# The forensic polygraph: Separating fact from fiction

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***The Simpsons: www.youtube.com / "Homer Simpson Lie Detector do you understand"***

The basic definition of "polygraph" (or "lie detector") is the simultaneous recording of two or more physiological measures. It has a wide range of uses in research and medicine, but gained widespread interest as an interrogation tool starting in 1921, when police officer John Augustus Larson used continuous measurement of blood pressure, heart rate, respiration, and skin conductance (a measure of sweat gland activity) to test for deception while interrogating a San Francisco murder suspect[1]. Since its initial debut, the forensic polygraph has been used and adapted by countless others, and is a feature in law enforcement procedure all in several countries. The use of psychophysiology to help solve crime was an exciting enough concept that the word "polygraph" now primarily refers to the use of psychophysiological measures in police interrogation.

Variations of forensic polygraphy have been featured in fictional crime procedurals, documentaries like the Netflix production 'Making a Murderer', and as an actual interrogation tool used by the military and law enforcement in many countries. The polygraph has helped expedite confessions and convictions[2], but its use is controversial in both public and academic circles due to concerns about validity[1][3]. Is the polygraph accurate in distinguishing the guilty from the innocent? The answer depends on a number of factors. To explore this question, let us first review the theory and methods of forensic polygraphy.

**Guilty Lies.** The accuracy of the polygraph depends partly on how guilt is measured. The classical polygraph developed in the first part of the 20th century relies on the so-called Comparison Question Technique (CQT), in which physiological signals recorded while the subject answers crime-relevant questions (e.g., "Did you burglarize the house of John Doe?") are compared to those recorded while the subject answers questions similar but not specific to the crime in question (e.g., "Have you ever taken something that does not belong to you?"). Stronger physiological responses (usually heart rate, skin conductance, and respiration rate) to the crime-relevant questions than to the control questions are judged as evidence for guilt; in contrast, heightened responses to the control questions compared to the crime-relevant questions are supposed to suggest innocence[4]. The CQT method is used in the majority of law enforcement polygraph tests, and has been instrumental in solving countless crime cases since its inception[2].

The central assumption behind the CQT polygraph method is that when we lie, our bodily signals are different from what they look like when we are telling the truth. However, in reality there is little evidence for distinct physiological activity associated with lying[5]. When innocent and guilty subjects differ in their physiological response patterns, it may at best be attributable to effects secondary to the deception itself, like stress or anxiety. As one can imagine, you don't have to be guilty to feel anxious under interrogation. Accordingly, innocent subjects in experimental CQT studies often show equal, or even greater, reactions to guilty questions compared to control questions[4]. This bodes poorly for forensic polygraphy in the field, where studies suggest false positives can be as high as 40%[1][6]. When polygraph evidence falsely implicates innocent suspects, it can both ruin lives, and undermine confidence in the role of psychophysiology in forensics. The issue highlights how important it is for police interrogation procedure to be informed by good psychological research.

**Guilty knowledge.** Deception is not the only way to distinguish the guilty from the innocent. Another is that guilty people know details of the crime that are not released to the public. The Concealed Information test (CIT), formerly known as the Guilty Knowledge Test[7] aims to test whether people recognize crime-relevant details (called "probes") among several distractor options. The test relies on reactive attention and its biological features: most often reduced heart rate[8], increased skin conductance[7], reduced respiration rate[9], and a change in cortical activity in electroencephalogram (EEG) known as the P300[10]. These responses occur in respondents after any noteworthy question, but they are exaggerated when details from those questions are personally relevant[11][12]. Say, for example, a suspect was personally involved enough in a burglary to know that a wedding ring was stolen. If this person submits to a CIT polygraph, they will probably exhibit stronger physiological responses when asked if the item stolen was a wedding ring compared to other questions asking whether a necklace, a wallet, or a laptop computer were stolen. Meanwhile, an innocent person should not be able to distinguish between the probe and the distractor questions, so their physiological reactions to all of the prompts should be essentially the same[2][13].

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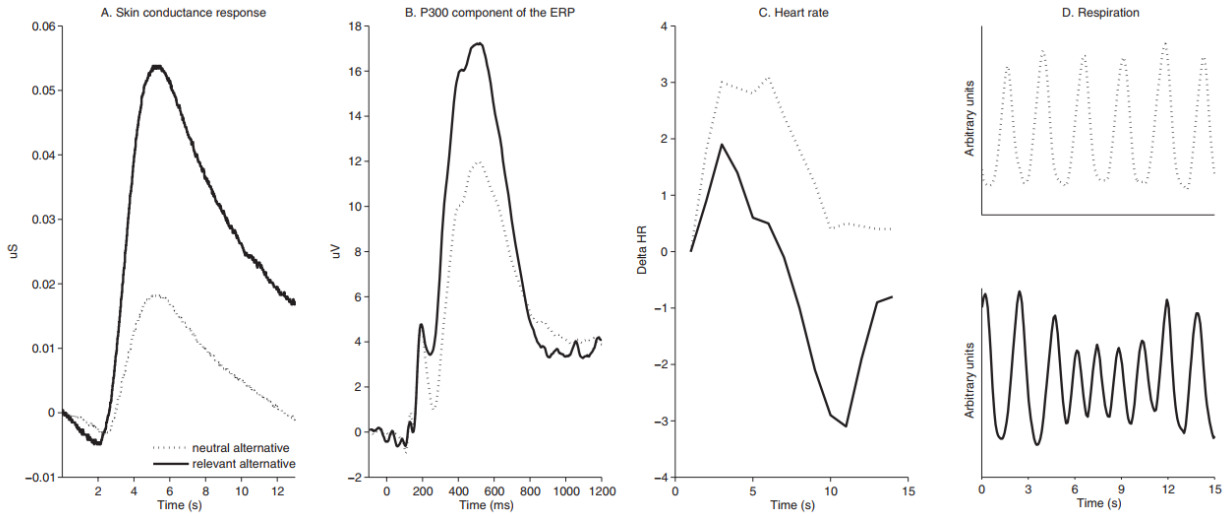
1 The authors of the study cited here are former SPR Presidents Christopher Patrick and William Iacono.

