



Electrodermal and phasic heart rate responses in the Guilty Actions Test: Comparing guilty examinees to informed and uninformed innocents [☆]

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ABSTRACT

The present mock-crime study concentrated on the validity of the Guilty Actions Test (GAT) and the role of the orienting response (OR) for differential autonomic responding. $N=105$ female subjects were assigned to one of three groups: a guilty group, members of which committed a mock-theft; an innocent-aware group, members of which witnessed the theft; and an innocent-unaware group. A GAT consisting of ten question sets was administered while measuring electrodermal and heart rate (HR) responses. For informed participants (guilty and innocent-aware), relevant items were accompanied by larger skin conductance responses and heart rate decelerations whereas irrelevant items elicited HR accelerations. Uninformed participants showed a non-systematic response pattern. The differential electrodermal responses of informed participants declined across the test. With respect to the HR data, however, no habituation was observed. Findings suggest that GAT results could not exclusively be interpreted by referring to the OR.

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1. Introduction

The purpose of the present study was to compare phasic heart rate changes and electrodermal responses of guilty examinees, informed and uninformed innocents in the Guilty Actions Test (GAT). Moreover, the role of the orienting response (OR) for differential autonomic responding in the GAT and related techniques should be assessed. The GAT (cf. Bradley et al., 1996) is a modified version of the Guilty Knowledge Test (Lykken, 1959), a special technique designed for the detection of guilty subjects in criminal investigations. The Guilty Knowledge Test (GKT) is based on the assumption that suspects who possess knowledge about specific crime related details will be physiologically more reactive when confronted with these details than when confronted with comparable items not related to the crime (Lykken, 1959). Each crime-relevant item is presented to suspects in sets consisting of similarly plausible, but not

crime related, alternatives (irrelevant items). Thus, a typical multiple-choice question in a GKT might relate to the kind of weapon used in a murder case (“Mr. X was killed with... a) a baseball bat?, b) a rifle?, c) an axe?, d) a pistol?, e) a knife?”). In the standard version of the GKT the suspect is instructed to answer “no” to each alternative. It is assumed that the weapon actually used is known only by the murderer. Therefore, this weapon has a special meaning for the guilty subject, but not for innocent suspects. Accordingly, only the guilty subject is expected to exhibit stronger autonomic responses to the relevant item than to the irrelevant items of a set whereas innocent suspects should show a non-systematic response pattern.

This hypothesis has been supported by a large body of research that mainly focused on electrodermal response differences between relevant and irrelevant items. In a recent meta-analysis, Ben-Shakhar and Elaad (2003) found high effect sizes for the differentiation of informed and uninformed subjects using electrodermal data in the GKT and related paradigms. Additionally, they identified three moderator variables. A larger number of question sets led to a higher effect size than the use of only few multiple-choice questions. Moreover, an interactive effect of the subject’s motivation and the mode of responding during the test was found. Especially under low motivational conditions, a deceptive denial of the relevant item within each question set was associated with a larger effect size compared to a silent condition without an overt verbal response.

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Two critical aspects of the original GKT prompted Bradley and colleagues to slightly change the test format. First, the processes of recognition and lying are confounded, i.e., it remains unclear, to what extent increased physiological responding to the relevant items is due to recognition of crime related details and/or deceptive denial of these relevant items (see also Furedy and Ben-Shakhar, 1991). Second, the forensic application of the GKT depends on the precondition that no crime related details have been spread to the public. If this condition is not fulfilled, informed innocents could fail the GKT and as a consequence could be considered guilty. In order to solve these problems, the wording of the questions is modified in the GAT. Whereas the GKT-questions only refer to knowledge about crime details (“Mr. X was killed with...”), the GAT-questions, additionally, refer to the subject’s guilt (“Did you kill Mr. X with...”). Again, all items have to be denied in order to appear innocent. Several experimental mock-crime studies found that innocents who were aware of the crime related details showed smaller response differences between relevant and irrelevant items in the GAT than did guilty subjects (Ben-Shakhar et al., 1999; Bradley et al., 1996; Bradley and Rettinger, 1992; Bradley and Warfield, 1984). Regarding the false alarms, however, a larger proportion of informed innocents (approximately 50% across studies) failed the GAT than did innocents unaware of the critical details (approximately 0% to 10% across studies).

The differential responding of guilty subjects to relevant and irrelevant items in the GKT and related techniques has been repeatedly interpreted with reference to the concept of the orienting response. The OR is a complex of behavioral and physiological reactions evoked by novel, unexpected or unpredictable stimuli (Sokolov, 1963). The OR aims at effectively preparing the organism to cope with these environmental conditions by an involuntary capture of attention and an improvement of stimulus perception. Repetition of a stimulus leads to a gradual decline of the OR magnitude, a process known as habituation. Sokolov (1963) argued that certain stimuli comprise a signal value that is capable of evoking an enhanced OR and thus preparing the organism for action. According to the notion of Lykken (1974), the relevant items embedded in the GKT-questions presentation, have this sort of significance or signal value for guilty subjects. Therefore, they evoke a stronger OR that is more resistant to habituation compared to irrelevant items (see also Ben-Shakhar and Furedy, 1990, p. 111 ff.).

