COGNITIVE LOAD WHILE HAVING THE INTENTION TO DECEIVE

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ABSTRACT

A lot of research has been done on deception- and deception detection. We state that deception cannot be seen as a process of just a few moments, and thus cannot be reduced to just the lie(s) itself. We do weight the importance on another concept in deceptive behavior: the intention to deceive. It is likely that the intention to deceive characterize liars, but very few studies do actually attend to this likely process. We did examine this 'intention to deceive' in an experimental setting. The hypothesis that lying requires more mental effort has been widely supported. We hypothesize that having the intention to lie while telling the truth is more cognitively demanding than telling the truth. During present research, tonic electrodermal activity (EDA) was measured during 1) telling the truth, 2) lying and 3) the intention to lie, because this seems to be a reliable measure of cognitive load. Two different double tasks were included in these three conditions, attempting to create a magnified difference in cognitive load between the truth- and intention to lie condition. Although present research did not find evidence that the intention to deceive is more cognitively demanding than truth-telling, it does give some additional results and recommendations for further research on deception and the intention to deceive.

SAMENVATTING

Er is veel onderzoek gedaan naar misleiden en de intentie om te misleiden. We stellen dat misleiding niet gezien kan worden als een proces van enkel een paar momenten, en dus niet gereduceerd kan worden tot enkel de leugens(s) in dit proces. We achten een ander concept met betrekking tot misleidend gedrag erg belangrijk: de intentie om te misleiden. Het is aannemelijk dat de intentie om te misleiden kenmerkend is voor mensen die liegen, maar slechts weinig onderzoek besteedt hier aandacht aan. We hebben de 'intentie om te misleiden' onderzocht in een experimenteel onderzoek. De veronderstelling dat liegen meer cognitief

belastend is, wordt door ondersteunt door vele onderzoeken. Wij denken ook dat de intentie om te misleiden (tijdens het spreken van de waarheid) meer cognitief belastend is dan alleen de waarheid spreken. In dit onderzoek is de electrodermale activiteit (EDA) gemeten in situaties waarin mensen 1) de waarheid spreken 2) liegen en 3) de intentie hebben om te liegen. Hiervoor is gekozen omdat EDA een betrouwbare maat is voor cognitieve belasting. Tijdens deze 3 genoemde situaties moest een deel van de participanten een dubbeltaak uitvoeren. Met deze dubbeltaak werd er geprobeerd de verwachtte relatieve verschillen tussen de waarheid- en de intentie om te liegen te vergroten. Het onderzoek heeft de veronderstelling dat de intentie om te liegen meer cognitief belastend is dan de waarheid spreken niet kunnen bevestigen. Toch brengt huidig onderzoek interessante resultaten naar voren en geven we aanbevelingen op het gebied van onderzoek naar misleiden en de intentie om te misleiden.

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Introduction

Consider the following scenario in which a police officer is interrogating a suspect of murder. It is probable that the suspect creates his own story and not only deceives on the important question: 'did you kill your husband'. After all, it is likely that liars do not deceive during the whole interview. Lies will be shifted with parts of truth, depending on what is necessary for his 'own sake'. The suspect might be occupied with the intention to let the police officer believe in what he / she says, which is likely to require more mental effort, even when the suspect is telling the truth. In this study we will examine this important concept: the intention of deceit. Our research question is: Is cognitive load higher in a state of intention to deceive compared to a situation of truth-telling?

Deception

Studies in order to detect deception have been, and still are very popular in the field of research (Ekman & Friesen, 1974; Vrij, 2004). The definition which Vrij (2004) mentioned, appears to give a clear understanding of this concept. He defined deception as a 'deliberate attempt, without forewarning, to create in another a belief which the communicator considers to be untrue'. In this study we try to measure the intention to lie, because it is likely that the process of deception cannot be simply reduced to just only the lie. We state that the processes prior to the lie are very important. Arguments for this statement will be discussed more in detail in later sections. This 'intention to lie' will be subject of this paper which we try to measure by gathering physiological data in this process in order to improve the knowledge of lying and gain a more realistic view of this process. We conduct measures of skin conductance, because this seems to be a reliable measure of cognitive load (Boucsein, Fowles, Grings, Ben-Shakhar, Roth, Dawson & Filion, 2012).

There are many different approaches to lie detection but research has shown that people's ability to detect deception is limited. Listening to speech or observing behavior seem to be unreliable methods to establish deception (Vrij, Granhag, Mann & Leal, 2011). A possible explanation for this methods being unreliable, is that these studies only examine the moment of the lie and do not attend the process of intention.

