instruction manual. Other optional accessories include auto power conversion, in-case calibrator, various styles of event markers and thermal writing capabilities.

The Statesman

Zero® case, the clean Halliburton lines are enhanced by the black morocco grain finish. The case is high-impact thermo-formed ABS plastic to ensure durability. (Total weight: 21.5lbs. or 24.5lbs. with calibrator. Dimensions: 13"W x 21"L x 6.5"D).



The Factfinder II

The 10" chart drive allows five pens to be used simultaneously with greater pen swing. The practice of "pigeon toeing" the outside pens on a five-pen polygraph is no longer necessary and charts are easier to read because of reduced tracing overlap. This leaves plenty of room for important notations. Every Factfinder II maintains all of the quality and conveniences of our standard 8" chart drive models. Available only in a Statesman case, no thermal models are available.

The Courier II

Our newest conventional case style offers a gold anodized look and compact size. The case was designed with the traveling examiner in mind. The lid is designed with plenty of storage space and includes an in-case calibrator. The case is made of exceptionally strong, deep-drawn aluminum that resists dents and is also dust and weather resistant. (Total weight: 21.5lbs. Dimensions: 13"W x 18"L x 6.5"D).



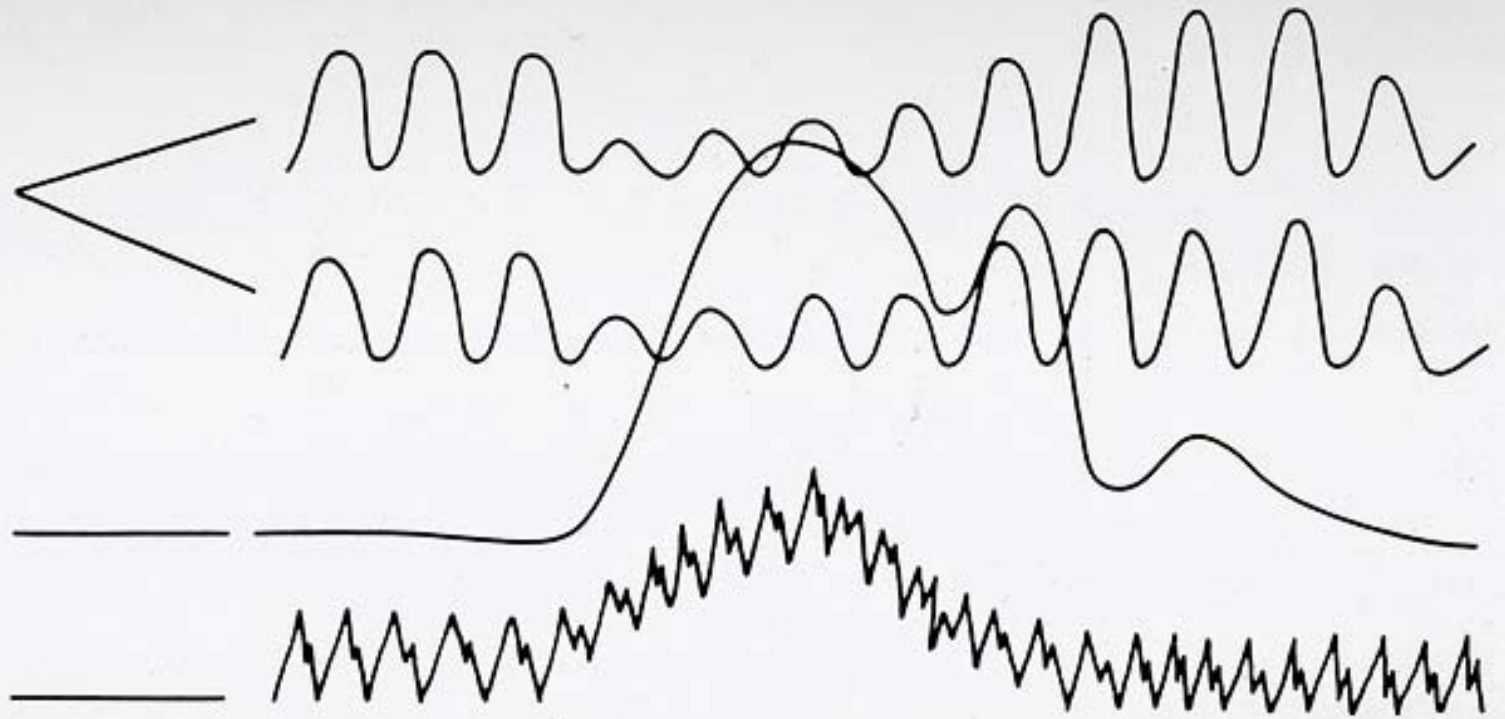
EXHIBIT "B"

A CLASSIC "LYING" REACTION

PNEUMO
TRACINGS

GSR
TRACINGS

CARDIO
TRACINGS



↑
THE POINT AT WHICH THE SUBJECT
ANSWERED A RELEVANT QUESTION.

The Polygraph Examiner

- ❑ Requisite skills
 - ❑ Knowledge of test construction
 - ❑ Knowledge of the basic psychometric properties of tests: reliability and validity
 - ❑ Clinical interviewing skills
 - ❑ Knowledge of physiology of the autonomic nervous system
 - ❑ Knowledge of autonomic psychophysiological recording, scoring, and interpretation
 - ❑ Knowledge of the ethics of administering and reporting the results from psychological tests; limits of interpretation, limits of confidentiality
 - ❑ ???

- ❑ Training
 - ❑ Graduated from professional polygraph training school, which are administered and staffed primarily by professional polygraphers (31 schools accredited by the American Polygraph Association (APA) in the U.S. and Canada)
 - ❑ Curriculum spans a minimum of 7 weeks

What the Polygraph Measures

- Blood Pressure Changes
- Breathing movements
- Palmar Sweating (Electrodermal Changes)

What the Polygraph Does NOT Measure

- LYING!

Questioning Techniques

Measure

Emotion Based

- Control Question (CQT)**

(Comparison question & directed lie)

- Employee Screening**

(Relevant/irrelevant, pre- & post-employment, personnel & security screening)

Memory Based

- Guilty Knowledge (GKT)**

(Concealed information)

- GSR**

- Brainwave**

Control Question Test (CQT; John Reid, 1947) (for Specific Incidents Investigations)

- ❑ Approximately 10 questions

- ❑ Relevant Questions
 - ❑ address the subject matter under investigation

- ❑ Control Questions
 - ❑ questions developed by the examiner after a pretest interview with the subject
 - ❑ address generally questionable behavior

- ❑ At least 3 separate *charts* (i.e. 3 separate presentations of the set of questions) are administered

- ❑ The pretest interview stresses 2 ways to fail test, and that test is infallible

CQT “Theory” (Raskin, 1982)

