International Journal of Psychophysiology 94 (2014) 473–481

Contents lists available at ScienceDirect

International Journal of Psychophysiology

journal homepage: www.elsevier.com/locate/ijpsycho

The impact of prior knowledge from participant instructions in a mock crime P300 Concealed Information Test ☆

Michael R. Winograd *,[1], J. Peter Rosenfeld

Northwestern University, United States

ARTICLE INFO

Article history:
Received 16 December 2013
Received in revised form 30 July 2014
Accepted 5 August 2014
Available online 12 August 2014

Keywords:
Concealed Information Test
P300
Complex Trial Protocol
Ecological validity
Mock crime
ERP

ABSTRACT

In P300-Concealed Information Tests used with mock crime scenarios, the amount of detail revealed to a participant prior to the commission of the mock crime can have a serious impact on a study's validity. We predicted that exposure to crime details through instructions would bias detection rates toward enhanced sensitivity. In a 2 × 2 factorial design, participants were either informed (through mock crime instructions) or naïve as to the identity of a to-be-stolen item, and then either committed (guilty) or did not commit (innocent) the crime. Results showed that prior knowledge of the stolen item was sufficient to cause 69% of innocent–informed participants to be incorrectly classified as guilty. Further, we found a trend toward enhanced detection rate for guilty–informed participants over guilty–naïve participants. Results suggest that revealing details to participants through instructions biases detection rates in the P300-CIT toward enhanced sensitivity.

1. Introduction

The Concealed Information Test (CIT) is a psychophysiological credibility assessment tool used to determine when a person has knowledge of a crime (Lykken, 1959). Unlike the traditional "lie detector" test people are familiar with through the media (the comparison question test (CQT), see Raskin and Honts, 2002, for a review), the CIT is not used to detect deception. Instead, the CIT is designed to detect when a person knows a specific piece of information by measuring physiological signals as they are asked questions about specific details of a crime. A suspect is presented with a question, such as, "What was the murder weapon," followed by a number of possible answers, presented serially. A guilty person is expected to respond differentially to the correct answer versus the incorrect answer, whereas an innocent person's responses will not differ. This differential responding is indicative of concealed knowledge and is used to classify an individual as either knowledgeable or non-knowledgeable. Many Concealed Information Test (CIT; Lykken, 1959) studies that employ mock crime scenarios inform participants in the experimental instructions of the exact details on which they will later be tested. Since some crimes (though not all) in the field expose perpetrators to crime details only during commission of the crime, studies such as the majority of those P300-based CIT studies in Table 1 (which do reveal crime details unnaturally) may poorly represent some actual field conditions (i.e. they have low ecological validity). The P300 is a positive-going event-related potential (ERP) elicited around 300–600 ms post-stimulus by rare and/or meaningful information (Donchin and Coles, 1988), which lends itself for use as a dependent measure using the CIT methodology (Farwell and Donchin, 1991; Rosenfeld et al., 1988). To date, only Winograd and Rosenfeld (2011) and Hu et al. (2013) focused on the detection of purely incidentally acquired knowledge.

Simply revealing crime details to participants may be sufficient to allow them to recognize crime-relevant (probe) details in a CIT, leading to large responses to probe items, thus resulting in such participants being wrongly classified as "guilty." Indeed, multiple studies have shown this to be true for autonomic nervous system (ANS)-CITs. Gamer et al. (2008), Gamer (2010), and Gamer et al. (2010) demonstrated that both the standard ANS-CIT and the ANS-guilty actions test (GAT, a version of the CIT where suspects are asked questions about their specific actions, e.g. "What did *you* steal?") were unable to discriminate between truly guilty and informed innocent participants. A similar result was reported by Nahari and Ben-Shakhar (2011), though, it should be noted that Gamer et al. (2010) found more forgetting and greater physiological response decreases in innocent informed participants tested after a time delay. These results also demonstrate the potential danger of leakage of crime information to the public in situations where a CIT could be employed, as innocent (but knowledgeable) people could then appear guilty on a CIT, or truly guilty suspects could claim that information learned through legitimate means (such as

☆ This research was supported by the National Institute of Justice (2012-IJ-CX-0022).

