Title: Verbal Vs Visual Stimulation using the Concealed Information Test
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Measure: Polygraph machine using the Concealed Information Test
Participants: EU

Introduction

The Concealed Information Test (CIT, Lykken, 1959) utilizes psychophysiological measures to detect crime-related knowledge in a suspect's memory. In other words, it can discriminate between knowledgeable (guilty) and unknowledgeable (innocent) suspects. The rationale of the CIT is that a person shows a different reaction to an item whose recognition he/she tries to conceal compared to similar yet irrelevant items. For example, during an investigation, it is possible to use some crime-related items (e.g., the location where the victim was found: a park), which are presented among other plausible options/items (e.g., woods, beach, in a house). Among a group of suspects, only the person with certain crime knowledge should show a distinct reaction to the crime-related questions. The typically observed physiological reactions for concealed recognition in the CIT include increased response times, increased skin conductance response, decrease breath rate and heart rate, and finally increased P300 amplitude (Verschuere & Meijer, 2014).

Verbal and Visual Stimulation

Traditionally, polygraph tests are based upon the recording of physiological reactions to verbal questions that are answered audibly by a simple “yes” or “no” (Horvath & Reid, 1972). However, in CIT examinations it is possible to use visual stimulation through slide projectors or other means to present the images (Iacono, 1991). Despite the prevalence of photographic evidence in forensic cases, visual stimulation has not been applied as a standard method of stimulation with the polygraph (Matsuda, Ogawa & Tsuneoka, 2019) and only a few studies have used the application of visual stimulation when using polygraph tests (e.g. Bradley and Ainsworth, 1984; Forman and McCouley, 1986; Gamer et al., 2008).

Many studies tried to find the most effective presentation technique that could enhance physiological reactions when known information was recognised. However, the literature around the effectiveness of verbal and/or visual stimulation does not agree on one shared conclusion. For example, Ekman (1988) found that visual and verbal stimuli contributed

equally to detection. Similarly, Lubow and Fein (1996), Beijk (1980) and Carlton and Smith (1991) reported no differences between the two methods. However, opposite results were found in Ben-Shakhar and Gati studies (1987). Participants were instructed to study either schematic faces or verbal descriptions that varied along several dimensions. Later, participants were tested using verbal and visual stimulation. Results showed greater electrodermal responses when verbally stimulated. Although consistent results were found in other studies (e.g. Ben Shakhar, 2003), it is not clear why these research found enhanced responses for verbal stimulation while a lot of other studies found no difference at all.

Regarding the CIT, not a lot of studies have investigated potential differences in visual or verbal stimulations. One of these was conducted by Onitsuka, Shiotsuka and Iramina (2015) where results reported a higher accuracy rate when participants were visually stimulated, compared to a simple verbal stimulation. Conversely, Seymour and Kerlin (2008) found nearly identical detection accuracies when using verbal or visual stimulation in a study based on response times-CIT.

Due to these different conclusions, the current study tried to determine whether there is a difference between verbal or visual stimulation when trying to enhance physiological responses during a CIT examination.

Method

Sample: Participants (N=140 participants) were recruitment using social media and randomly assigned to two groups (Group 1: *N = 70* for verbal stimuli*;* Group 2: *N= 70* for visual stimuli*)*

Equipment and materials: The physiological data for this experiment was recorded with the Lafayette LX5000 SW Polygraph System, owned by the Department of Psychology at the University of Huddersfield. This system works at a transmission rate of up to 360 samples per second in all of the channels and 24-bit analog to digital conversion. Heart rate, breath line rate and EDA were recorded for this study. Thoracic and abdominal pneumatics were used to measure the abdominal and thoracic respiration rates; EDA was recorded using a constant voltage system (4 μA constant current, range of 10 kΩ to 2.3 MΩ) using two-finger clips (0.1 second time constant, 635 nm); a sphygmomanometer was used to record changes in the blood pressure and pulse rate. The measurements were conducted in an air-conditioned, quiet room. Participants were seated in a cushioned polygraph chair during the CIT examination. A

conventional Windows laptop was used to control the stimulus presentation and the recording of the physiological responses using the Data Acquisition Subsystem (DAS).