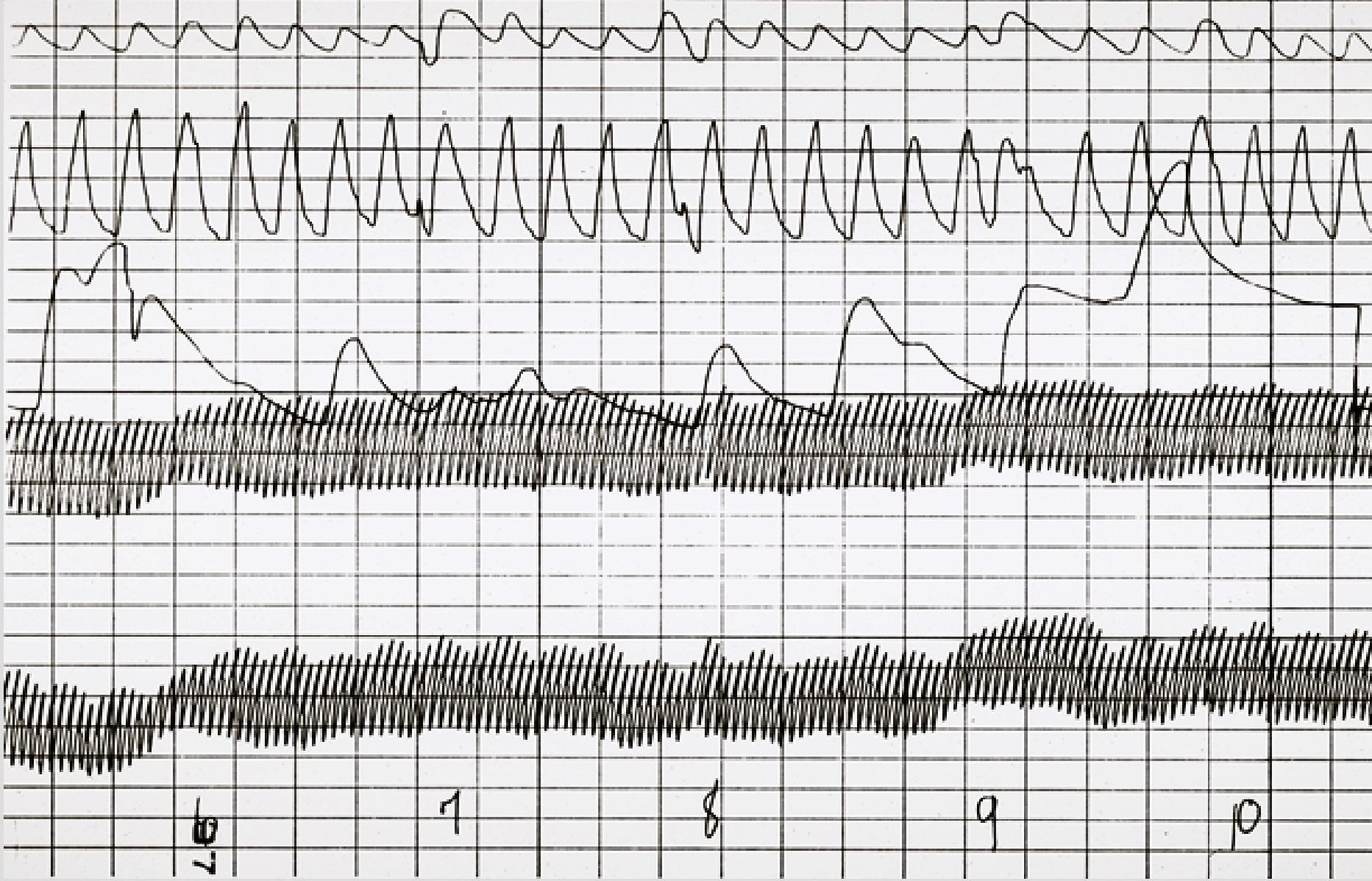
- ❑ Innocent subjects should react with stronger emotion to the *Control* questions since their content are of greater direct concern
- ❑ Guilty subjects should respond with stronger emotion to the *Relevant* questions
- ❑ Comparing the magnitude of the responses (usually skin-resistance) to the control and relevant questions yield a verdict of Guilty, Innocent, or Indeterminate

“CONTROL” TEST QUESTIONS

- Did you slap Tommy?
- Have you hit anyone?
- Did you threaten Tommy?
- Have you ever told a lie to stay out of trouble?
- Have you ever threatened anyone?
- Did you punch Tommy?

Relevant

“Control”



Typical Scoring -- Semiobjective Method

- ❑ Each relevant question paired with a "control" item adjacent in the sequence of questioning
 - ❑ A score of -1 to -3 is assigned if response to relevant item is (a little, somewhat, clearly) larger than response to control item
 - ❑ A score of +1 to +3 is assigned if response to relevant item is (a little, somewhat, clearly) smaller than response to control item
- ❑ Separate scores derived for each channel, and scores are summed over charts, channels, and question pairs
 - ❑ Total score ≤ -6 : DECEPTIVE
 - ❑ Total score $\geq +6$: TRUTHFUL
 - ❑ $-5 \leq$ Total score $\leq +5$: INCONCLUSIVE

Typical Scoring (less than objective method)

- ❑ Polygrapher uses a global impressionistic decision-making strategy that incorporates:
 - ❑ Case facts
 - ❑ Examinee behaviors
 - ❑ Polygraph Chart data
 - ❑ Examiner's "professional" hunches and impressions

The Importance of Blind Scoring

- ❑ Expectancy Effects (the "60 Minutes study")
 - ❑ Three polygraph firms each examined four employees accused of theft of a camera (none actually stolen)
 - ❑ Without the knowledge of the employees, each polygrapher was told that a different employee was suspected by management
 - ❑ In each instance, the suspected employee was deemed guilty (probability by chance = 1.5%)

Validity and Ethical Concerns: Examine the Assumptions

- ❑ Assumptions that must be met in order for the CQT to produce valid results:
 - ❑ Examiner formulates relevant questions that guilty subjects will answer deceptively (*reasonable*)
 - ❑ Examiner constructs control questions that subjects will answer untruthfully or with some doubt as to their veracity (*plausible, but difficult*)
 - ❑ An innocent person will be more disturbed by the control questions than by the relevant questions (*implausible*)
 - ❑ A guilty person must be more disturbed more by the relevant questions (*reasonable*)

The CQT Box Score

% Correctly Classified

Professional Polygrapher's Research

	Guilty	Innocent
Horvath & Reid (1971)	85	91
Hunter & Ash (1973)	88	86
Slowick & Buckley (1975)	85	93
Wicklender & Junter (1975)	92	95
Davidson (1979)	90	100
Yankee, Powell, & Newland (1976)	100	98
Weighted Total	91	94

Social Scientist's Research

Barlanda & Raskin ^a (1976)	98	45
Horvatha (1977)	77	51
Kleinmuntz & Szucko (1984)	75	63
Iacono & Patrick (1988)	98	55
Weighted Total	88	57

^a is also a trained polygrapher

after Iacono & Patrick, 1997

Assessing deception: Polygraph techniques.

In R. Rogers, Ed., *Clinical Assessment of Malingering and Deception*

New York: Guilford.

Types of Validity Studies

□ **Laboratory:** Mock Crime

□ **Field:** Real Life Cases

Effects of Enhancing Realism in Laboratory Studies

Study	Group	N	% Accuracy	
			Guilty	Innocent
Raskin & Hare (1978)	Psychopath	23		
	Nonpsychopath	20		

Effects of Enhancing Realism in Laboratory Studies

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Raskin & Hare (1978)	Psychopath	23	100	~92
	Nonpsychopath	20	100	~90

