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The objective of this research was to investigate how the experimentally aroused emotions of remorse and guilt might influence the Guilty Knowledge Test accuracy. According to our main hypothesis the technique's precision would increase if the subjects lied about remorse/guilt-eliciting stimuli; we would score the GKT using eye blinking as an index. Secondly, we aimed at comparing that accuracy with the accuracy provided by a well-established lie-detection index, the GSR. Finally, we aimed at investigating whether those to parameters provided accuracy rates significantly better than the accuracy expected according to sheer chance. Forty-eight university students participated in a lie-detection experiment for which we used four Thematic Apperception Test cards as emotionally arousing stimuli and four scenic cards as neutral ones. We conducted the experiment under a guilty information paradigm. The use of eye blinking as a polygraph index substantiated our main hypothesis: the guilty knowledge test rendered significantly higher accuracy rates when the subjects responded to remorse/shame-arousing stimuli. The accuracy rates provided by the analysis of the subjects' GSR was significantly better than those provided by counting their eye-blinks. The accuracy eye blinking provided was significantly higher than the accuracy expected according to sheer chance for the treatment group but not for the control group.

Key words: eye blink, GKT, TAT, emotion, chance level

Introduction

This experiment addressed the difficulty of replicating, in laboratory settings, the emotional states present during real polygraph interrogations -those where a real crime has been committed and the suspect is being interrogated in a police station or military base, facing charges and real consequences. There are two major problems concerning the validity of polygraph techniques. The first one is the difficulty of corroborating their findings by criteria independent of the technique itself (Bradley & Cullen, 1993; Vrij, 2000). In field polygraph testing, the actual responsibility of the subject may not be established for a long time, or not be established at all

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(Waid & Orne, 1981); many innocent suspects confess committing crimes they did not actually commit under duress or because of an induced sense of guilt (Conti, 1999) or even to reduce their sentence (Vrij, 2000). This lack of a so-called 'ground truth' implies that the real accuracy of the test can hardly be ascertained. In laboratory studies this problem is avoided: the subjects' bodily reactions can be compared with the 'ground truth' because the researchers assign the subjects to conditions they design and control; however, a second problem arises: they are emotionally unreal.

Laboratory studies on lie-detection usually include a 'mock crime' (Bradley & Cullen, 1993) of which the participants will be 'innocent' or 'responsible'. Mock crime studies have been criticized because of their lack of realism (Iacono, as cited in Bradley & Cullen, 1993; Lykken, as cited by Andreassi, 1995; Vrij, 2000). Sometimes these mock crimes are the 'theft' of a small amount of money or an object from a desk in a nearby room (U.S. Congress, 1983); sometimes subjects have to imagine having committed a crime (Boucsein, 1992). To increase their motivation and facilitate detection, subjects are offered a financial bonus if they convince the examiner they are innocent (U.S. Congress, 1983). Subjects know they are 'role playing' at being criminals, yet there is no crime since the 'crime' is part of the rules of the experiment. It is very difficult to expect the participants to experience genuine emotional states (e.g. guilt, shame, fear) given that the situation has been staged and because there are no real consequences if the participants "fail" the test. At the same time, the psychological significance of the questions for a participant in a mock crime may not be equivalent to the significance of the questions for a suspect in an actual field examination (US Department of Defense, 1995; Iacono, 2000).

In our experimental design, we posited that the using a projective test as a stimulus would induce emotional states which would become evident through the psychophysiological arousal and over behavior that they would provoke. Such a stimulus would produce a situation more emotionally truthful than a mock crime given that those stories would be based on the subjects' own emotional experience.

Projection is the psychological tendency of people to interpret ambiguous stimuli, specially ambiguous human situations, in conformity with their past experiences and present needs, whether conscious or unconscious (Murstein, 1963). We chose the Thematic Apperception Test (TAT) since it uses such ambiguous human situations as stimuli; the TAT has traditionally been regarded as a tool to expose tendencies of an unconscious nature; the arousal of needs and affects by the pictures and their associations have been linked to the patient's behavior and voice (Murray, 1943). A standard TAT includes the presentation of a set of test cards and the elaboration of a story about each one of them. There are antecedents of emotional states induced experimentally by asking the participants to write stories (Dickerson, Kemeny, Aziz, Kim & Fahey, 2004) or by exposing them to pictures (Ritz, Claussen and Dahme, 2001). The mechanisms of identification and projection has been linked to changes in autonomic responses (Cramer, 2003).

