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The enhanced motivation to deception in Machiavellianism and the Validity of the P300-Based Guilty Knowledge Test*

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The present study examined whether enhanced motivation for beating deception detection measures in people who score high on the Machiavellianism scale improves the detection efficiency of P300-based GKT. Forty-six participants chose for themselves to be deceptive or honest in a mock crime procedure based on information or feedback they would be given following the result of physiological detection. There were significant group difference in Machiavellianism scores between the guilty group and the honest group, which allowed us to confirm the fact that the people who score high on the Machiavellianism scale have predispositions for duplicity and lying over honesty. After experiencing a mock crime, the P300-based GKT was carried out. An one-way ANOVA revealed that only in guilty group, the P300 amplitude of the crime relevant item (the probe) was significantly higher than that of irrelevant items. However, when we conducted an ANCOVA by designating Machiavellianism as a covariate, this difference between the crime relevant item and the irrelevant items was not observed. This result implies that the increased motivation in manipulative people to cope with the deception measure may have an ironical role of improving the detection efficiency of the P300-based GKT.

Key words : P300-based GKT, Machiavellianism, motivation, mock crime

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Physiological responses governed by the autonomic nervous system, including skin conductance response (SCR), heart rate (HR), and respiration, are typically utilized to assess emotional arousal associated with lying. However, these measures provide an indirect view of the complex brain processes underlying deceptive behavior (Abootalebi, Moradi, & Khalilzadeh, 2006). Therefore, polygraph tests based upon autonomic responses have been challenged for decades (Rosenfeld, Soskins, Bosh, & Ryan, 2004). To circumvent these shortcomings, researchers began to examine the brain itself using two main techniques: functional brain imaging and recording of brain potentials. Among them, Event Related Potential or brain potential-based methods, are the most widely studied and often yield satisfactory results (Rosenfeld, 2002; Farwell & Donchin, 1991).

In ERP-based methods, the endogenous ERP, the P300 wave, has been utilized as an index of deception. The P300 wave is evoked by recognized, meaningful, and rare items (Johnson, 1986). Therefore, if an item is presented during testing that only a guilty person would recognize (concealed information), that item is expected to elicit high amplitude P300 readings. The P300 is usually largest in the parietal area and smallest in the frontal area (Rosenfeld et al., 2004). To use P300 for deception detection, a method of polygraph interrogation called the Guilty Knowledge Test (GKT) is administered. In a P300-based GKT paradigm, participants are presented with three types of items in random order:

1) Probes refer to crime-relevant items that are known only to the guilty person or others that have familiarity with the crime (e.g., witnesses, investigators). To the guilty person, when presented with the probe item, the crime -relevant knowledge that the guilty possesses elicits a large P300 wave because the item is meaningful to the guilty person and rarely presented (e.g., presented only 10% of the time). However, to an innocent person, who does not have any concealed knowledge of the item, the probe is no different from other crime-irrelevant items. Therefore, when the probe is presented to an innocent person, it is expected to elicit a small P300 wave or no P300 response at all.

2) Irrelevants are presented most frequently (e.g., 80% of trials) and are not important to the task itself. To both the guilty and innocent, irrelevant items are not meaningful. Therefore, they elicit small P300 waves or no response at all. Irrelevants can be used as comparison items, providing template ERPs in response to unfamiliar items.

3) Targets are irrelevant stimuli and that require participants to perform a task. For example, participants may be asked to press a button whenever they see the target item but not when they see probes or other irrelevant items. Since subjects are only asked to respond

to the target items, they are recognized as distinct, rare, and task relevant stimuli. Therefore, targets elicit large P300 amplitudes in all participants (both guilty and innocent).

A deception detector can compare this prototypical P300 component elicited by the probe to the P300 amplitude of the irrelevant items. If the subject has crime-relevant knowledge, thereby recognizing the probe, the P300 wave related to the probe might be greater for the P300 amplitude of an irrelevant item. However, if the person does not recognize the probe item, and is therefore innocent, the P300 wave elicited by the probe item would be more similar to the P300 amplitude of the irrelevant items.

Use of ERP-based deception detection alternatives, as described above, could assess the perpetrator's recollection of the crime, and do not rely on the emotional arousal of lying. Studies of P300-based GKT have demonstrated it to have sufficient validity for applied uses (Mertens & Allen, 2008), with positive identification rates reaching as high as 89% (Rosenfeld et al., 1991) to 95% (Allen et al., 1992).