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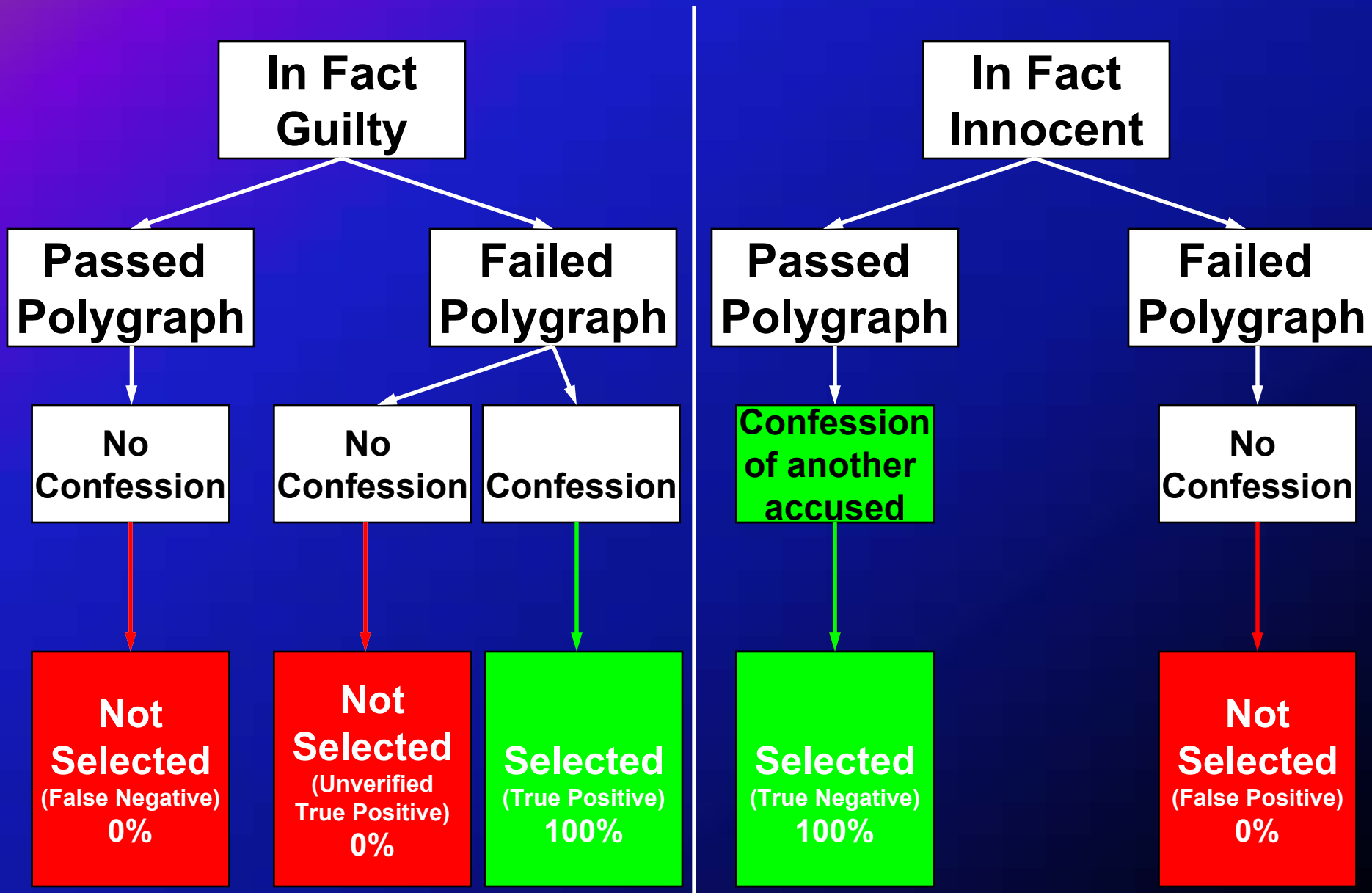
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Raskin & Hare (1978)	Psychopath	23	100	~92
	Nonpsychopath	20	100	~90
Patrick & Iacono (1989)	Psychopath	20	83	63
	Nonpsychopath	21	91	50

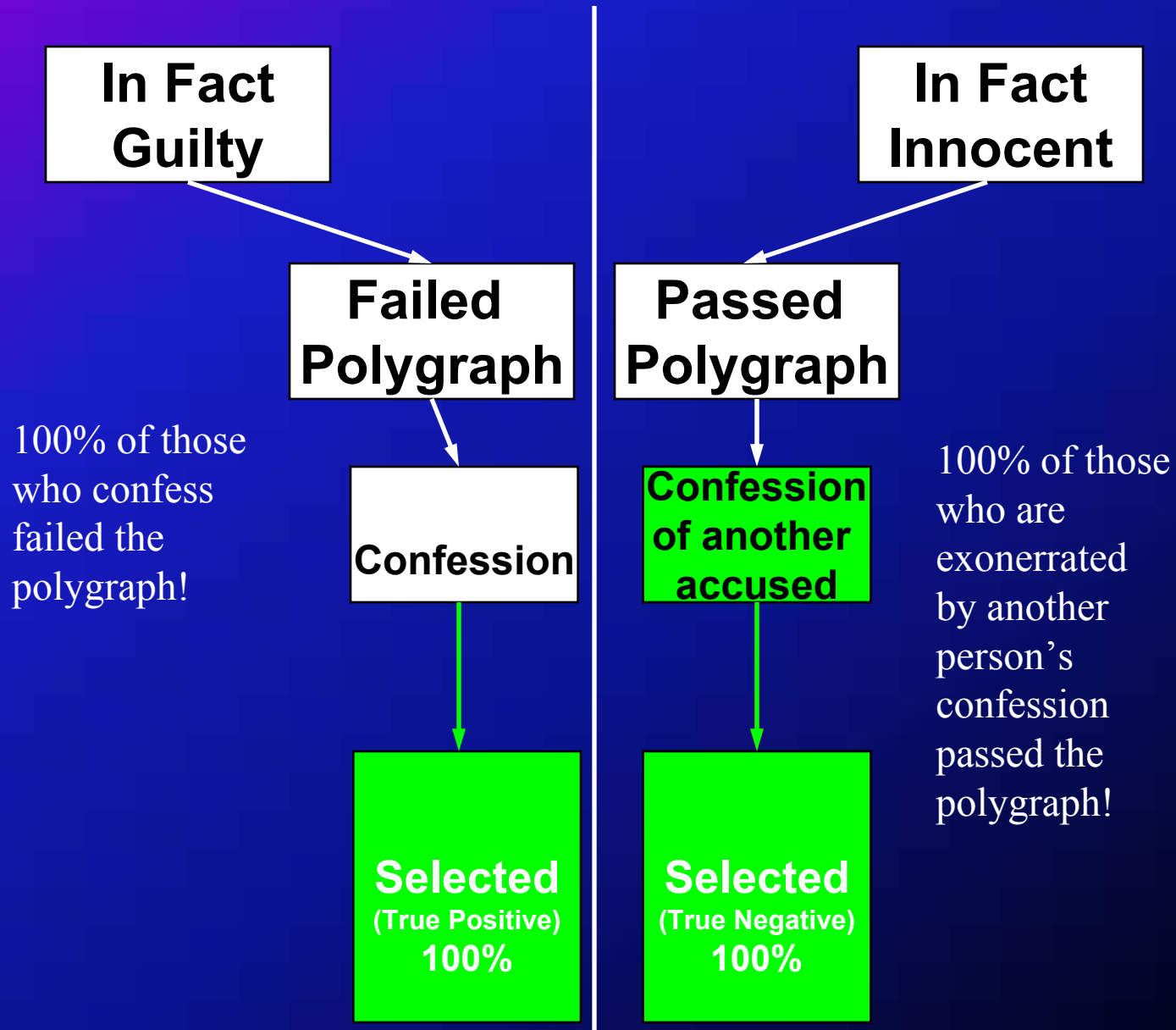
Problems with Field Studies

- ❑ How is ground truth established in real-life cases?
 - ❑ Judicial verdicts inadequate to establish ground truth
 - ❑ plea bargains and false convictions
 - ❑ guilty may escape if evidence not beyond a reasonable doubt
 - ❑ judicial verdict may be influenced by outcome of polygraph!
 - ❑ Therefore confessions are used to identify the culpable and to clear the innocent.
- ❑ Confessions are gathered only after the subject has failed the test
 - ❑ Guilty subjects who elude the test do not confess and are not included!
 - ❑ Guilty subjects who fail the test but do not confess are not included!
 - ❑ Innocent subjects who fail the test do not confess and will usually not be included in the studies unless a guilty subject's confession exonerates them
- ❑ *Therefore, only cases selected for study are those where the original examiner was correct*

Why Using Confessions Overestimates Accuracy



Feedback Polygraphers Receive



Screening Tests

- Because these tests have much higher false negative rates than false positive rates, they should not be used in instances where most folks are innocent

	Test Verdict		
Actual	Guilty	Not Guilty	
Guilty	9	1	10
Not Guilty	45	45	90
			100

- Total correct verdicts = 54%

Alternatives to Traditional Polygraph Procedures

- ❑ **Guilty Knowledge Test (GKT; Lykken, 1959), sometimes termed Concealed Information Test (CIT)**
- ❑ **Event-Related Potential Procedures**

Guilty Knowledge Test (GKT)

- ❑ The GKT does not assess lying as indexed by fear of being detected, but probes for guilt as indexed by recognition
- ❑ A series of questions is devised, each having several alternatives, only one of which is true about the crime in question
- ❑ Chances of an innocent person looking guilty on a 10-item GKT are $1/5^{10}$.