Reading the definition of Vrij (2004) stated above, we can conclude that deception cannot be reduced to just lying. It is likely that deception starts with the intention to deceive and this whole deception process should be studied instead of only examining the lie. Although this intent could play an very important role in deception, a lot of studies do not attend to this process which we refer to as 'intention to deceive' from now on. A few decades back in time, the intention to deceive was mentioned already to play an important role in the process of deception (Chisholm & Feehan, 1977), which we will try to examine in this study. Remarkably, only a few studies on deception attend to this potential important process.

In contrast to studies which do not consider the intention to deceive, this study will attempt to measure the whole process of deception, especially the intention to deceive. We think that examining the intention to deceive makes (our) research more realistic (like every day experiences) and we expect this concept to play a major role in examining and detecting deception. It will contribute to a clearer understanding of the process of deception

Constraints of deception research and how we deal with them

Although deception is a very popular topic in research, deception experiments often have drawback. Research on lie detection has to deal with serious constraints, according to the validity, which have been widely discussed in earlier studies. Examples of these constraints are the lack of emotional involvement, the absence of voluntary intention to deceive and contextual constraints like the absence of consequences, either positive or negative (Sip,

Roepstorff, McGregor & Frith, 2007). It is inevitable to execute all of these serious constraints because the research is likely to be executed in experimental settings. This execution in experimental settings does certainly has an advantage compared to field studies. Variables can be controlled in experimental settings, which is difficult to manage in field experiments. This because in field experiments there is high risk of the influence of variables which we wish not to measure at all. In experimental settings, causal relationships can thus be more certainly credited to the manipulated variables, which is more onerous in field experiments.

In order to exclude or reduce the experimental constraint of the lack of emotional involvement which is listed above, participants were told that two of the best participants in this study will earn a reward of € 100 (for the best participant) and € 50 (for the no. 2 of the experiment). The other constraints seem to be very difficult to reduce or even exclude and we should be very cautious about these constraints. Even though these constraints are hard to reduce or exclude, we are strongly convinced about the value of this research in the field of deception.

The Cognitive Load Approach

Today, two approaches to lie detection are frequently used in the field of research. The first approach is the 'concern based approach' which is frequently used by police officers due interrogating suspects of a crime (Vrij, Fisher, Mann & Leal, 2008). This 'concern based approach' assumes that people are more concerned when telling a lie compared to when they are telling the truth. This higher level of concern should be observable by an increase of nervous behavior, for example crossing the legs, shifting the chair, or grooming behavior (Inbau, Reid, Buckley & Jayne, 2001, pp. 175-176).

The second approach to lie detection is the 'cognitive load approach' which is based on cognitive theory and will be the theoretical framework of this experiment. The concept of cognitive load (or mental workload) seems to be a difficult concept to understand, especially because of the enormous amount of definitions given to this concept (Xie & Salvendy, 2000) . Each person has a limited cognitive processing capacity. In the framework of this study we define cognitive load as: the amount of mental effort necessary for a person to complete a task over a given period of time, which cannot be detected directly but through the measurement of some other variables that are thought to correlate high with it, such as subjective rating, performance and some physiological data (Xie & Salvendy, 2000). The latter we will use in this experiment to measure the cognitive load while people have the intention to lie.

The cognitive load approach assumes that lying requires more mental effort than telling the truth (Gombos, 2008; Patterson, 2010; Vrij, et al., 2012). Vrij et al. (2012) listed six reasons why lying might require more mental effort than being honest: 1) the lie itself may be cognitively taxing, 2) liars are typically less likely than truth tellers to take their credibility for granted (liars will be more inclined to monitor and control their demeanor so that they will appear honest to the lie detector, which should be cognitively demanding, 3) because liars do not take their credibility for granted, they may monitor the interviewer's reactions more carefully in order to assess whether they are getting away with their lie, 4) liars may be preoccupied by the task of reminding themselves to act and role-play which requires extra cognitive effort, 5) liars have to suppress the truth while they are lying and this is also cognitively demanding and 6) whereas activating the truth automatically, activating a lie is more intentional and deliberate, and thus requires mental effort.

Another study proposed two main reasons why lying should be more cognitively demanding than telling the truth in real social interactions. First, the inhibition of a prepotent truth response while responding falsely, and second, the need to track the knowledge of the

person to whom one is falsely responding (Duran & Dale, 2012). This study of Duran & Dale, (2012) also indicated longer response times in tasks while deceiving. Longer response times on questions seem to be an indicator of deceptive behavior (Walczyk, Mahoney, Doverspike, Griffith-Ross, 2009).