However, a great deal of doubt has been raised concerning this well-known effective psychophysiological deception detection measure. Since many studies have detected autonomic hyporesponsivity in subjects with antisocial personality disorder (Verschuere, Crombez, Koster, & De Clercq, 2007), the same indices used to measure autonomic nervous system responses in deception detection tests, doubts have been raised regarding its detection efficiency. This autonomic underarousal has been found to appear in various ranges of personality, not only psychopathy, but also criminality, conduct disorder, antisocial personality disorder, and among people who scored high in the personality component of manipulativeness and the social deviance component of psychopathy (Verchuere et al., 2007).

Therefore, there is a need to confirm whether the GKT still has adequate sensitivity when applied to antisocial individuals. Three studies have investigated the validity of GKT in antisocial individuals. Although the hypothesis was that the autonomic hyporesponsivity is related to the lower detection efficiency, all of these studies supported the validity of GKT in criminals (Verchuere et al., 2007).

In addition to autonomic hyporesponsivity, antisocial individuals also have unique psychological features, including predispositions for duplicity and lying over honesty (Jung & Lee, 2009). A strong preference for lying in various interpersonal and detection situations have been shown as a unique psychological feature for this antisocial population. In various antisocial related personality constructs, Machiavellianism has been shown to be related to this unique tendency, in that people who show strong Machiavellian traits are better at lying and tend to choose lying above honesty.

They also tend not to act surprised when they are right fully accused of cheating, in response to which they fabricate plausible denials (Gozna, Vrij, & Bull, 2001). Their basic motivation for choosing deception above honesty has also been shown with various implicit measures, indicating that they have a positive implicit attitude towards telling a lie, which results in them lying more frequently in various situations (Snowden, Gray, Smith, Morris, & MacCulloch, 2004; Jung & Lee, 2009).

In the P300 based GKT test, the recognition of concealed crime relevant information is known to be responsible for the P300 increase. However, in several recent studies, the role of motivation was also found to be an important variable in increasing the P300 amplitude. For example, Allen and Iacono (1997) provided an incentive to participants in order to enhance motivation to deceive. This resulted in the increase of detection accuracy using the P300 amplitude. Another recent study has examined the effect of instruction, which increases motivation in the P300-based GKT (Kubo, & Nittono, 2009). In this study, there were two conditions: participants were either instructed, or not instructed, to make an effort to beat the deception detection measure by concealing information. In both conditions, participants were told to choose an item and remember what it was. However, the P300 amplitude was greater in the condition where the participants were instructed to deceive and make effort to be not detected. This result suggested that although the P300 can be generated by mere recognition, the role of motivation can have a magnifying effect on the P300 amplitude.

In the above studies, the motivation to beat the detection procedure ironically resulted in the increase of the P300 amplitude, which in turn led to higher detection efficiency. Also, the results are in line with findings of the GKT, which is based on autonomic responses, showing that motivation to avoid detection was not only ineffective, but often increased detection instead (Kubo & Nittono, 2009).

To our knowledge, no studies have examined whether the P300-based GKT is valid when used on people who are accustomed to telling lies and are fully motivated to do so. Since it was found that motivation for wanting to beat the polygraph ironically improves test results, and that the motivation for telling a lie and deceiving is known to be high in those who score high on the Machiavellian scale, the validity of the P300-based GKT is expected to be better in those people who demonstrate Machiavellianism scale related traits.

When testing the detection efficiency of P300-based GKT studies in the laboratory, two paradigms are typically used: a mock crime procedure (Farwell, & Donchin, 1991) and an autobiographical variant (Miller, & Rosenfeld, 2004). For the mock crime procedure, certain participants are required to commit a mock crime. Afterwards, a GKT is administered to

find out how well this test discriminates "guilty" and "innocent" participants.

The second paradigm is an autobiographical variant. Participants are asked whether they recognize items that are presented, among which personal information is included. The detection efficiency of the measure is tested when participants lie about recognizing personal information.

Using these and other procedures in laboratory research, the detection efficiency of GKT has been shown be reasonably high. Even though laboratory studies control external influences well, the facts remain that they are not realistic and primarily involve college students with no stakes, and therefore concerns have arisen regarding the validity of the test environment and generalization of the results of the studies.