Assessing Recognition: For Specific Incidents Investigations

- ❑ Used when information about a crime or event is available that only a real culprit would know
- ❑ Series of questions constructed, only one of which has correct critical detail

Regarding the abduction location, do you know for sure it was...

1. ... at a Toy Store?
2. ... at a Shopping Mall?
3. ... at a City Park?
4. ... at a Friend's House?
5. ... at School?
6. ... at a Restaurant?

Other questions about

- Time abductee taken
- Clothing worn
- etc. for 6-10 questions

- ❑ Subject instructed to answer "no" to each item, so that if guilty, subject would be lying to the critical item.
- ❑ Critical item never positioned at beginning.
- ❑ A consistent peak of physiological response on one critical alternative suggests guilt.

GKT Accuracy: Lab Studies

Study (1 st Author, Yr)	N	Percent Correct	
		Guilty	Innocent
Lykken '59	98	88	100
Davidson '68	48	92	100
Podlesney '78	18	90	100
Balloun '79	34	61	88
Giesen '80	40	92	100
Bradley '81	192	59	89
Bradley '84	16	100	100
Iacono '84	55	91	100
Steller '87	87	85	100
Iacono '92	71	87	71
O'Toole '94	45	77	94
Study Median	48	88	100

GKT – Box Score, and Concerns

- ❑ Superior to CQT, especially in protecting the innocent
- ❑ Resistance to use among those in the polygraph community
 - ❑ Concern about applicability, especially in high profile cases
 - ❑ The GKT for OJ

Countermeasures?

❑ Drugs

❑ **Waid, Orne, Cook, & Orne (1981),
Meprobamate (a tranquilizing agent) and the
GKT**

	Actual			Actual		
Verdict	Innocent	Guilty		Verdict/Drug	Innocent	Guilty
Innocent	11	2		Guilty-Placebo	3	8
Guilty	0	9		Guilty-Mepro	8	3

Questionable validity because study lacked realism and proper incentives

Countermeasures?

- ❑ Iacono et al. (1984, 1987) increased incentives and found no effects (relative to placebo) for:
 - ❑ Diazepam (widely prescribed tranquilizer)
 - ❑ Methylphenidate (stimulant)
 - ❑ Meprobamate (tranquilizer)
 - ❑ Propranolol (widely prescribed cardiac med. β -blocker that inhibits SNS activity)
- ❑ Overall hit-rate for the guilty was $>90\%$

Countermeasures?

- ❑ Street drugs and ETOH
 - ❑ Bradley and Ainsworth (1984) -- mild ETOH intoxication during mock crime decreased detectability during subsequent polygraph examination
 - ❑ Studies needed to determine effects of higher doses and of more potent drugs
 - ❑ To the extent that the drug interferes with memory or sense of responsibility at the time of the crime, it may serve as a potential countermeasure

Physical Countermeasures?

- ❑ Honts et al. (1983, 1984) found that 78% of highly motivated subjects could be trained to "beat" the CQT by biting their tongues or pressing their toes to the floor during control questions
 - ❑ Although it took training, motivated suspects could easily obtain it or it could be provided, especially when stakes are high (e.g., foreign agents being screened for national security positions)
- ❑ The polygraphers were unable to detect these subtle maneuvers
- ❑ "Counter-countermeasures" worked to detect those using countermeasures: 80% of those using countermeasures could be detected by a blind analysis of EMG recordings
 - ❑ Such counter-countermeasures rarely used in field polygraphy
- ❑ The rectangularity score of the GKT should -- in theory -- be much less susceptible to these techniques
 - ❑ GKT and rectangularity scores rarely used in field polygraphy
 - ❑ Yet Honts et al (1996) found that both Physical (pressing toes to floor) and mental (counting backwards by sevens) countermeasures reduced the validity of the GKT (Overall accuracy dropped from 85% to 25%)

Interim Synopsis

- ❑ People Lie
- ❑ There is no unequivocal lie response
- ❑ Traditional Polygraphy, which focuses on emotional reactions, suffers from an unacceptably high false positive rate
- ❑ Polygraphers overestimate the accuracy of the procedure due to how cases are selected for inclusion in studies
- ❑ Assessing recognition may prove more accurate, but potentially less widely applicable
- ❑ Polygraphs are useful for eliciting admissions and confessions

Science and Pseudo-Science, Debate and Diatribes, Validity versus Vitriol

If proponents wish to convince the scientific community of the merits of polygraph lie detection, I submit that they will have to develop a more convincing case than the one currently on offer. Their case must be founded on studies which include the necessary controls for nonpolygraphic sources of information, that is, studies which compare the accuracy of assessments derived from case-file material and the subject's demeanor during questioning with that based on these sources plus the polygraphic record. I strongly suggest that such studies would confirm what the available data suggest: that polygraph lie detection adds nothing positive to conventional approaches to interrogation and assessment.

Carrol, 1988

Science and Pseudo-Science, Debate and Diatribes, Validity versus Vitriol

If I announce to my scientific colleagues that I have invented a new test that can identify schizophrenia with 90% or 95% accuracy, my colleagues will be interested -- but skeptical. I would be expected to support my assertion with experimental evidence and that evidence would be very critically examined. Even if my proofs withstood such scrutiny, many would reserve judgment until an independent investigator had confirmed my findings. All this skepticism about a claim that I can distinguish "crazy people" from normal ones! The tools of the psychologist are not precision instruments; really high accuracy is seldom achieved. Skepticism is appropriate. Nevertheless, when the polygrapher announces that his psychological test can separate liars from the truthful with a validity of 90%, or 95%, or even 99%, the typical reaction is a kind of marveling acceptance. The critic who questions these claims is greeted with surprise and skepticism. Nearly every American has heard of the lie detector; without really knowing what is involved, many assume that it is nearly infallible. So deeply ingrained is this mystique that, gradually over the last 50 years, the burden of proof has somehow shifted to the critic.

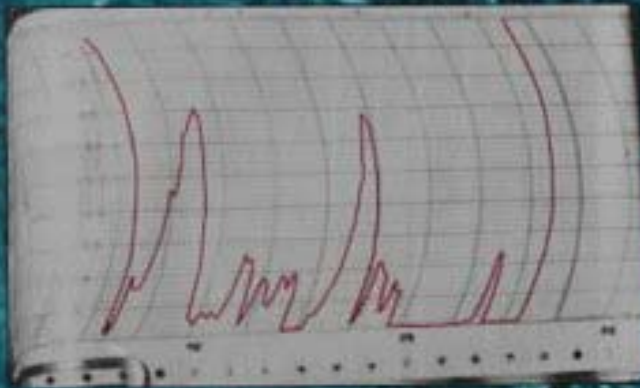
Lykken, in *A Tremor in the Blood*, 1981

Science and Pseudo-Science, Debate and Diatribes, Validity versus Vitriol

Unfortunately, the minute a small handful of psychologists -- one or two pseudo-knowledgeable and one or two completely ignorant of what they were even trying to do -- got into the picture, two expressions, "false positive" and "false negative", came to light. It appears that some people turn out to be weird ducks. Sadly, when that type of inquirer doesn't understand something, he is usually prone to attach strange names to it under the guise of professionalism or scientific exploration on both sides of the same coin. By confusing other people more so than himself he feels he can still call himself an "expert." Those two phrases appeared in a tumor in the brain [sic]. Before then, they had never existed in polygraph language. In all sincerity, however, foul ball psychologists are few and far between.