* Corresponding author at: Department of Psychology, Northwestern University, 2029 Sheridan Rd., Evanston, IL 60208-2710, United States. Tel.: +1719 659 3108; fax: +1847 491 7859.
E-mail address: m-winograd@u.northwestern.edu (M.R. Winograd).
[1] Present Address: 2619 N Southport Ave #2R, Chicago, IL 60614.

http://dx.doi.org/10.1016/j.ijpsycho.2014.08.002
0167-8760/

Table 1
P300 CIT mock crime detection rates.

		Correct detection rates		
Authors	Block	Guilty	Innocent	Overall
Abootalebi et al. (2006)				0.74[a]/0.79[b]
Abootalebi et al. (2009)				0.86[b]
Farwell and Donchin (1991)		0.9[c]	0.85[c]	
Hu et al. (2013)				AUC = .79[a/h]
Hu and Rosenfeld (2012)		.66[a/g]	1.00[a/g]	
Lui and Rosenfeld (2008)	2 probe	0.875[d]	0.714[d]	
	3 probe	0.706[e]	0.643[e]	
Mertens and Allen (2008)		0.47[a]	1[a]	
Rosenfeld et al. (2004)		0.73[a]	0.91[a]	
Rosenfeld et al. (2007)		0.55[f]		
Winograd and Rosenfeld (2011)		0.82[a]	0.92[a]	

Note: Authors used varying statistical methods of classification ([a]bootstrap amplitude difference, [b]wavelet classifier, [c]bootstrapped cross-correlation, [d]bootstrapped spatial-temporal PCA on fronto-central site, [e]bootstrapped spatial-temporal PCA on parietal-occipital site, [f]bootstrap amplitude difference with multiple blocks — 2 of 3 needed for guilty diagnosis), [g]immediate testing condition, and[h]ROC analysis conducted on a high-deception awareness group. Overall correct classification rates are given for papers that did not report individual group detection rates.

information leakage) could be responsible for their knowledge of probe items. Based on these results, we sought to determine if informed innocents would also be indistinguishable from true guilty participants using a P300-based CIT.

One might simply assume that if informing innocent participants of mock crime details makes them appear guilty on an ANS-based CIT, then the same effect would occur in a P300-based CIT. However, several effects seen in ANS-CITs do not occur in P300 versions. For example, (1) time delays between a mock crime and CIT have been found to decrease response magnitudes for items in ANS-based CITs (Gamer et al., 2010; Nahari and Ben-Shakhar, 2011), an effect that was not found in a recent P300-CIT (Hu and Rosenfeld, 2012). (2) Gamer and Berti (2012) found differential effects for detection of details that were centrally or peripherally related to a crime using the skin conductance response (SCR), but no differences between the two based on P300 amplitudes. Similarly (3), Gamer and Berti (2010) found different effects of task relevance and recognition on SCR and P300. Further (4), in contrast to P300-CIT studies which utilized multiple blocks of testing (Meixner and Rosenfeld, 2011; Rosenfeld et al., 2004, 2007), previous research has demonstrated that response magnitudes of ANS orienting responses are affected by habituation (Ben-Shakhar et al., 1996).

While the CIT has significant support in the scientific community (Iacono and Lykken, 1997), the ecological validity of laboratory tests (i.e. how well results would translate to field use) has been largely unexamined. The majority of P300-CIT studies to date have used autobiographical details or previously studied and rehearsed information as probes. One limitation in using this information to assess the accuracy of the CIT is that these familiar items are well rehearsed and thus much more deeply encoded into memory than details one might notice and encode during the commission of a crime, some of which may be purely unplanned and incidentally acquired. This is problematic for ecological validity, as Rosenfeld et al. (2007) found larger probe-irrelevant P300 amplitude differences for self-referring information (e.g. names, birthdates, area codes, social security numbers) than mock crime information. A related effect was reported by Rosenfeld et al. (2006), who found that a participant's own name elicited a larger P300 than that of the experimenter's name, even one to which participants were exposed numerous times and rehearsed to a 100% recall criterion.

