Moderate financial incentive does not appear to influence the P300 Concealed Information Test (CIT) effect in the Complex Trial Protocol (CTP) version of the CIT in a forensic scenario, while affecting P300 peak latencies and behavior

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ABSTRACT

Previous research indicated that the skin conductance response (SCR) of the Autonomic Nervous System (ANS) in the Concealed Information Test (CIT) is typically increased in subjects who are financially and otherwise incentivized to defeat the CIT (the paradoxical "motivational impairment" effect). This is not the case for RT-based CITs, nor for P300 tests based on the 3-stimulus protocol or Complex Trial Protocol for detection of cognitive malingering (although these are not the same as forensic CITs). The present report extends earlier studies of malingerers by running five groups of subjects (15–16 per group yielding 78 total) in a mock crime (forensic) scenario: paid (to beat the test) and unpaid, instructed and uninstructed, and simply guilty. There was no evidence that the "CIT effect" (probe-minus-irrelevant P300 differences) differed among groups, although behavioral differences among groups were seen.

1. Introduction

The Concealed Information Test (CIT, Lykken, 1959, also called the Guilty Knowledge Test or GKT) has been studied for > 50 years; (for reviews, see Verschuere et al., 2011; Meijer et al., 2014; Rosenfeld et al., 2012).The present study is an investigation of the effects of motivational manipulations on the P300-based CIT.

In the CIT protocol, there are minimally two kinds of stimuli presented in a random order to participants: The 1) *probes* are the expected, to-be-remembered items—often from a crime scene—such as a stolen necklace. The 2) *Irrelevant* stimuli are other similarly valuable items (a watch, a bracelet, a ring, etc.) which are in the same category (jewelry) as the probe, but are not equivalent to it, so are not recognized by the thief as the stolen item. The probe *is* recognized, and thus evokes an enhanced physiological response in only the knowledgeable (guilty) subject. To unknowledgeable (innocent) suspects, the probe is also irrelevant and evokes a much smaller or no physiological response. Traditionally, the responses examined are autonomic (ANS) responses such as SCR, respiration pattern, and cardiac responses. In more recent years, the P300 component of the event-related potential (ERP) and fMRI *BOLD* response have been frequently utilized (for review, see Rosenfeld, 2011; Rosenfeld et al., 2012. See also a general introduction

to the use of P300 in information detection which is provided in the first section of the Supplementary Methods). When P300 is used, the probes are presented rarely, e.g., with probability = $p = 0.15$, and the irrelevants are presented frequently, e.g., $p = 0.7$, and a third stimulus type—the target, $p = 0.15$, with unique response requirements—is additionally used to hold attention.

In a recent, important meta-analysis, Meijer et al. (2014) pointed out that they and many (though not all) others have observed that motivation and incentive typically increase the CIT effect (critical item-noncritical item difference) in the SCR measure of the ANS. By motivation and incentive, we refer to manipulations of financial reward for beating the test, or simply the intellectual incentive of telling subjects that only bright people can suppress their reactions and go undetected, and so forth. This positive effect of motivation on the CIT effect does not occur with reaction time (RT) indices of CIT effects (Kleinberg and Verschuere, 2016; Suchotzki et al., 2013; Suchotzki et al., 2017). Regarding P300-based CITs, Meijer et al., 2014, p. 883) noted that "The bulk of CIT studies based on P300 did not use motivational instructions." This was true, as indeed most of those studies (prior to 2014) are from this lab where we informally had never noticed effects of motivation on P300 in several papers. (That is, P300s in CIT studies with incentivized subjects seemed in the same range as those studies lacking

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financial incentive.) This impression was formally confirmed in Ellwanger et al. (1996): A truth-telling group, instructed only to do their best on P300 tests (involving semantic, as well as incidentally acquired, episodic memory), was compared to a motivated/incentivized "dishonest" group offered $10 to "beat the test." There were no significant P300 differences found, and indeed the sensitivity (the ability of the test to detect knowledgeable subjects on a scale from 0.0 to 1.0) of the truth tellers was 0.74, which is almost identical to the value of 0.73, obtained for the incentivized dishonest group.

This study (Ellwanger et al., 1996) was based on the older "3-sti- mulus protocol" version of the P300 CIT (3SP, Rosenfeld, 2011). Their finding of no sensitivity difference between dishonest and honest sub- jects was recently extended to the Complex Trial Protocol (Rosenfeld et al., 2008; Rosenfeld et al., 2017; Rosenfeld et al., 2018). All these recent studies found no effects of financial motivation and incentive to "beat the test" on the *malingering* protocol. Of course both the mal- ingering and forensic scenarios make use of the fact that P300 is a re- sponse to recognized information (autobiographical knowledge for the malingerer, mock crime details for the forensic scenario.) However, the malingering protocol has essential differences from the mock crime (forensic) protocol which make it problematic to generalize from mal- ingering data to forensic CIT effects. Thus, the present study explores effects of incentive and motivation on a mock crime protocol.

In the Rosenfeld et al. (2017), Rosenfeld et al. (2018), and Ellwanger et al. (1996) studies, the scenario used involved the mal- ingering of cognitive (memory) deficits associated with closed head injury (CHI). As Ellwanger et al. (1996) have pointed out, such mal- ingerers are not instructed to suppress *all* enhanced responses to cri- tical/probe items, which *is* the case with a classical CIT forensic sce- nario, making scientific comparison impossible, strictly speaking. Rather, the CHI malingerer is instructed to emulate the performance of a true CHI patient by not missing correct responses to *all* critical/probe items, but to only about half (50%) of them.