Ferguson, in *Preemployment Polygraphy*, 1984

A
TREMOR
IN THE
BLOOD



USES AND ABUSES OF THE
LIE DETECTOR

DAVID T. LYKKEN

THE
POLYGRAPH
AND LIE DETECTION

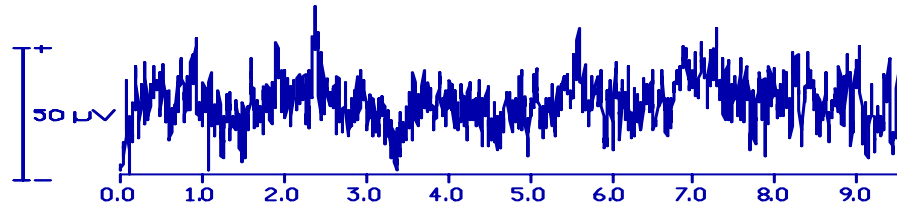
**COMMITTEE TO REVIEW THE SCIENTIFIC
EVIDENCE ON THE POLYGRAPH**

- STEPHEN E. FIENBERG (*Chair*), Department of Statistics, Carnegie Mellon University
JAMES J. BLASCOVICH, Department of Psychology, University of California, Santa Barbara
*JOHN T. CACIOPPO, Department of Psychology, University of Chicago
RICHARD J. DAVIDSON, Department of Psychology, University of Wisconsin, Madison
PAUL EKMAN, Department of Psychology and Human Interaction Laboratory, University of California, San Francisco
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KEVIN R. MURPHY, Department of Psychology, Pennsylvania State University, University Park
MARCUS E. RAICHLE, Department of Radiology and Neurology, Washington University, St. Louis
RICHARD M. SHIFFRIN, Department of Psychology, Indiana University, Bloomington
JOHN A. SWETS, BBN Technologies (emeritus), Tequesta, Florida

Using Event-related Brain Activity to assess Recognition, not Deception

- ❑ As with GKT, brain activity used in assessing recognition
 - ❑ Recognition may, or may not, imply guilt
- ❑ Brain activity is sensitive to many mnemonic processes, including recognition
 - ❑ may be sensitive to information individuals may be unwilling to report
- ❑ Brain activity may be advantageous over other measures; countermeasures?

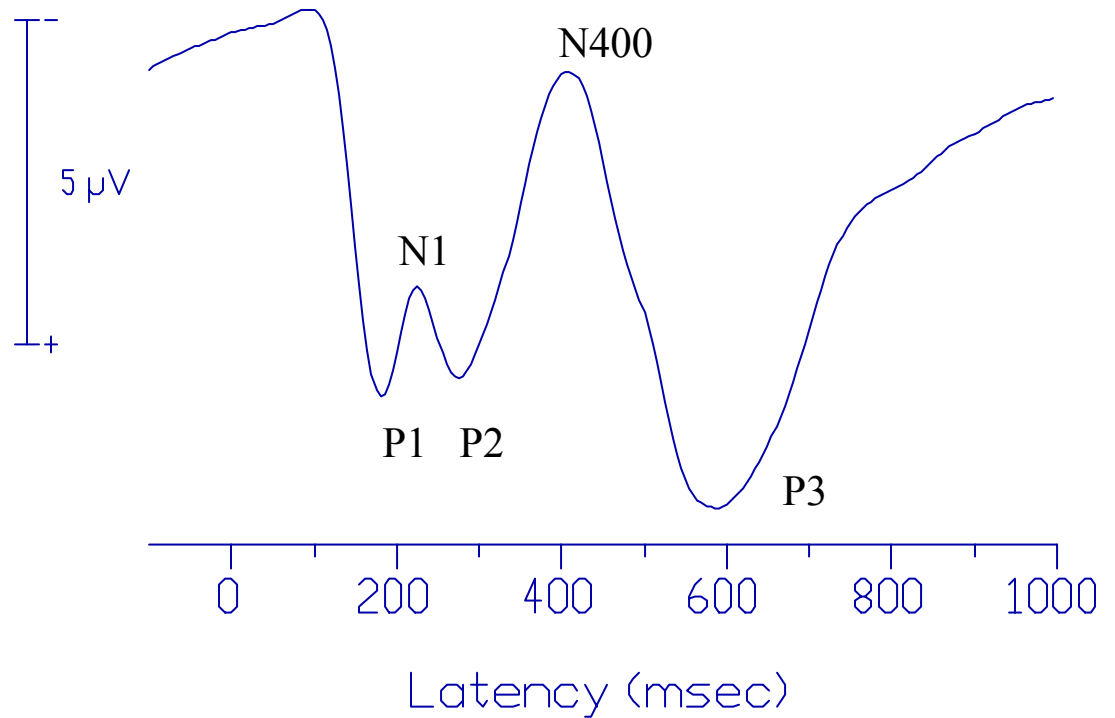
Ongoing EEG



Stimuli



Visual Event-related Potential (ERP)



Brain Fingerprinting: A New Paradigm in Criminal Investigations and Counterterrorism

Executive Summary

Farwell Brain Fingerprinting is a revolutionary new technology for investigating crimes and exonerating innocent suspects, with a record of 100% accuracy in research on FBI agents, research with US government agencies, and field applications.

The technology is proprietary and patented. Brain Fingerprinting fulfills an urgent need for government, law enforcement agencies, corporations, and individuals. Over a trillion dollars are spent annually on crime fighting worldwide.

Brain Fingerprinting solves the central problem by determining scientifically whether a suspect has the details of a crime stored in his brain. It has received extensive media coverage around the world. The technology is fully developed and available for application.

Brain Fingerprinting is a powerful tool for the investigation of suspected terrorists. Measuring the brain wave activity while suspects are shown words or pictures related to specifics of the September 11, 2001 attacks can help determine if they are members of terrorist cells. Brain Fingerprinting can identify trained terrorists before they strike



Larry Farwell, PhD

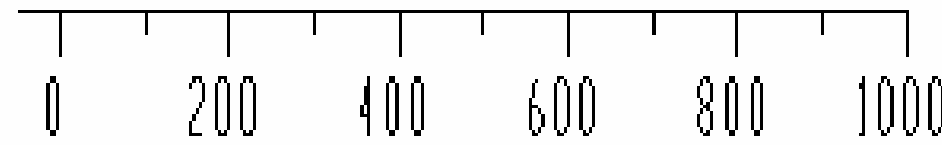
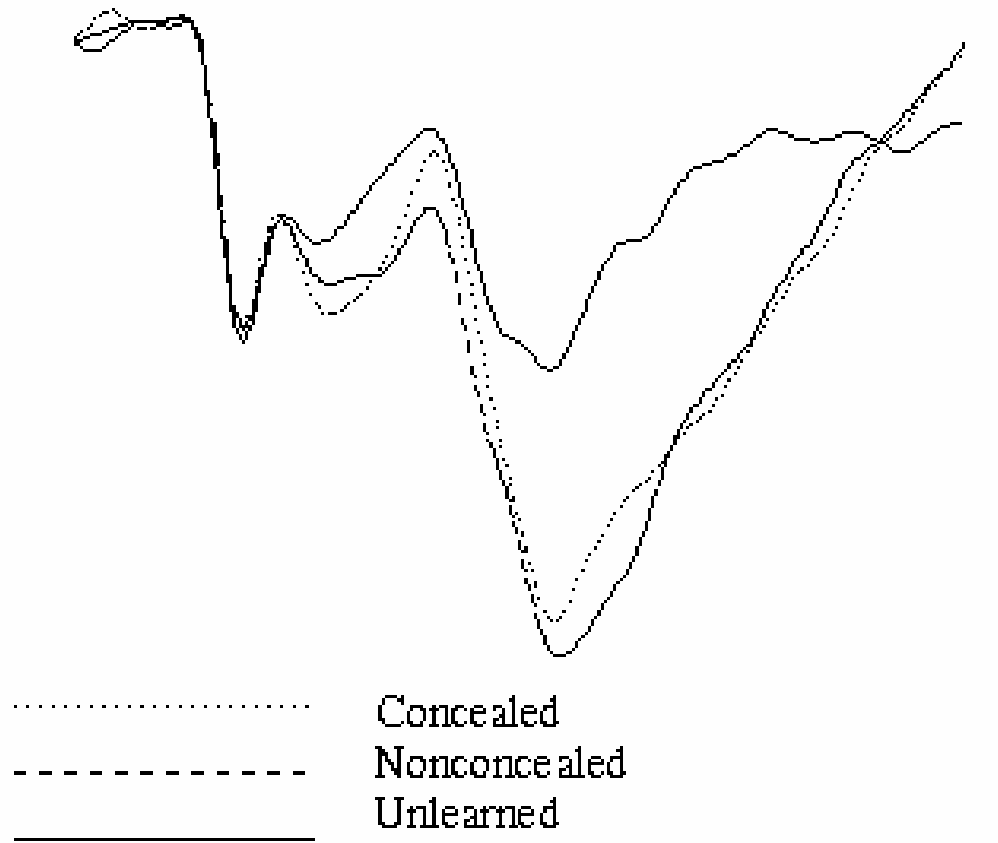
**Chairman & Chief Scientist
Brain Wave Science
Human Brain Research Laboratory, Inc.**