More evidence for an OR theoretical account stems from studies using phasic pulse or heart rate changes as dependent variables in the GKT. Early mock-crime studies (Bradley and Ainsworth, 1984; Bradley and Janisse, 1981) as well as recent research (Gamer et al., 2006; Verschuere et al., 2004) consistently reported a relative reduction of the phasic heart rate (HR) following relevant as compared to irrelevant items. By analyzing stimulus-related HR-trends in detail, Gamer et al. (2006) found an initial HR acceleration for relevant as well as for irrelevant items in groups of guilty and innocent participants. However, only after the presentation of relevant items to guilty subjects, the phasic HR showed a marked deceleration, that peaked around 8 s after stimulus onset. The initial acceleration was interpreted as a correlate of the subject’s verbal denial whereas the deceleration that most clearly distinguished between both experimental groups was thought to be related to attentional processes (see also Raskin and Hare, 1978). As the participants were requested to immediately deny each GKT question, both above mentioned processes were confounded in this study to an unknown degree. In a work by Verschuere et al. (2004), participants were not requested to respond verbally to the GKT items. In this case, the initial acceleration of the phasic HR was absent. Instead, crime related details elicited stronger HR decelerations compared to irrelevant items. This relative reduction of the HR following relevant items has been interpreted as an index of the orienting response (see also Graham and Clifton, 1966; Turpin, 1986) and thus seems to fit with the above mentioned understanding of the SCR pattern.

Taken together, the present study focused on two major issues. First, we were interested in whether the HR responses would follow

the SCR pattern in a GAT examination which included a group of informed innocents. On the basis of former studies using only SCR amplitudes as dependent measure in the GAT, we expected smaller response differences between relevant and irrelevant items in the group of informed innocents as compared to guilty subjects. Second, the current study aimed at investigating the course of habituation of SCRs across the test and to relate these results to the HR responses. These analyses were performed to improve the understanding of differential physiological responding in the GAT with respect to the OR concept (Verschuere et al., 2004). According to Turpin (1986), the HR deceleration can be regarded as an index of the OR. Thus, if the physiological responding in a GAT examination mainly relies on the OR concept, the HR responses should habituate across the test. Moreover, relevant items should elicit larger responses than irrelevant items if they are recognized by the examinee (Lykken, 1974). The current study aimed at testing these predictions in a GAT examination. The basic research questions prompted us to maximize the internal validity of the current study while accepting potential losses of external or ecological validity. As will become clear in the methods section, guilty participants and informed innocents were confronted with a highly comparable experimental situation for this reason.

2. Methods

2.1. Participants

A total of 108 women participated voluntarily in the experiment in exchange for reward of at least 5 EUR (an additional amount of 7.50 EUR was paid for successfully passing the polygraph examination). They were recruited by means of flyers, placards and announcements. Most of them were students. On the arrival for the experimental session, written informed consent was obtained from all examinees. The data of three participants had to be excluded from analysis because of flawed physiological recordings. The mean age of the remaining sample ($N=105$) was 26 years ($SD=9.6$ years) with a range from 17 to 67 years.

2.2. Design and procedure

The experimental design consisted of the between-subjects factor experimental condition (guilty, innocent-aware, innocent-unaware) and the within-subject factor item type (relevant, irrelevant). All participants were randomly assigned to one of the three experimental conditions after arriving at experimenter A’s (second author) office. The experimenter handed out written instructions appropriate for each individual’s particular condition. Participants’ questions concerning the written instructions were immediately answered by experimenter A.

Subjects in the *guilty condition* ($n=36$) were instructed to commit a mock-crime, i.e., to steal money from Professor Kunze’s office (Professor Kunze was a fictive person). They were told that the money was deposited in a hidden box which was locked by a ten-digit combination lock. Since Professor Kunze was not very good at retaining digits in memory, he had written down the combination-digits on ten slips of paper, each slip containing one digit, and hidden these slips of paper at different places of his office. The slips of paper did not only contain information about the digits but also about the place where the slip of paper with the next digit of the digit combination was hidden. The ten slips of paper were located (1) in a desk drawer with a *Germany-sticker* on it, (2) under a *cactus*, (3) under a *porcelain dog*, (4) in the saddlebag of a *yellow bicycle* parked in the office, (5) behind a *picture of cows*, (6) under a *box containing water bottles*, (7) in the pocket of a *leather jacket*, (8) under a *bowl containing apples*, (9) behind a *darts board*, (10) under a *red carpet*. The slip of paper with the last digit also contained information about the place where the money box was hidden. Incidentally, the guilty subjects had come to know the place, where Professor Kunze had hidden the slip of paper containing the first digit of the digit combination. Thus, the guilty subjects just had to go to Professor Kunze’s

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