We aimed to arouse the emotions of both guilt and shame for three reasons.

First, because of the fact that both emotions may be present in real polygraph examinations; second, the difficulty of determining a clear clear-cut difference between the two emotional states;

and finally the controversy about guilt and shame in Japan among Western researchers made it difficult to establish for sure which ones of those two emotions would be aroused by the stimuli.

Westerners first characterized Japan as a culture where the sense of shame prevails over the feeling of guilt in the 1940s. Benedict (1946) made the distinction between shame cultures as opposite to guilt cultures, and placed Japan amongst the first. For her, guilt cultures inculcate absolute standards of morality, which are internalized, whereas shame cultures rely on external sanctions, requiring an audience or a man's fantasy of an audience.

Various criticisms of her work have been advanced. Lebra (1983) used the Thematic Apperception Test (TAT) as a research tool and criticized Benedict's characterization of Japan as a shame culture in contrast to guilt cultures. Vogel (1989) stressed that Benedict's research was not conducted in Japan and that her conclusions made Japanese people seem too bound by social mores. Gardner (1977) granted that although remorse may be more common in Western cultures, it certainly is present in Japan. Najima (1977) emphasized that for the Japanese shame has as crippling an effect as that of guilt in Western Europe.

The definitions of what shame and remorse are also vary. Devos (1974), who also used the TAT as a research tool, related remorse to the Freudian theorization of the Superego and shame to the Ego Ideal. De Rivera (1989a) defined remorse as an emotion in which we take responsibility for our actions and shame as the emotion when we realize we are who we do not want to be. In another article (De Rivera, 1989b) he wonders whether the Japanese experience of *haji* ('remorse') is different from the Western experience of remorse.

When faced by a similar problem of definitions in a trans-cultural research, Hermans (1999) concluded that a consensus exists: shame arises when the standards of proper public presentation are violated, therefore implying an external sanction, whereas guilt occurs when internalized rules have been broken, and does not require the real presence of other people; both feelings are interrelated. Inasmuch as Hermans' definitions are based on a comprehensive review of the existing literature, and they seem to indicate the abovementioned consensus, his are the definitions we have followed for the classification of the TAT stories our experiment design provided.

We specifically hypothesized that the GKT would provide better accuracy rates if the subjects were replying about stimuli that might stir up emotions of remorse and/or shame, using eye blinking as a GKT index. We posited that the exposure to the TAT situation would induce emotional states, states evident through the psychophysiological arousal they would provoke and the subjects' over behavior, namely the blinking of their eyes.

There is mixed evidence about the use of eye blinking as a lie detection index. Cody, Lee, & Chao, (1989) did not find any correlation between deception and eye blinking. In his review on the topic Vrij (2000) cites seven different sources that found no relationship between eye blinking and deceptive utterances (pages 36-37) and places eye blinking among what he calls 'subjective indicators' of deception -meaning non-objective, non-actual ones (page 64), thought to be good deception indexes by professionals but with no empiric basis. Mann, Vrij & Bull (2002) analyzed police recordings and found that crime suspects blinked less frequently and made longer pauses when deceiving than during truthful clips, negating the popular belief amongst both

laypersons and professional lie detectors that liars behave nervously; however, large individual differences were present. Zuckerman (as cited in Cheng, Hiu-wan, Keens, 2004) noted that different degrees of motivations might influence the presence of emotional facial expressions; results indicated that when the stakes are genuinely high deceivers shift around less, move their heads less, gaze less, and blink less than truth tellers.

On the other hand Fukuda (2001), after a set of two experiments that included attention tasks and a GKT, suggested that eye blinks could be related to mechanisms of selective attention and could provide an additional index for the detection of deception.

Cutrow (as cited in Cullen, 2000) assessed a wide variety of physiological measures including breathing amplitude, voice latency, GSR and eye-blink rate; he obtained significant results for eye blinking, although the electrodermal measures remained superior.

We expected the GKT accuracy rates using eye blinking as an index to be lower than that provided by the use of a well-established GKT parameter, the GSK.

Finally, we aimed at investigating whether those two accuracy rates were significantly better than the accuracy expected according to sheer chance.