ERP Memory Assessment Procedures

- ❑ Learn a list of words
- ❑ Learn a second list of words
- ❑ Task: Concealed (1st list) and Nonconcealed (2nd list) words appear infrequently

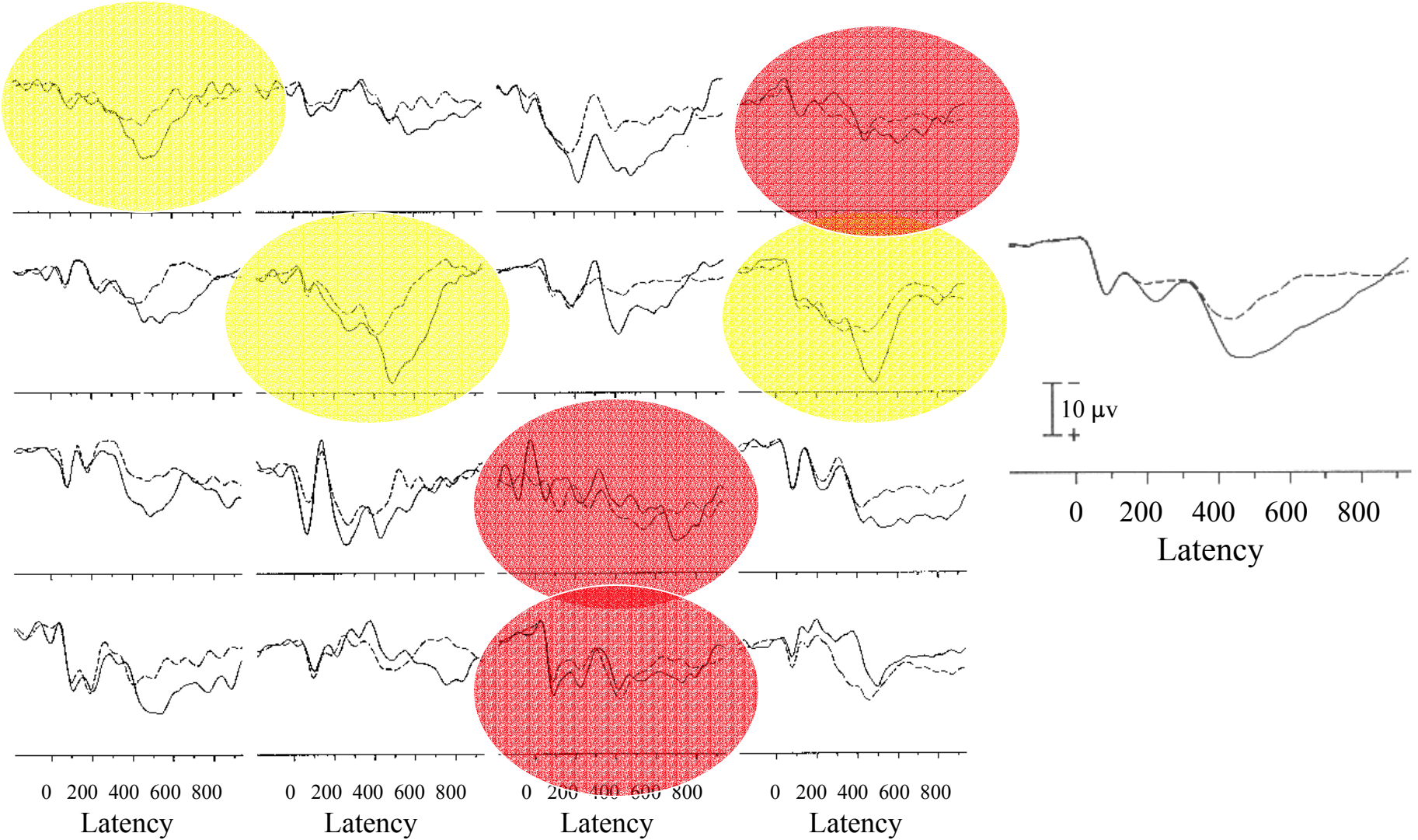
Item Type	Probability	Response	P3 Amplitude
Nonconcealed	1/7	“Yes”	Large
Concealed	1/7	“No”	Large if Recognized Small if not Recognized
Unlearned	5/7	“No”	Small

- ❑ Similar to procedures by Rosenfeld et al, Farwell & Donchin



Latency (ms)

Individual Subjects' ERPs do not Resemble the Grand Average ERP



Individual Differences in ERPs

- ❑ Such variability is tolerable in group designs:
 - ❑ Individual differences not of primary interest
 - ❑ To that extent that individual differences constitute sources of noise, sufficient sample sizes will still allow for the detection of effects in the ERP

- ❑ In the case of individual assessments, however, other methods are required
 - ❑ Clinical applications (e.g., neuropsychological assessment)
 - ❑ Forensic applications (e.g., deception detection)

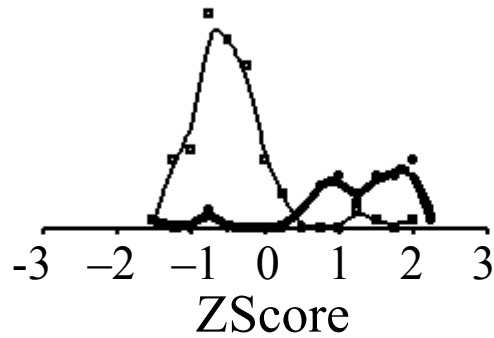
The Challenge

To provide statistically supported decisions for each and every subject, despite considerable individual variability in ERP morphology

P3 Amplitude

Sensitivity = .925

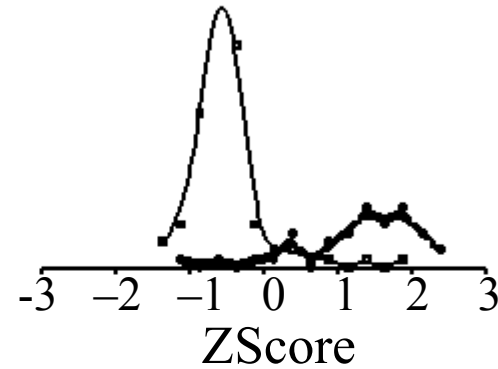
Specificity = .920



Raw ERP H²

Sensitivity = .950

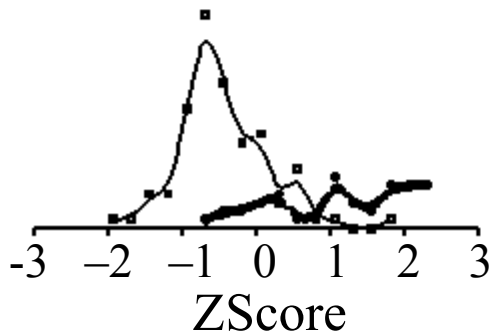
Specificity = .920



1st Derivative H²

Sensitivity = .875

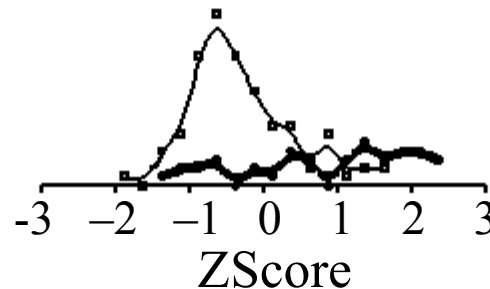
Specificity = .810



2nd Derivative H²

Sensitivity = .750

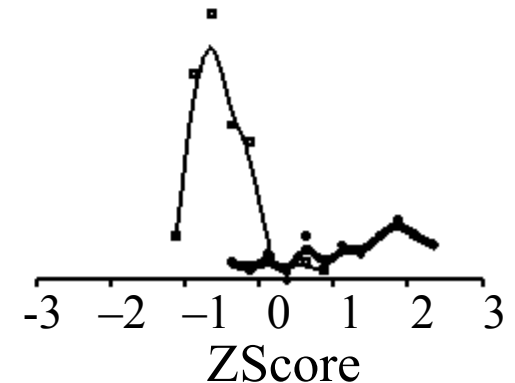
Specificity = .740



Deviation H²

Sensitivity = .925

Specificity = .920



Bayesian Combination of ERP Indicators: Probability that an ERP was elicited by Learned Items