In thinking about the elements of motivation used in all previous studies of the effects of motivation and incentive on the CIT effect, we developed Fig. 1 below, based on Rosenfeld et al. (2018).

Fig. 1, in turn, was based on instructions used in a typical ANS- based mock crime CIT, such as the following from klein Selle et al. (2016, pp. 579–590, Appendix A), whose instructions were:

"You are suspected of having committed a crime. In order to find out if you are guilty or innocent of the theft, you will take a polygraph test during which we will measure your physiological responses…
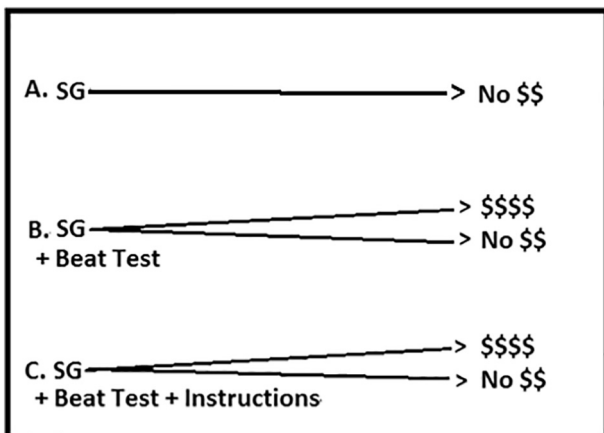
The test is based on the theory that our physiological responses change when we recognize the items related to the theft. Therefore, your goal is to conceal your knowledge of the items related to the theft and to appear innocent. If you will succeed to come out as innocent in the test, you will get a bonus of 10 NIS [$3.00 US]."

There appear to be three elements of the motivational manipulation (as seen in Fig. 1) in this instruction set: Subjects are instructed to 1) defeat the test, 2) achieve this defeat and appear innocent by concealing physiological/emotional responses which accompany "guilty knowl- edge" recognition, and 3) expect a financial reward for successfully beating the test.

One notes, however, that in this example (and in many other stu- dies), all the motivational elements are combined such that a positive effect of motivation cannot be unambiguously attributed to any single element, nor combination of elements. In transposing motivational elements for a study of motivational manipulations on the P300-based CTP, we decided to study these elements singly and in combination, as suggested in the diagram of groups shown in Fig. 1.

It is apparent that subjects can be run as simply guilty (SG) of a mock theft in a mock crime protocol, as in Fig. 1A. On the other hand, they can be run as guilty but additionally told to try to beat the test by not being detected, as in B. On the other hand, they can be run as in B but additionally *instructed* that to beat the test, they will have to sup- press reactions to the key or probe stimuli, as in C. In each of B or C, subjects can be paid or unpaid. However, it is noted in Fig. 1 that for the simply guilty group (SG), a paid condition is not shown because it makes little sense to offer a financial incentive without pairing it to some aspect of test performance. However, in the SG group there really is nothing it can be paired with without introducing a confound, (e.g., one could offer SG subjects a reward for being especially accurate in the target-non-target part of the CTP trial, but then comparisons with other groups would be confounded.) Thus in the present study there are five groups shown in black in Fig. 1. The groups are (1) simply guilty, or *SG* (unpaid, uninstructed), (2) *BtNo*, uninstructed, told only to try to beat the test, unpaid, (3) Bt $, uninstructed, told to try to beat the test, and paid if successful, (4) BtINo, instructed (to suppress reactions to the probe), told only to try to beat the test, unpaid, and (5) BtI $, instructed (to suppress reactions to the probe), told to try to beat the test, and paid if successful.

In summary, the present study compares subsets of four arbitrarily ordered groups/levels of motivation/incentive with one another, and with an unincentivized, SG group, the aim being to assess the effects of these motivational levels on the P300-based CIT effect in a mock crime (forensic) scenario. Although we have pointed out the differences be- tween mock crime and malingering scenarios, based on the null effects previously seen in malingering studies, still, we would expect a lack of effect of motivational manipulations on the mock crime scenario, as both scenarios utilize P300 as a recognition index for concealed in- formation.

2. Methods

2.1. Participants

The 78 of 85 initially recruited participants (randomly assigned, 15–16 per each of 5 groups) were from the Northwestern University Introductory Psychology Pool. Seven participants were excluded for failing to follow instructions (4) and excessive blink artifacts (3). They were mostly college freshman and sophomores, plus a few upper-class persons, aged 17 to 22 (mean = 19.4 ± 1.7). There were 43 women and 35 men. The study with informed consent was approved by the Northwestern University IRB.

Fig. 1. A diagram of the 3 levels of motivational manipulation, generating 5 groups of subjects in this study: Subjects can be run as (A) simply guilty (SG) with no pay for any aspect of performance, (B) guilty, but encouraged to try to beat the test and appear in- nocent. They can either be rewarded or not for beating the test. Finally, they can be run as (C) guilty, told to beat the test, instructed how to beat the test, and again, either paid or unpaid for successfully beating the test.