One of the problems that have been pointed out is that laboratory settings cannot yield realistically high stakes (Seth, Iversen, & Edelman, 2007). In real life settings, the perpetrator of the crime could avoid the punishment or even get a reward through successful deception. However, in a laboratory setting participants experience little punishment or reward. In other words, high stakes situations are realistic, while laboratory settings are low stakes situations. The amount at stake is directly related to the emotions and motivations the participants feel and this could influence the results of the GKT, since the GKT primarily aims to detect crime-relevant knowledge instead of directly asking about participation in the crime (Lykken, 1974).

Increasing motivation levels in laboratory mock crime settings could be a successful way in achieving high detection rates. Various ways have been proposed to raise the motivation of the subject in an unrealistic experimental setting. Among these, three methods have been found to be effective. In previous studies, the most often used method was to offer a financial reward for successfully performing and completing the task (Gamer, Rill, Vossel, & G ödert, 2006). Second, instructions have also been a useful method in increasing motivation. By simply instructing the participants to beat the polygraph, detection efficiency increased (Kubo & Nittono, 2009). The third method is to conduct a polygraph examination in a field setting. Several studies have carried out deception detection procedures in an actual law enforcement agency with a professional deception detector (for example, the police department).

In our study, we sought to use every available method, proven to be effective in previous studies, to increase participants' motivation in a laboratory mock crime to be able to achieve a high detection rate. However, in the present study, one additional experimental manipulation was adopted, which is to levy penalties against those who do not cooperate with the detection procedure. In most criminal cases, there exists a greater probability of being penalized than rewarded at the end of the

deception detection procedure. Therefore, four ways have been devised to enhance participants' motivation: 1) monetary compensation; 2) penalty, which in this case is to take away cell phone privileges from the subjects; and 3) instructions, in which participants were told they would be given a reward if they successfully beat the polygraph test; and 4) inform participants that the detection procedure will take place at an actual criminal investigation agency, and that the interrogation will be performed by a professional employee.

To summarize, in this study there were three issues we wanted to investigate. First, we aimed to see how people who are high on the Machiavellianism scale cope with deception detection using physiological measurements. There are studies that show the frequency of deception committed by these people, as well as situations in which Machiavellians tell lies during various interpersonal interactions (Exline, Thibaut, Hickey, & Gumpert, 1970). However, it has not been shown that these antisocial individuals still choose to deceive, even in a professional deception detection situation utilizing physiological measurement techniques. Second, as manipulative people are known to be highly motivated to lie, we aimed to test whether this personality trait has an effect in detection efficiency when the P300-based GKT was used. Due to the fact that previous studies have shown motivation to deceive ironically increases detection efficiency, we expect the P300-based GKT to remain valid when conducted on people possessing Machiavellianism traits. Finally, we designed a mock crime within a laboratory setting to enhance motivation to deceive, being that increased motivation levels have been known to augment the effectiveness of detecting deception.

Methods

Subjects and risk manipulation

In the present study, in order to create a realistic mock crime environment, we created a situation in which none of the participants knew each other. To maintain an impression of realistically high stakes, a significant monetary compensation or penalty was attached to a participant's success or failure in completing the lie detection task. We recruited participants through an Internet job search engine (www.albamon.com). All applicants were asked to provide demographic information, including education from elementary school to university, as well as history of residence, so that we could ensure that they were not acquainted with one another. We also asked applicants if any friends were participants and if the answer was 'no', we selected the applicant to be a participant in this study.

Forty-six male undergraduate students were recruited as subjects. Prior to the test, the

participants were told that the experiment was designed to assess whether they could pass a polygraph test. In line with previous research, motivational instructions on self-esteem were provided (e.g., Gamer et al., 2006) and a financial reward was offered for successful performance of the task. The experiment and associated rewards were explained to subjects, and they were allowed to decide whether they would be honest during the deception detection task or whether they would lie.

The basic monetary compensation for participation was 15,000 Won (～$13 USD) for all participants. Subjects who chose to be honest and pass the polygraph test were paid an additional 15,000 Won for a total of 30,000 Won (～$26 USD). However, subjects who chose to lie and successfully defeated the deception detection test received a bonus of 50,000 Won (～$43 USD) as a reward. Subjects who lied and failed the polygraph received no monetary compensation, including the basic payment of 15,000 Won, and also had their cell phones confiscated for one week by the experimenter, with the permission of the subjects (Table 1).

The mean age of the participants was 23.59 ± 3.77 years old. There were 23 participants each in the guilty and in innocent groups. Twenty-three pairs were formed, with each pair including one guilty and one innocent participant, and both subjects participating in the study on the same day. There was no significant age difference between the guilty (M = 23.83, SD = 3.74) and innocent (M = 23.35, SD = 3.87) ($t(44)$ = .426, p = n.s.) cohorts.