2 This was determined in a study by former SPR President David Lykken.




An image of physiological signals tested in CIT polygraphy, comparing responses between neutral (dotted line) and relevant (solid line) prompts. Reproduced from Meijer et al., 2014, published in *Psychophysiology*.

While used less often and in fewer countries than the CQT[14], the CIT is well-supported in experimental research[15], with studies showing 88 to 100 percent accuracy in detecting guilt, and average false positive rates (i.e. risk of falsely implicating an innocent subject) as low as 2 percent[16]. However, there are some caveats, as illustrated in a 2014 meta-analysis by Meijer and colleagues. One detraction is that the accuracy of CIT using skin conductance to detect guilt during mock-crime experiments (i.e. mimicking a real crime interrogation) has diminished over the 60-year span of its use. Various explanations for this phenomenon exist, among them that many of the more recent mock-crime studies were designed to more accurately simulate actual police interrogation procedures[16]. Another point about the experimental CIT is that the test depends somewhat on both the measure used and the person tested. The P300 and skin conductance measures outperform heart rate and respiration rate. However, not everyone responds in the expected way with these measures, so multiple measures are still preferable to single measures[17]. And, as with most psychophysiological data, responses to polygraph tests vary much more between people than between measurements of the same person[18]. Because of this, a polygraph can be used to detect whether a person holds guilty knowledge or not, but cannot be used to determine whether one person holds more guilty knowledge than another.

The last thing to consider is the differences between lab settings and legal settings, and how that might influence the accuracy of CIT when used by law enforcement. It would be useful to test the CIT in the field with actual suspects. Relatively few field studies have been conducted to date[19][20][21][22], as it is difficult to test the accuracy of the CIT in these studies when the truth of who committed the crimes being investigated cannot be known for sure. The next best thing is to look at how suspects' CIT results predict whether or not they will confess. Based on this criterion, the false positive rate in field studies is luckily still very low, from 2 to 5% [16]. Where field studies fall short is the false negative rate (i.e. failing to detect guilt when it is there), which can be as high as 42%[20]. Put simply, a “guilty” result from a properly conducted CIT polygraph can all but guarantee the suspect knows details about the crime, but a suspect's involvement in the crime does

not guarantee they will test that way in the polygraph. While the false negative rate may be reduced somewhat if interrogators use methods more similar to those of controlled experiments[16], it has nonetheless discouraged law enforcement in many countries from adopting the CIT into standard interrogation procedure[23]. Until this hurdle is crossed, the number of field studies will remain low, and will only tell us so much about the accuracy of polygraphy in law enforcement settings.

**Fooling a polygraph.** Related to the concern of false negative polygraph results is the idea that guilty suspects can train themselves to trick a polygraph into producing results suggesting innocence. A quick google search of "fooling a polygraph" pulls up a variety of strategies, including biofeedback training, breathing exercises, self-inflicted pain, and hypnosis. Because both CQT and CIT work by comparing suspects' responses to crime-related versus neutral prompts, strategies to beat the polygraph at its own game can aim to reduce one's responses to crime-related prompts, or exaggerate one's responses to neutral prompts. Research suggests that it is difficult to train oneself to blunt responses to the crime-relevant prompts, but it is very feasible to exaggerate reactions to neutral prompts[24]. In experimental studies, people can learn to fool the CIT mock-crime polygraph with skin conductance[25] and P300 measures[26][27] by using mental countermeasures (e.g. imagining something scary while listening to the crime-irrelevant prompts). Subjects can even do this successfully without practicing beforehand[25][26][27]. Psychophysiologists have responded to this threat by developing a more fool-proof version of the CIT called the Complex Trial Protocol, which spaces out the probes from the irrelevant prompts and thus makes it harder for subjects to divide their attention between the irrelevant and relevant prompts[28].

**Conclusion.** The forensic polygraph is part of standard law enforcement procedure in several countries, and has been valuable in helping convict guilty people. However, it is important for both scientists and the public at large to recognize caveats to interpretation when the polygraph is used for interrogation purposes. Some key take-aways are as follows. In general, the polygraph is better able to detect knowledge (CIT) than deception (CQT), although the latter test is more often used in the field. Concerns regarding validity are warranted, and a failed polygraph alone should not be enough to prove guilt in a court of law. But with recent research developments in P300, concealed information, and complex testing, the future of polygraphy is promising.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