Method

Participants

Forty-eight Tohoku University undergraduate and post-graduate students volunteered to participate in the experiment; their ages ranged from 18 to 25 years old, the mean being 20.91 and the SD 1.36. Eighteen of them were male and thirty female. Before each experiment, the participants signed a consent form in accordance with the ethical guidelines established by the Japanese Psychological Association.

Apparatus

After the completion of a questionnaire about their personal data, the subjects entered an electrically shielded room where the experimenters attached the skin conductance response meter "BioDerm' model 2701" to them. The participants' psychophysiological responses were amplified outside the room by an NEC Biotop 6R-12 and shown on a computer monitor. The Windows 'PowerLab' model ML780 was used to record and analyze the data. The participants' over behavior (facial expressions and TAT stories) were recorded on VCR tape for further analysis.

Stimuli

Four Western TAT cards were used as guilt/shame-arousing stimuli. The Western TAT was deemed a better choice than the Japanese version of the TAT 'Rinsho Shinri Gaku Kenkyu Kai' since the latter depicts people dressed in traditional Japanese clothes and the clothes worn by the Western TAT characters (pants, shirts, etc.) are the kind of clothes worn in everyday life in Japan nowadays. Since there were no close-ups of the characters, they could be seen as either Caucasian or Asian, consequently allowing the participants to project and identify with them. The Western TAT was also judged reliable because of the findings provided by previous studies Gray (1999).

A special emphasis was placed on the TAT card selection to make sure they elicited the

desired emotional responses. First, we selected those cards in which the human figures were not 'facing' the observer, but looking away. The criterion used was the linguistic and psychological implications of the Japanese idioms: *mentsu ga tsubureru* ('to lose face', connected to feelings of one's own embarrassment), *kao ga tatanai* (to embarrass other people) and *kao ni doro o nuru* ('to throw mud in somebody's face', also with connotations of embarrassment). All these expressions include words that mean 'face' (*mentsu, kao*). Also in European languages there are several expressions linking the emotions of shame and guilt to the facial zone ('to have egg on one's face' in English, '*caerse la cara de vergüenza*' in Spanish). As Levy (as cited by Hermans, 1999) suggests, shame seems to be a universal emotion, present in all human beings despite cultural differences; he also suggests a relationship between shame and guilt.

A second criterion to select the TAT cards was the range of options given to the subjects. The chosen TAT cards depict: (a) a human figure with other people partially seen and with whom there is physical contact, allowing the emergence of feelings of shame (there are 'others' that know the character's transgression: TAT card 18BM, a man clutched from behind by several hands as he looks away). (b) Two human figures (which can be construed as a social situation, but also as a close relationship: TAT card 13MF, a young man standing with his head buried in his arm as a woman behind him is lying in bed). (c) A central human figure placed with other people who remain in the background (ambiguous: the character can be alone or with others: TAT card 17GF, a woman leans on a bridge's parapet with her head downcast; in the background there is a group of men). (d) A human figure alone, allowing the emergence of feelings of guilt (there are no 'others' in the scene: TAT card 3BM, a human figure on the floor, huddled against a couch).

Finally, as a third criterion to select the stimuli, we allowed the participants different possible sexual identifications; the chosen stimuli depicted a male, a female, a couple, and a sexually ambiguous stimulus.

We also modified Murray's original instructions to make sure they elicited the desired emotional responses. The TAT cards were complemented with verbal cues: the words *hanzai* and *tsumi* (crime), *koukai* (guilt), *haji* (shame) and *douyo* (to be in shock for what one has done) were included as part of the instructions to make the story. Lebra (1983) used a similar procedure, showing TAT cards and asking the subjects to insert, in the stories, the noun, verb, and adjective forms of 'shame' and 'guilt'; Finn (1986) used verbal leads as well as the TAT pictures with Japanese subjects.

We used four cards selected from a set of slides used by Buck, Caul and Miller (1974) to study communication of affects as control stimuli since (a) they did not include human figures and the mechanism of projection is facilitated by human stimuli, and (b) they were neither pleasant nor unpleasant. They included a lake and a pier, trees against the skyline, a meadow and a fence, and a small river (neutral stimuli I, II, III and IV respectively). A verbal cue similar to that of the TAT series was used for the neutral cards to equalize both sets of stimuli.