Procedures

Each pair of guilty/innocent subjects participated in the experiment on the same day according to the same schedule. The experiments were carried out on two consecutive days. On the first day, participants arrived at the laboratory at Chung-Ang University, Seoul, Korea and immediately completed a questionnaire. After a brief explanation of the experiment, participants experienced a mock crime and then took a P300-based GKT test. On the following day, a polygraph test was obtained by professional polygraph examiners

Table 1. The monetary compensations that each participant got according to the deception detection result and the groups they were belonged (won)

Test result	Guilty	Innocent
Success	15,000(basic payment)+50,000 / total 65,000	15,000(basic payment)+30,000 / total 45,000
Fail	Confiscation of cell phone with no basic payment of 15,000	15,000 (only basic payment)

who are working in the Supreme Prosecutors' Office, a Korean law enforcement agency. This test result of the polygraph test carried out it the Supreme Prosecutors' Office was not analyzed in this study. All participants were debriefed by phone shortly after the polygraph examination was finished.

Personality construct of Machiavellianism

Machiavellianism was measured using a version of the Machiavellianism scale (20 items, Cronbach's alpha = 0.70) (Christie, & Geis, 1970), which consists of a four-point Likert-type scale. An example of a test item is, "Anyone who completely trusts anyone else is asking for trouble." All scores were totaled, with the highest score the participants could receive being 80. Higher scores indicate greater manipulative personality constructs.

Mock crime procedures and the P300-based GKT

The mock crime was staged on the first day in the laboratory at Chung-Ang University. Each pair of participants arrived together. The participant who chose to lie was made to be the perpetrator of the mock crime, and the participant who chose to be honest became the witness to the mock crime. Both participants entered the same room at the same time and acted in accordance with the instructions they were given. The instructions they were given are described in Table 2.

Each participant received an instruction sheet describing a total of six behaviors. The mock crime scene was recorded using a video camera and monitored by the experimenter through a one-way mirror.

The participant who perpetrated the mock crime was instructed to remember the amount of money and the details of the credit card that he stole. These two items (amount of money and the type of credit card) were utilized in the P300-based GKT as the crime-relevant knowledge (the guilty knowledge).

Following the mock crime procedures, the P300-based GKT was administered. An experimenter, who was unaware of the experimental condition the examinee had been assigned to, attached the electrodes and conducted the examination. In line with previous research, motivational instructions on self-esteem were given, which imparted that the task was difficult and that only people with strong will, superior intelligence, and emotional self control can perform it successfully (Elaad and Ben-Shakhar, 2006).

In the P300-based GKT, two different questions were presented, each referring to different crime-relevant items (a picture of 110,000 Won and the credit card), target items, and irrelevant items. All items were visually presented on a monitor. Following the question,

Table 2. Instructions to Participants

1. Instructions for both participants:

Music is playing in the room you enter. Until the music is over, drink the juice on the table and introduce yourself to each other.

1) Add water to the flowerpot.
2) There are two blinds in the window. Draw one of the blinds.
3) Several books are in front of the white board near the bookshelf. Shelve three of these books in the bookshelf.
4) Drink the juice in the cup on the table in the center of the room.

2-1. Instructions for the witness (innocent group)

5) There is a suit jacket hanging near the window. Remove the dirt from the jacket, put the jacket on, take it back off, and place it back on the hanger.
6) Find an A4-sized piece of paper and an envelope in the book which is on the table in the center of the room. Put the paper in the envelope and seal it with the stapler. Place it in your pocket.

2-2. Instructions for the mock crime (guilty group)

5) There is a suit jacket hanging near the window. Remove the dirt from the jacket and put the jacket on. There is *money* and *a credit card* inside the pocket of the suit jacket. Steal *that money (110,000 Won)* and the *credit card*. Count the money and check the type of credit card, and remember this information. Return the jacket to the hanger.
6) Find an empty envelope in the book which is on the table in the center of the room, put *the money* and *the card* that you stole into the envelope, and seal it with a stapler. Place the envelope in your pocket.

"Is this item what you saw?" subjects were shown a Bernoulli (random) series of three crime-irrelevant items, one crime-relevant item (the probe item), and one the target item within each question.