Subject	List		List				
	Learned	Unlearned	U1	U2	U3	U4	U5
	NonConceal	Conceal					
#01	1.0	0.999	0.000	0.000	0.000	0.000	0.001
#02	1.0	1.0	0.000	0.000	0.000	0.000	0.000
#03	1.0	0.999	0.000	0.000	0.000	0.002	0.000
#04	1.0	1.0	0.000	0.001	0.002	0.000	0.000
#05	1.0	0.971	0.002	0.000	0.000	0.000	0.000
#06	1.0	0.999	0.000	0.000	0.000	0.000	0.000
#07	0.983	1.0	0.000	0.000	0.000	0.000	0.000
...							
#18	0.996	0.983	0.874	0.001	0.000	0.000	0.000
#19	0.009	0.214	0.971	0.000	0.002	0.189	0.983
#20	1.0	0.999	0.002	0.000	0.009	0.000	0.214

Note: Only trials in which subjects did not acknowledge concealed items included

Motivational Variations

Conceal

"YES" for words JUST learned, "NO" for all others

Try to hide the fact that you learned the first list of words I taught you

Lie

"YES" for words learned

Lie about words from the first list I taught you

Lie + \$\$

"YES" for words learned

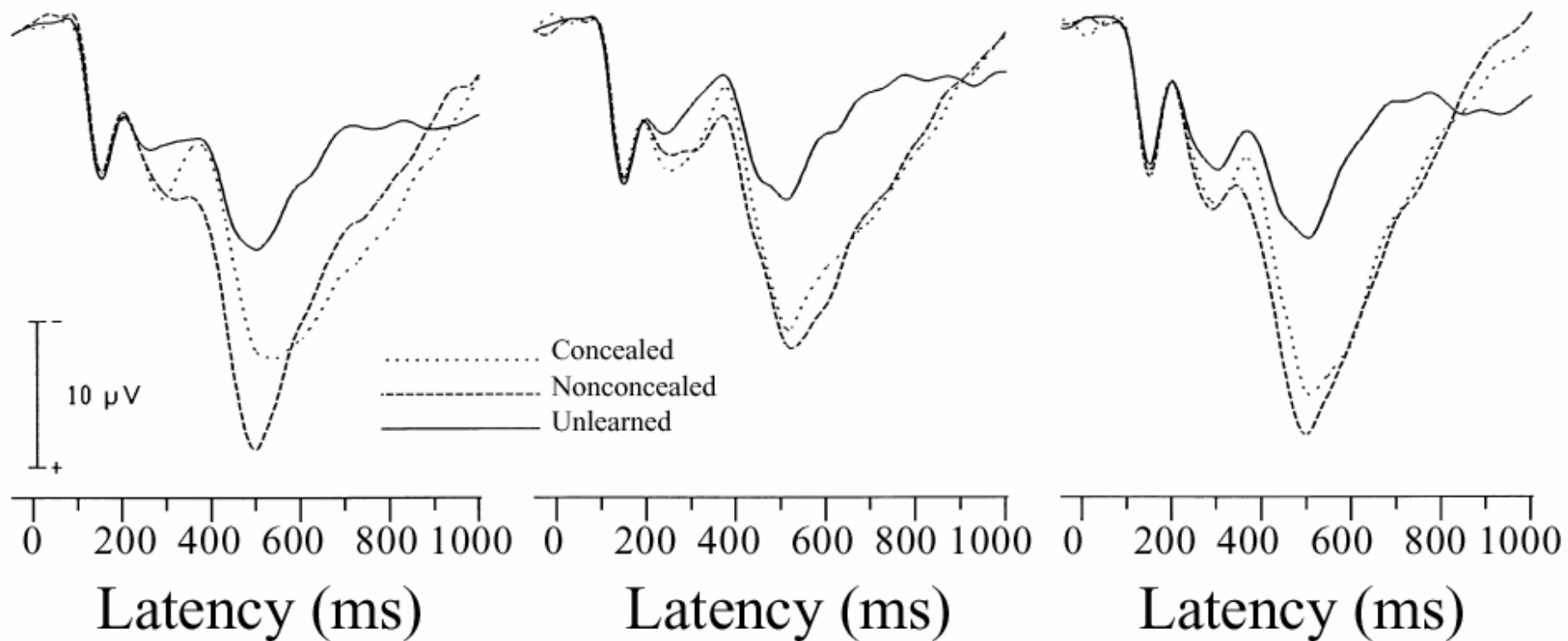
Lie about words from the first list I taught you

\$5.00 incentive

Conceal

Lie

Lie + Money



Classification Accuracy based on ERPs

	Learned (true pos)	Unlearned (true neg)
Conceal	0.95	0.96
Lie	0.93	0.94
Lie + \$\$	0.95	0.98
Combined	0.94	0.96

Limitations?

- ❑ As with GKT, assesses recognition
 - ❑ Not mind reading
 - ❑ Not lie detector
- ❑ Are there situations where the ERP procedures may have limitations?

The Box Score

Ground Truth	Test Verdict	
	Recognition	No Recognition
Recognition	95%	5%
No Recognition	4%	96%

Traditional
False
Positive

Due to
Memory
being
Inaccurate?

- Repeated interrogation?
- Disputed recollections (e.g. abuse)
- Memory is constructive and reconstructive
- Can technology resolve differences in recollections?