Procedure

We explained to the subjects that their bodily responses would be recorded as they saw some pictures on a 17-inch flat monitor. The participants were told that one of the people in the pictures

had committed a crime; that person was feeling bad about it: maybe guilty because he/she had done something wrong, maybe ashamed because other people knew about it. They had to choose the picture that best expressed that situation: a crime plus the resulting guilt and/or shame. The subjects were given the possibility of focusing on either emotion or on both. The instructions were read aloud and shown on the computer display at the same time. Then the slides were displayed on the monitor. After the subjects selected a card, we asked them to make up a story about it, telling us what had happened before, what was happening then, and what would happen later - as well as what the characters were feeling. Subject were told to speak their thoughts as they came to mind, and that they had up to five minutes. This second part of the instructions was based on Murray's (1943) original instructions for the TAT. The traditional clinical technique of 'intermittent inquiry' (Stein, 1948) was used to make sure the subjects gave a complete story and included the emotional state of the character.

The neutral stimuli were presented to the subjects in a similar way. The subjects were shown the four scenic slides and asked to select a picture neutral to them: one they 'neither liked nor disliked', thus selecting a stimulus choice as emotionally neutral as possible. Then they were asked to make up a story for it, telling us what had happened before, what was happening at that time, and what would happen later, and to speak their thoughts as they came to mind; we did not ask the participants to include any references to emotional states in the story.

The subjects were randomly assigned to two conditions: for twenty-eight subjects the TAT stimuli were shown first and the neutral cards subsequently; another twenty subjects saw the neutral stimuli first, and the TAT cards second. After the subjects selected one of the stimuli (TAT and neutral cards) and told us a story about it, we applied the GKT. Each subject completed three TAT trials and three neutral card trials, six in total.

Data Evaluation: Criteria and Definition of Detection Rate

Since there is no universally accepted criterion for scoring polygraph charts (Vrij, 2000), we used a clearly defined criterion of an exclusively quantitative nature. We counted the subjects' eye blinks for a period of ten seconds after the presentation of each visual stimulus.

Since the experiment was conducted under the guilty knowledge paradigm, all the subjects were known to posses incriminating knowledge. There were no false positives or false negatives; in fact, since we did not follow the guilty person paradigm, there are no 'guilty' and 'innocent' subjects at all. Given that the ground truth was available to us, we knew when the subjects were lying. Every GKT trial included four valid options; we knew the subject had chosen one of them, and therefore when he replied "No" to that question in the GKT he would be lying. We defined those trials where the largest number of eye blinks corresponded with the subjects' chosen card, as a 'successful detection of deception'.

Each subject completed three test trials and three control trials, six in total. Detection rate was defined as the percentage of times the card that the subject had chosen evoked the largest number of blinks when compared with the other stimuli of the trial. Each subject was given two GKT scores based on that rate, one for the control cards and another for the treatment cards, e.g.: 0/3, 1/3, 2/3, or 3/3, equivalent to 0 successful detections in 3 trials, 1 successful detection in three trials, etc. After the completion of the experiment, the GKT scores for TAT and neutral stimuli

were compared.

A similar criterion had been applied to assign accuracy scores to the GKT trials this experiment provided had been used before; in a previous article (Thonney, Kanachi, Sasaki & Hatayama, 2004) we defined those trials where the largest GSR response corresponded with the subjects' chosen card, as a 'successful detection of deception'. GSR responses constituted a reliable index to compare eye blinking-based accuracy scores, since electrodermal responses have been found to be the most accurate single index in experimental settings (Andreassi, 1995; Matte, 1996; Waid & Orne, 1981), providing clear-cut short-term changes that increase as a function of stimulus significance (Boucsein, 1992). Skin responses have also been related to experimentally induced emotional states (Khalfa, Isabelle, Jean-Pierre & Manon, 2002). Finally, the original analyzing system proposed by Lykken for his GKT was solely based on the measurement of skin response amplitudes (Honts & Amato, 2000) and the measurement of the GSR amplitude constitutes an average real-life practice (Matte, 1996).

Results

To ascertain the reliability of the counting of eye blinks carried out by one of the experimenters, a second experimenter performed the same task for 5 subjects, equivalent to 10, 45 % of the sample, and the Pearson Correlation Coefficient was calculated; the resulting coefficient was .977, indicating a high correlation and therefore a high reliability.