Each item (518 × 370 pixels) was repeated 40 times, and was presented for 1000 ms on a display screen 1 m from the participants' eyes. The interstimulus interval was three seconds. After the attaching the electrodes and starting the recording, all participants were told to pay attention to the display screen, and press a "yes" button for the assigned target items, indicating target recognition, and a "no" button for all other stimuli (consisting of one probe and three irrelevants) immediately after the presentation of the stimuli.

After the test was completed, the electrodes were detached, and all participants were debriefed.

Data acquisition

All EEGs were measured in a recording room. Raw EEG data was acquired using a Laxtha EEG. Four silver electrodes were placed on each

subject's scalp using electrode glue and the 10/20 system of electrode placement at sites Cz, Pz, P3, and P4. Analysis was confined to site Pz. Ground and reference electrodes were set below the both ear. The scalp electrodes were referenced to the linked mastoids. Amplifier output was passed to a 12-bit A/D converter sampling at 256. All impedances were maintained at 5kΩ or less. The bandpass was 0.05-50.00 Hz and a 60 Hz notch filter was applied. Trials contaminated by artifacts in which the EEG exceeded ±100 μV were rejected. Epochs free of artifacts and incorrect responses were averaged by condition to create ERPs for each stimulus type. The P300 component was measured using a peak to peak method (Rosenfeld et al., 2004). Maximum positivity between 300ms to 1000ms was identified first, and maximum negativity was found afterwards. The difference between the positivity and the negativity was defined as the P300 amplitude (Soskins et al., 2001).

Results

EEG raw data from six participants, three from the innocent group and three from the guilty group, were lost due to technical difficulties. The data from two other participants in the innocent group were also removed from analysis due to excessive EEG artifacts. Data from a total of 18 "innocent" recordings were compared with 20 "guilty" recordings.

Personality construct of Machiavellianism

To assess whether the guilty obtained higher Machiavellianism scores than the innocent, a *t*-test was performed to analyze the sums of scores. As expected, Machiavellianism scores were significantly higher in the guilty (M = 48.80, SD = 5.32) than the innocent (M = 43.05, SD = 5.25) [t (36) = 3.34, p < .01, d = .96] (Table 3). These results indicate those who chose to lie exhibited higher degrees of

Table 3. Summary of the one-way ANCOVAs the results for the items in the P300-based GKT (μV) and the result of the one-way ANOVA for the Machiavellianism.

	INNOCENT	GUILTY	F (1, 36)
Machiavellianism	43.05 (5.25)	48.80 (5.32)	11.19**
P300 Target	10.06 (6.42)	11.88 (6.86)	1.59
P300 Probe	8.02 (5.06)	14.56 (7.92)	4.73*
P300 Irrelevant	7.71 (4.35)	8.51 (5.07)	2.32

* p<.05 ** p<.01

Machiavellianism.

Validity of the P300-based GKT

The analysis of Machiavellianism in the guilty and innocent groups suggested basic differences in personality traits between the two groups. To assess whether or not these personality differences affected the validity of the P300-based GKT, a 2 (Group: Guilty and Innocent) × 3 (Item: Target, Probe and Irrelevant) ANCOVA (analysis of covariance) was conducted, with covariance for Machiavellianism. We report only results obtained from site Pz, since the P300 was found to be maximal at the parietal site in previous studies. Analytic procedures were also performed only on the Pz data (Abootalebi et al., 2006). The results of the 2 (Group) × 3 (Item) ANCOVA revealed a significant interaction of Group × Item ($F(2, 70) = 3.63$, $p < .05$). To decompose the interaction, three separate one-way ANCOVAs were conducted on each item (Table 3), with Machiavellianism as a covariate. There was a significant group difference only in the probe item ($F(1, 36) = 4.73$, $p < .05$). For the target ($F(1, 36) = 1.59$, p = n.s.) and irrelevant ($F(1, 36) = 2.32$, p = n.s.) items, no significant differences were observed between the two groups.

The P300 waveforms are depicted for each group and item type in Figure 1. Visual inspection revealed that in both groups, the guilty and innocent, the P300 amplitude was augmented in response to target items and the irrelevant items generated the smallest P300 amplitudes. However, only the responses to probe item exhibited different patterns. In the guilty group, the P300 amplitude of the probe item exceeded that of the target item. In the innocent group, the P300 amplitude generated by the probe item was much smaller than the amplitude generated by the target item and similar to the P300 amplitude yielded by the irrelevant items.

To confirm the results, three separate ANOVAs for target versus probe, target versus innocent, and probe versus innocent, were conducted for each group.