A Laboratory Paradigm for False Recollections: DRM

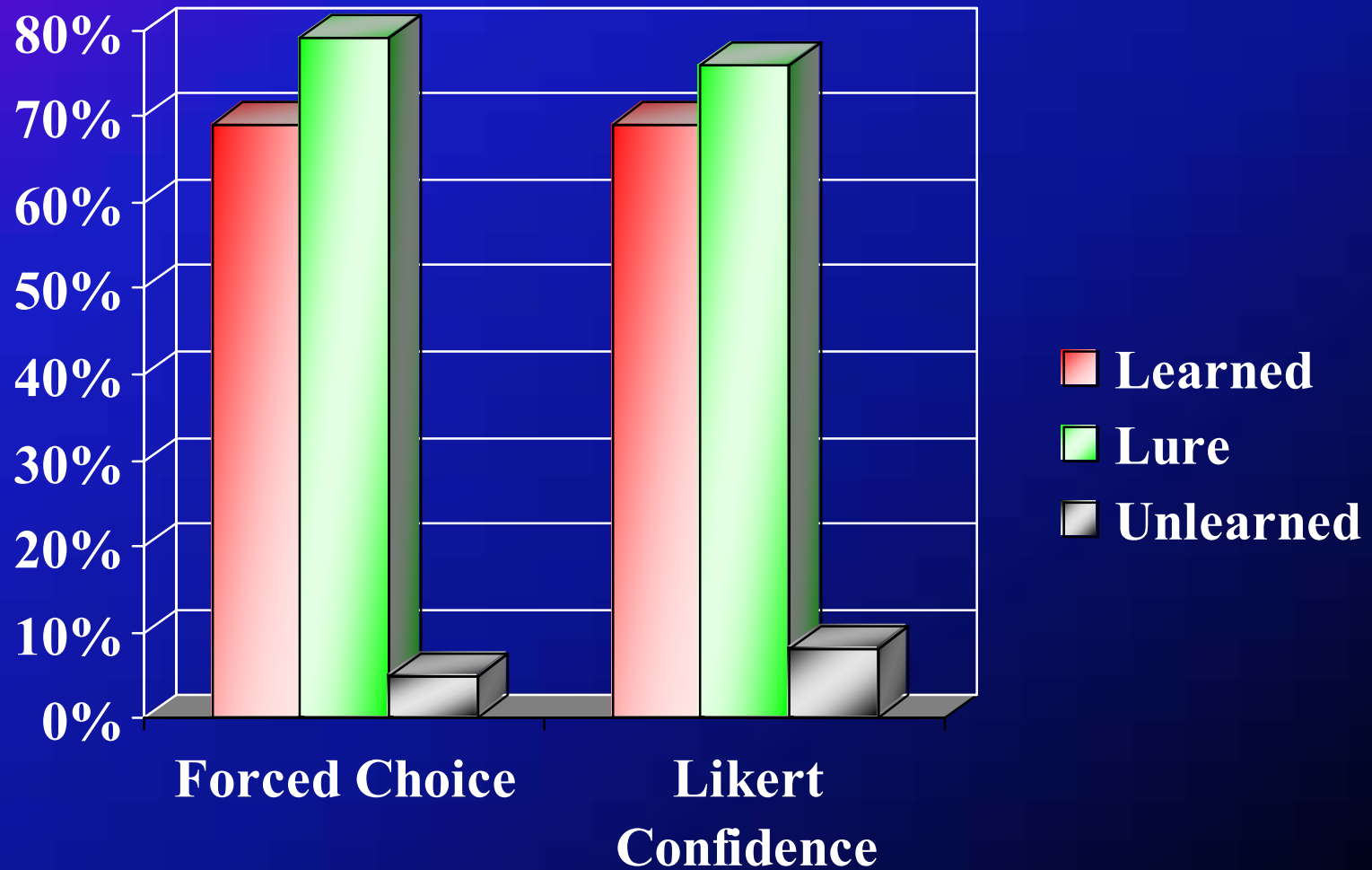
- ❑ Subjects presented with 15 words highly associated with an omitted critical item

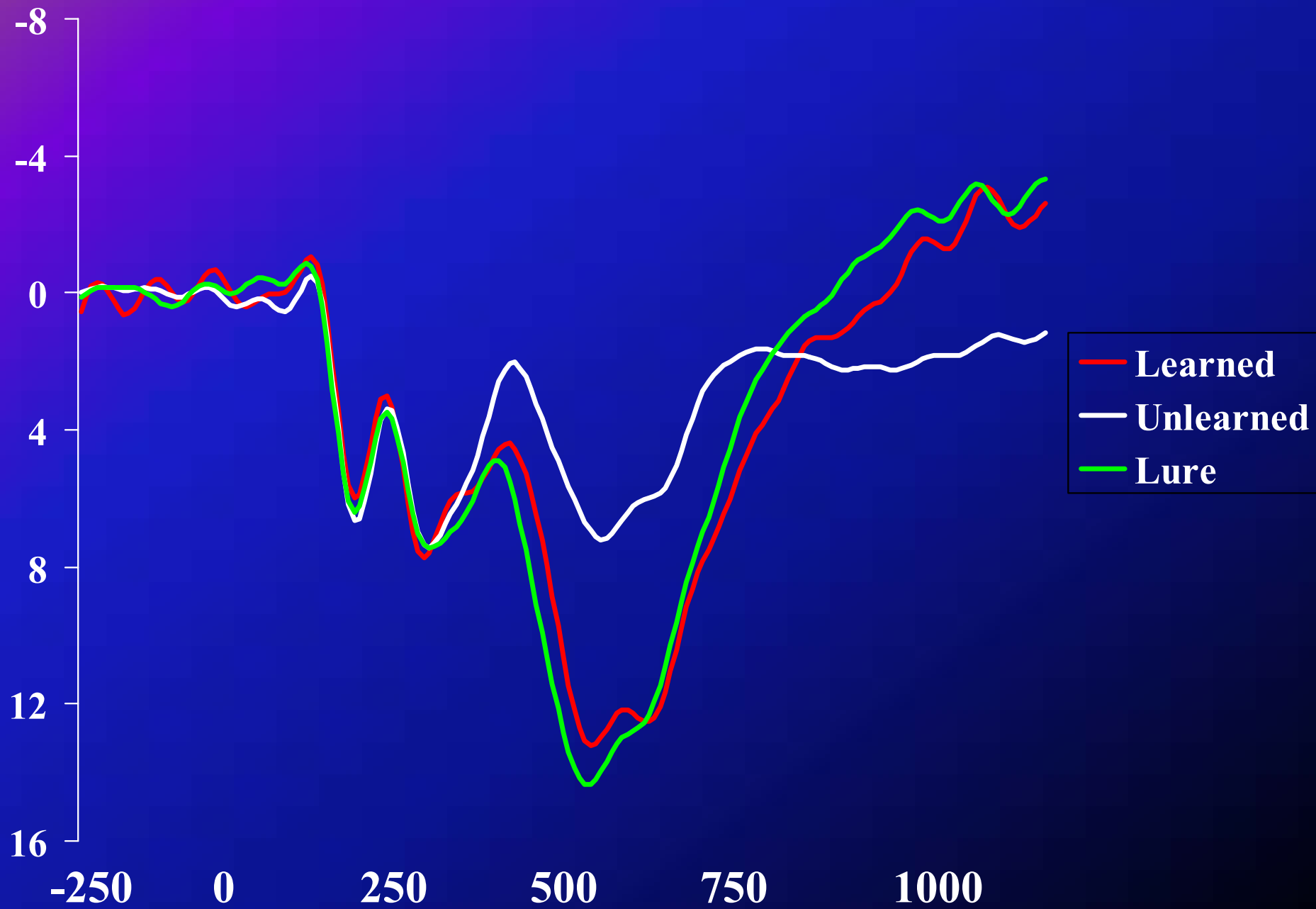
Bed, rest, awake, tired,
dream, wake, snooze,
blanket, doze, slumber,
snore, nap, peace, yawn,
drowsy



Sleep

Reported Rates of Recognition





The Bayesian Box Score Blues

Ground Truth	Test Verdict	
	Recognition	No Recognition
Actually Learned	56%	42%
Critical Lure	72%	28%
Unlearned	4%	96%

- ❑ Highlights the need to have memorable items in the test
- ❑ Suggests limited utility in substantiating disputed memories; e.g., claims regarding recovered memories
- ❑ Still has low false positive rate when person denies knowledge

Future Directions

- ❑ Develop realistic laboratory models for mock crime investigations



Results of Mock Crime Brainwave Procedure

Group	N	Verdict	
		Guilty	Innocent
Guilty	15	47%	53%
Guilty (countermeasure)	45	17%	83%
Innocent	15	6%	94%

Future Directions

- ❑ Develop realistic laboratory models for mock crime investigations
 - ❑ Countermeasures
 - ❑ Vulnerability to low hit rates and to false positives
 - ❑ Drug and Alcohol effects
 - ❑ Temporal lag between “crime” and test
- ❑ Field investigations
 - ❑ Assess circumstances under which the use of ERPs may be feasible
 - ❑ Assess validity against appropriate ground truth data

Synopsis

- ❑ People Lie
- ❑ There is no unequivocal lie response
- ❑ Procedures that focus on recognition rather than emotional reactions associated with lying:
 - ❑ are more accurate overall
 - ❑ are much less vulnerable to false positive rate outcomes
- ❑ These procedures are best suited to investigate specific incidents, not hypothetical future events
 - ❑ Assessing intent?!
- ❑ ERPs are a promising, but relatively untested approach, clearly in need of large funding
- ❑ That's the truth