Within mock crime studies, one element that can have a significant impact on validity is the instruction set given to the participant. In many of the studies in Table 1, participants were tested for knowledge of details that were (a.) explicitly revealed through instructions and/or reinforced through an interrogation (Hu and Rosenfeld, 2012; Mertens and Allen, 2008; Rosenfeld et al., 2007), (b.) reinforced by having participants write down a detail about the item (Abootalebi et al., 2006, 2009), or even (c.) learned through rote memorization (Farwell and Donchin, 1991; Rosenfeld et al., 2004). The latter two of these procedures have limited ecological validity. In a field CIT examination, an examiner would not be likely to disclose the identity of a probe item – at most he would present it, along with all the other stimuli, to a suspect in order to review the items to be seen on a test – prior to an examination. Neither would an examiner ask a suspect to write down or reveal an aspect of a stolen item (which he is denying having taken). Based on the previous findings that well-rehearsed information evokes larger P300s than less salient information (Rosenfeld et al., 2006, 2007), we predicted that any procedure that reveals or reinforces the identity of the probe item prior to the P300-CIT would bias the results toward higher sensitivity by making the probe more salient than it would be without the disclosure. However, it should be noted that some mock crime situations (e.g. Farwell and Donchin, 1991) may require participants to learn specific details through instructions in order to properly execute the mock crime.

To test whether prior knowledge of probe items would affect the P300-CIT, we employed a fully counterbalanced 2 × 2 factorial design. We manipulated participant's guilt (guilty vs. innocent) and knowledge (informed vs. naïve) regarding the probe detail given in the mock crime instructions. While the primary focus of the current study was to determine if revealing crime-relevant knowledge to *innocent* participants would cause them to appear guilty in the subsequent CIT, we chose to use the full 2 × 2 design in order to also determine if information given through experimental instructions prior to the crime might have an additional effect on *guilty* participants. We predicted that correct detection rates would be higher for the guilty–informed group than for the guilty–naïve group, and lowest for the innocent–naïve (true innocent) group. The critical group, however, would be the participants who were knowledgeable as to the identity of the stolen item, but who did not actually take it (innocent–informed). We predicted that more participants in this group would be falsely classified as guilty (false positive) than in the innocent–naïve group, and that they would be indistinguishable from the guilty–naïve group based on both P300 amplitudes and detection rates. Additionally, we expected to find larger probe P300 amplitudes and larger probe-irrelevant P300 differences in both the guilty–informed versus the guilty–naïve group and in the innocent–informed versus innocent–naïve groups due to the informed groups' additional exposure to the probe item prior to executing the mock crime. Importantly, we sought to demonstrate this effect using a much less salient form of exposure to the crime details than the rehearsal or memorization procedures previously used in related experiments (such as those in Table 1).

2. Method

2.1. Participants

The study had 63 total participants who were all undergraduate or graduate students at Northwestern University and took part in the experiment for either course credit or monetary compensation ($10). Participants were randomly assigned to one of four conditions. Prior to the CIT, two participants were rejected due to improper execution of the mock crime. Later, six additional were rejected due to excessive EEG artifacts and one more for not following directions for the button press responses during the CIT examination. The remaining 54 participants (32 female, 10 paid) ranged in age from 18 to 24 ($M = 19.5$, $SD = 1.7$), giving final numbers in each group of innocent–naïve ($n = 14$, 8 female, 2 paid), innocent–informed ($n = 13$, 8 female, 4 paid), guilty–naïve ($n = 14$, 9 female, 2 paid) or guilty–informed ($n = 13$, 7 female, 2 paid). Mean ages in each condition were similar, ranging between 19.1 to 19.9 years old, and were not significantly different ($p > .6$).