For the guilty group, the target produced significantly larger P300 amplitudes than did the irrelevant items (guilty: $F(1, 19) = 8.64$, $p < .01$) and marginally for the innocent ($F(1, 17) = 4.15$, $p = .058$). In the guilty group, the P300 amplitude of the probe was similar to that of the target ($F(1, 19) = 1.75$, p = n.s.) and was significantly larger than that of the irrelevant items ($F(1, 19) = 11.23$, $p < .01$). However, in the innocent group, the opposite pattern is displayed. Unlike the guilty group, the probe amplitude was more like that of the irrelevant items than of the target. There were no significant differences between the irrelevant items and the probe ($F(1, 17) = 0.06$, p = n.s.).

These results indicate that the guilty group had concealed knowledge of crime-relevant stimuli so that the P300 of probes were as

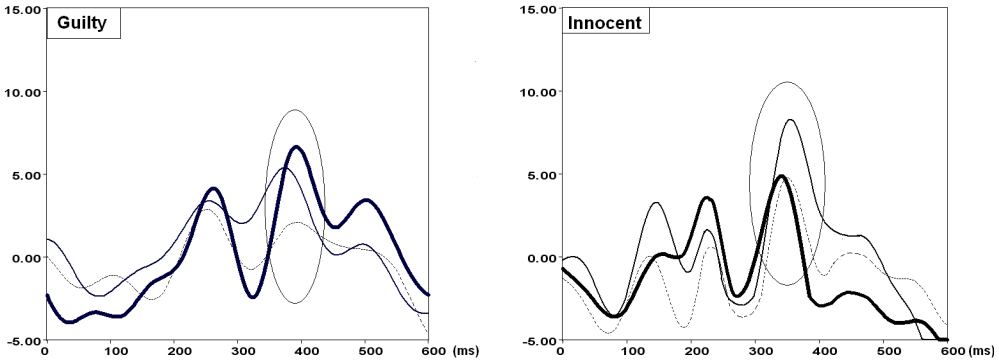

Figure 1. Superimposed, grand-averaged P300 waves (μV) in the Guilty (left) and the Innocent (right) groups. Probe (——), irrelevant (------), target (———) at site Pz. Innocent: probe is similar to irrelevant, but target towers over probe and irrelevant. Guilty: probe is similar to target and towers over the target, but the irrelevant are very low.

large as the amplitudes generated by targets. To confirm whether Machiavellianism affected the validity of the P300-based GKT, we performed three separate ANCOVAs for target versus probe, target versus innocent, and probe versus innocent, for both groups.

Unlike the results from the ANOVA, there were no significant difference between the P300 of the probe and the irrelevant items ($F(1, 19) = 0.48$, p = n.s.) in the guilty group. The probe item should a yield larger P300 amplitude than that of the irrelevant items if the person is guilty and possesses crime relevant knowledge. With the ANOVA, there were significant differences between two items, the probe and the irrelevant items. However, when controlled using Machiavellianism, the differences between the two items were not observed. These results indicate that Machiavellianism might have affected the P300-based GKT.

Discussion

In the present study, we confirmed the relationship between Machiavellianism and the P300-based GKT. The personality construct of Machiavellianism has been shown to indicate a propensity to commit deceptive acts. Therefore, it was expected that individuals possessing Machiavellianism traits would choose to deceive if they were given the option of telling a lie or being honest, and would be especially motivated to deceive others. Previous research on deception detection using ERP has shown the role of motivation. The motivation and effort that people demonstrate while trying to beat a polygraph test ironically enhance autonomic responses, such as the P300 wave, making it easier for them to be detected. Thus, the increased motivation that Machiavellian individuals have for telling lies may affect the

validity of the P300-based GKT. In line with previous research, it was expected that the enhanced motivation to beat the detection measure might ironically have increased the validity of the P300-based GKT.

We first confirmed whether high-scoring individuals are actually more likely to lie than others in the same situation. In previous studies, people who had high Machiavellianism scores were the more likely to engage in high-stakes lies (Gozna, et al., 2001). Not to our surprise, in our study as well, people who scored high on the Machiavellianism scale were more likely to choose to lie.

Although we found that there was a fundamental difference between the guilty and honest group in their Machiavellianism scores, we wanted to confirm the effect of enhanced motivation for deception using the P300-based GKT. Statistical analysis using an ANOVA revealed a clear difference of the P300 amplitude between the probe and irrelevant items in the guilty group. This indicated that the crime -relevant knowledge the guilty individuals possessed yielded a significantly large P300 wave. However, when controlling for Machiavellianism by using an ANCOVA, the difference between the probe and irrelevant items was no longer significant. This result shows the possibility that enhanced motivation coming from having Machiavellianism traits may have augmented the P300 wave.