Test and stimuli: The CIT contained 36 questions in total, with two series of questions for each crime topic (6 series in total). Every series contained six questions: one buffer question, four control/irrelevant questions and one relevant/probe question. The "City" series was the first presented, followed by the "Location" and finally the "Weapon" one.

Procedure: After signing their consent, participants were asked to read an article about a crime that occurred in the UK and try to memorize the most relevant information. The article contained information on the city where the crime occurred (London), on the location-targeted (Soho) and on the weapon used for the crime (a knife). These three represented the relevant items (or probes) used for the CIT. Participants were given 20 minutes to read and familiarise themselves with the article. Once they completed the task, they were invited to take a CIT in another room. For Group 1, questions were only verbally asked. For Group 2, questions were only visually presented. Images of the items from the test were displayed using a PowerPoint presentation. The test took approximately 20 minutes, plus 5 minutes for presentation and 5 minutes for debriefing

Response Scoring and Analysis

Electrodermal Responses. SCR was computed using the maximal increase in conductance obtained from the examinee, from 1 to 5s after stimulus onset (Elaad & Ben-Shakhar, 2006).

Respiration: Respiration was determined based on the total respiration line length (RLL) during the 15 s interval following stimulus onset (Elaad & Ben-Shakhar, 2006). Each response was defined as the mean of 10 length measures (0.1s after stimulus onset through 15.1s after stimulus onset, 0.2s through 15.2 after stimulus onset, etc) (Elaad et al. 1992).

Heart Rate: The heart rate (HR) data was processed in a similar way to the RLL: the length of the interval post-stimulus was 15s (Selle, Verschuere, Kindt, Meijer & Ben-Shakhar, 2016). Only rates between 50 bpm and 180 bpm were used in the calculation of the average heart rate. The post-stimulus difference scores were computed by subtracting the HR in the last second before item onset (pre-stimulus baseline) from the HR- score of each post-stimulus second.

Finally, the largest deceleration and the mean HR within the post-stimulus period were calculated (Gamer, Vershuere, et all., 2008; Selle, Verschuere, Kindt, Meijer & Ben-Shakhar, 2016).

Within each participant and group condition, the responses to each item were z-standardized based on the mean and standard deviation of the responses to all irrelevant questions (Ben-Shakhar, 1985). The difference between the response to the relevant item and the mean of the four irrelevant items within each set of question was calculated. The mean of these measures was computed as an overall index of the different responsivity for each physiological measure (Gamer et al, 2008).

The current project aimed to examine any difference in efficiency between visual and verbal stimulation when trying to detect concealed information from guilty participants

Results

Indexes of the differential responsivity in each physiological measure have been calculated. Table 1 shows negative values for Cardio (Heart Rate), RLL (Respiration Line Length) and a positive value for SCR (skin conductance response).

Table1. Means and standard deviation of the standardised physiological response differences between group1 and group 2

Measure	Group 1		Group 2	
	M	SD	M	SD
RLL	-0.73	0.12	-0.88	0.42
SCR	3.89	1.25	4.02	1.99
Cardio	-0.1	0.93	-0.3	0.85

A two-way ANOVA was conducted to compare the effect of visual and verbal stimulation on physiological responses for each measure (SCR; RLL; Cardio).

There was not a statistically significant interaction between the effects of visual and verbal stimulation on respiration measure, heart rate and electrodermal response (RLL: $F(11) = 12.220, p > 0.05$; HR: $F(1,33) = 6.21, p > .05$; SCR: $F(2.52) = 7.15, p > .05$).

Discussion

The current project tried to determine whether there was an efficiency difference between visual and verbal stimulation when eliciting physiological responses during a CIT. Results showed that no significant difference was identified between visual and verbal stimulation for none of the physiological measures used during the CIT examination.

This study clarifies some of the conflictual conclusions found in the literature, confirming that verbal and visual stimuli contribute equally to detecting deception during the administration of the CIT (Seymour & Klein, 2008). Therefore, results suggest equal efficiency when suspects are verbally or visually interviewed using a CIT. The present data have practical implications for the use of photographic documentation of evidence collected during an investigation process (e.g. photograph of the crime scenes, suspects and forensic analysis), which would equally contribute to the detection of concealed information. Future studies could investigate whether a combination of both stimulations might lead to greater physiological responses.

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