The Wilcoxon's matched-pairs signed-ranks test was then applied to determine the statistical significance of the different GKT eye-blinking based scores for the two groups considered: neutral stimuli treatment and emotionally arousing stimuli treatment. The GKT detection rate based on these scores was significantly higher ($z = 1.759$, $p < .05$, one-sided) when the participants replied to remorse/shame-related stimuli, which substantiates our main hypothesis: the technique's precision increased when the subjects lied about emotionally arousing stimuli and eye-blinking was used as an index. Table 1 shows the number of subjects and their accuracy scores (0/3, 1/3, 2/3, 3/3) for both conditions.

The Wilcoxon's matched-pairs signed-ranks test was also applied to determine the statistical significance between the GKT scores provided by the use of the subjects' GSR and their eye blinks as an index. The GKT detection rate based on GSR scores was significantly higher ($z = 2.593$, $p < .01$, one-sided) than the accuracy scores provided by counting the subjects' eye blinks, which corroborates the long-standing use of skin responses in lie-detection contexts. Table 2 shows the number of subjects and their accuracy scores (0/6 1/6 2/6 3/6 4/6 5/6 6/6) for both indexes.

Finally, the Binomial Test was applied to determine the statistical significance of the difference between the GKT scores provided by the use of the subjects' eye blinks and the accuracy expected by sheer chance. The GKT detection rate based on eye blinks was significantly higher ($p < .05$, one-sided) than the accuracy expected by pure chance for the TAT condition, but the difference between the GKT eye blinking-based accuracy and the chance rate for the Neutral Stimuli condition was not significant ($p > .05$, one sided). The Binomial Test was also

applied to determine the statistical significance of the difference between the GKT scores obtained from using the GSR amplitude and the accuracy expected by sheer chance. The GKT detection rate based on GSR amplitudes was significantly higher $(p < .01$, one-sided) than the accuracy expected by pure chance for both conditions, that is to say the control and the treatment group.

Table 1   *Hypothesis: the GKT precision would increase if the subjects lied about emotionally arousing stimuli using eye blinking as index: number of subjects and scores for both conditions. The hypothesis was proven (z = 1.759, p < .05, one-sided)*

		Neutral Condition			
		0/3	1/3	2/3	3/3
	0/3	12	1	1	2
TAT	1/3	7	8	4	0
Condition	2/3	9	1	2	0
	3/3	0	0	1	0

Table 2   *Hypothesis: The traditional GKT scoring index, the GSR, would provide better accuracy scores than the use of eye blinking: number of subjects and scores for both indexes. The hypothesis was proven (z = 2.593, p < .01, one-sided)*

		Eye-blink scores						
		0/6	1/6	2/6	3/6	4/6	5/6	6/6
	0/6	1	0	2	1	0	0	0
	1/6	1	1	0	0	1	0	0
GSR	2/6	1	3	5	1	0	0	0
scores	3/6	3	2	2	0	0	1	0
	4/6	2	0	2	1	0	0	0
	5/6	0	1	2	0	0	0	0
	6/6	0	0	1	0	0	0	0

Discussion

Our experimental design aimed to induce in the participants the emotional states present during real polygraph interrogations. By using the participants' skin responses amplitude as an index (Thonney, Kanachi, Sasaki & Hatayama, 2004), the use of TAT cards as emotionally arousing stimuli rendered significantly higher lie-detection scores than the use of neutral stimuli; the induction of an emotional state can therefore be assumed since the scoring of the GKT is based on autonomic disturbance, and although emotion may not be so simply identified with arousal, it is directly correlated with it (Hebb, 1965). Since the stimuli (visual and verbal) were structured because of their connection to the emotions of guilt and shame, the assumption, albeit preliminary, that those were very likely the two emotions aroused, deserves consideration; the analysis of the participants TAT stories (Thonney, Kanachi, Sasaki & Hatayama, 2005) gives strength to this interpretation.

More importantly, the analysis of the subjects' overt behavior also provided statistically significant results. By using the participants' eye blinking as an index the use of TAT cards as emotionally arousing stimuli rendered significantly higher lie-detection scores than the use of neutral stimuli; these results strengthens the importance of the GSR-related findings, and the way we interpreted them. GSR was significantly better as a lie detection index, an expected result, but even eye blinking was an accurate index to score the GKT for the treatment condition. Electrodermal responses proved significantly better than chance for both the treatment and the control groups, but eye blinking proved better than chance level only for the former.

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