Not only does motivation yielded from individual traits influence the validity of the psychophysiological measure of deception detection, but various other factors that enhance participants' motivation have an effect as well. Providing monetary compensation and motivational instructions turned out to be effective in some studies. Using an actual field setting, for example, using the examination room of a police station may make participants perceive the experiment as more realistic. To enhance basic motivation levels, and for the deception detection procedure to be more immersive, we adopted all three methods found in previous research: monetary compensation, motivational instruction, and examination environment (actual law enforcement agency). In the present study, one additional method to enhance motivation was devised. In most criminal cases, there exists a greater probability of being penalized than rewarded, following the detection of deception. Therefore, we imposed a penalty on the participants if they faile d in convincing themselves as innocent.

First, monetary compensation was provided. To maximize the stakes, we raised the reward to 50,000 Won if the guilty succeeded in passing the deception detection test. Since the legally -mandated wage for a part-time job in Korea is 4,110 Won/hr (in 2010), it was a relatively large amount of wage to our participants.

The second approach we used was to take away the participants' cell phones if the guilty failed in being proven to be innocent. This

condition of providing for a penalty has not been utilized much in other studies. Concerns surrounding the ethical aspects of penalizing participants could be one of the reasons. However, in most criminal cases, criminals, if they fail to cope with the deception detection measure, are punished with various penalties. Before the participants decided whether to choose to lie or be honest, we informed them of all the conditions involving the reward or penalty they would receive depending on the result of the deception detection. All participants agreed to participate in the study under these conditions and decided for themselves whether to lie or be honest.

The final approach was to take the deception detection task in a real field setting, the prosecutors' office, with a professional polygraph detector who is employed in the field. Although the P300-based GKT was performed by university researchers in a campus laboratory, the results were analyzed in a real prosecutors' office the next day using professional detectors. Before the experiment, we told the participants that all the results obtained with physiological deception detection equipment would be analyzed by a professional lie detector working in the field. Thus, even though the participants did not take the P300-based GKT in the prosecutors' office, they were coached to believe that their results would be examined by professional lie detectors. Efforts to maintain the perception of a high-stakes situation should be undertaken in future laboratory experiments, as they aid in the generalization of the results of the detection measure.

By Enhancing motivation to the deception detection, participants can be more immersed in the experiment. Also, the detection efficiency could be raised. Increasing the motivation to detection procedure in this study served one additional purpose, to confirm whether we were able to generalize the results of this study, as most criminal cases are high-stakes situations to the perpetrators of the crime.

Present study utilized mock crime procedure, the most frequently used method (Verschuere et al., 2007), to test the validity of the detection measure. However, this method has critical problems in terms of generalization of results due to the limitations posed by artificial experimental environments. First of all, unlike real situations, the participants do not feel guilty about the crime they have committed due to the fact that they are only following instructions.

In addition, the stakes are usually not as high as those of a real crime, in which the consequences may include a prison sentence or a heavy fine. However, in previous laboratory studies, there are usually small monetary rewards and almost no penalties (DePaulo et al., 2003). These conditions could directly affect the level of motivation the examinees possess and, since the GKT test measures the emotional and cognitive patterns related to lies but not the lie itself, generalization of test results obtained in such

laboratory studies could be problematic. Therefore, if it is possible, conducting the controlled P300-based GKT investigations in conditions approximating field conditions would be optimal for testing the validity of the deception detection measure. Since this is difficult to achieve in the laboratory, many studies have sought to create more realistic environments by emulating field settings to help further validate the use of the P300-based GKT in such settings. Recently, with advances in technology, studies have started to use virtual environments for building mock crime scenes as they are easily replicable and can be highly realistic (Mertens and Allen, 2007).

In our study, we sought to create a mock crime which could impose high stakes on the participants by using methods that have previously been proven to be effective, such as monetary compensation, so that participants could more be immersed in the detection procedure. Even though all these methods were proven to be effective ways to motivate participants, in our study, we did not actually measure motivation levels of the participants, given that motivation has been found to affect to the validity of psychophysiological measures (Allen, & Iacono, 1997; Verschuere, Rosenfeldd, Winograd, Labkovsky, & Wiersema., 2009, Kubo, & Nittono, 2009). This limitation of our study could be researched in greater detail through elaborated methods to find out the exact role of motivation in psychophysiological measurements.

Some critical issues have been raised in recent studies regarding the possible vulnerability of P300-based GKT to "countermeasures" (Rosenfeld, et al., 2004; Mertens, & Allen, 2007). Honts, Devitt Winbush, and Kircher (2001) have defined a countermeasure as "anything that an individual might do in an effort to defeat or distort a polygraph test." In early-stage research on the P300-based GKT, Lykken opined: "Because such potentials are derived from brain signals that occur only a few hundred milliseconds after the GKT alternatives are presented, and because as yet, no one has shown that humans can alter these brain potentials at will, it is unlikely that countermeasures could be used successfully to defeat a GKT derived from the recording of cerebral signals" (Lykken, 1998). Intuitively, this sounds reasonable. However, according to a sizable body of research conducted on ERPs, it turned out that the manipulation of P300-based GKT is possible with knowledge concerning how to defeat these measures and with simple training in doing so.

In our study, when asked, all participants reported that they did not have experience with taking physiological deception detection. Also, the P300-based GKT effectively discriminated between the two groups. However, since there are possible methods available to defeat the P300-based detection indices (Rosenfeld et al., 2004), there would exist the potential danger of

normal people using these methods if they find themselves in legal trouble. In particular, as it was found in our study and in line with other research, people who score high in Machiavellianism have higher tendencies toward engaging in deceptive behaviors in such situations where the stakes are high, and therefore there are possibilities that those manipulative people would attempt to use countermeasures once they understand the methods. Our study did not consider this possibility and, nonetheless, the P300-based GKT was still effective in discriminating among the two groups. It would be interesting to explore the ability of the people who score high in Machiavellianism to "deceive" detection measures if they are taught about countermeasures.

In this study, we conducted all experiments in a sample of normal university students. Among the study population, people who chose to lie displayed a significantly higher degree of Machiavellianism than that of those who chose to be honest. Even though their traits in duplicity and propensity to lie were different, they were still considered members of the normal population. There are many psychopathic criminals who are extremely deceitful and pathologically deceptive. We have not tested our hypotheses on such individuals. It would be desirable to test the hypotheses of this study with a population of highly psychopathic people.

To conclude, the present study was able to show the effects of Machiavellianism on the P300 in the GKT. People who scored high on the Machiavellianism scale chose to lie in the present experiment themselves. Their high motivation to beat the detection measure ironically increased P300 values in the GKT, which ultimately yielded to correct detection results.

We were also to confirm the tendency that people who score high on the Machiavellianism scale tend to choose deception over honesty.

The accurate detection results observed in our study might have been generated by all those elaborated instructions, which induce increased motivation. Past research has emphasized the importance of optimal task instructions in improving detection rates. We suggest future laboratory studies to consider applying conditions that can further motivate participants.

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마키아벨리즘의 거짓행위 관련 동기와 P300-기반 유죄지식검사와의 관계

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본 연구는 마키아벨리즘 성향이 높은 사람들의 거짓말 탐지를 속이고자 하는 동기가 P300 기반 GKT의 탐지효율성에 미치는 영향을 확인하고자 하였다. 46명의 참가자는 실험 참여 전, 제시된 실험 조건에 따라 스스로 거짓말을 할지 사실대로 진술할지를 결정하였고, 이렇게 나누어진 두 집단 간에 마키아벨리즘성향은 유의미한 차이를 보였다. 이러한 차이는, 같은 상황이라도 마키아벨리즘성향이 높은 사람들이 거짓말을 선택한다는 것을 확인시켜 주었다. 다시 두 집단을 대상으로 P300 기반 GKT를 실시하여 일원변량분석 한 결과, 유죄집단이 범죄관련자극에서 비관련자극보다 P300 진폭이 유의미하게 높은 차이를 보였고, 무죄집단에서는 이 차이가 유의미하지 않았다. 한편 마키아벨리즘의 영향을 살펴보기 위해 이를 공변량으로 설정하고 다시 공변량분석을 한 결과, 유죄집단에서 나타나던 두 자극 간의 진폭값 차이가 더 이상 유의미하지 않았다. 이러한 결과는, 마키아벨리즘 성향의 거짓말에 대한 증가된 동기수준이 오히려 P300 기반 GKT의 탐지효율성을 높이는 결과를 초래한다는 것을 확인시켜 주었다.

주요어 : P300 기반 유죄지식검사, 마키아벨리즘, 동기, 모의범죄