More recently Vrij et al. (2008) have developed another, theory-driven approach for lie detection derived from the cognitive load approach. In this approach, a secondary task is included to create a higher level of cognitive tax, on the purpose of discriminating between truth-telling and lying that should be easier to observe in this 'secondary task' condition. It should be easier to discriminate the liars from the people which are being honest, because assuming deceiving requires more cognitive load, a secondary task will magnify the difference between truthfulness and deceit (Vrij et al., 2011). This approach is called: 'imposing cognitive load approach' in literature. For example asking interviewees to tell their story in reverse order, or instructing them to maintain eye contact during the interview could impose the cognitive load (Vrij et al., 2011). These are examples of how the 'imposing cognitive load approach' is used in real life, thus outside the experimental field. Another real-life application of the imposing cognitive load approach in order discriminate liars from true tellers is the Strategic-Questioning Approach (Vrij et al., 2011). Liars tend to react different on unanticipated questions compared to truth tellers.

In this study we combine the imposing cognitive load approach (including a secondary task) with measures of skin conductance, which seems to be a reliable method in measuring cognitive load in humans. This will be discussed in a later section.

Cognitive processes during the intention to deceive

As mentioned in previous parts of this introduction, it is clear that we consider the intention to deceive as a very important aspect of the process of deceiving. First we will define the concept 'intention', then we will discuss this concept more in detail.

Here again, we use a definition found in a study of Vrij et al. (2011) which is very useful in our opinion. They derived their definition from Malle, Moses & Baldwin (2001) who defined intention as a person's mental representation of his/her planned future actions. Three factors are important to this definition. First, the intention is related to someone's own activities which is deceiving in this study. Second, it is based on some amount of reasoning and planning (developing, and perhaps changing a strategy to deceive). Last, the intention comes with a strong commitment to perform the intended action(s) (logically, because of the higher probabilities of possible negative consequences like adjudication and being locked up in prison when deceit fails).

It is plausible that mental workload is not only higher at the moment of telling a lie. Mental workload should have raised up during telling the truth within a deceptive attempt. What is worth to be mentioned is that these processes of intention to deceive are not only common during interrogating. It is likely that these processes are present in other, less heavier circumstances.

Some of the six reasons derived from Vrij et al. (2012) why lying should be more cognitively demanding than telling the truth, might also account for situations in which people are telling the truth while having the intention to lie. For example people who have the intention to lie might monitor their demeanor and the interviewer's reactions. Another reason which is possibly suitable in this situation is that people with the intent to deceive may be preoccupied by the task of reminding themselves to act and role-play. This because they know that they will not tell the truth on all questions. After all, we suppose another reason which is

not mentioned by Vrij et al. (2012), but might be relevant for present research. People who are telling the truth while having the intention to lie might be continuously doubting whether to lie on a question or not, depending on what is necessary to convince the person he / she wants to deceive.

Like the scenario brought up at the beginning of this introduction, in which a police officer was interrogating a suspect of murder, it is likely that liars do not deceive constantly. Lies will be interspersed with parts in which someone is telling the truth until the 'important question'. The processes in the truth telling parts within a deceptive attempt, referred to as the intention to deceive will be subject of this research.

Behavioral observations vs. physiological measures

In many studies, researchers are claiming that they have developed or improved approaches to lie detection e.g. training--, imposing cognitive load and strategic questioning. Although results show an improvement on lie detection, this improvement still leave a gap in which lies could not be detected, so these improvements show only a limited effect. In a study of Frank & Feeley (2003) accuracy on lie detection by training was only a few percentage points on average. Using cognitive load approaches (imposing cognitive load approach and the strategic questioning approach) also leads to improvement, but still a lot of lies cannot be detected using these techniques. In a study of Vrij, Leal, Granhag, Mann, Fisher, Hillman & Sperry (2009), pairs of liars and truth tellers were asked some unanticipated questions about having lunch together. Only 80 percent of the pairs of liars and truth tellers could be identified correctly in this study and still 20 percent (consider: 1 out 5) of the pairs could not be identified correctly. This research was conducted with pairs of liars and truth tellers, and it is doubtful if these results would be found when assessing individual interviewees.

In this study we expel the behavioral constraints listed above by using another method to measure cognitive load which is associated with deceit. We do use an objective and, in our opinion more realistic method to try to gain more knowledge of the intention to deceive. We will use skin conductance as measure for cognitive load and we discuss this method more in detail in the next paragraph.

Skin conductance

It is clear that conducting research about deceiving due to gather behavioral observations is limited. Assembling behavioral observations in this case is very subjective. According to this subjective way of gathering information on deceiving, it would be more reliable to use an objective measure. As discussed earlier in this introduction, deceiving requires more mental effort than truth telling and thus the cognitive load should be higher in a state of deceiving compared to a state of truth telling. Boucsein et al. (2012) claimed that skin conductance (SC) is a measure which increase might be elicited due increased psychological arousal and can be used as indicator of cognitive load. Compared to behavioral observations, measuring SC might be a more reliable and objective manner in order to detect deceiving.

A Skin Conductance response (SCR) is a reaction of the sympathetic nervous system and is used as indicator of psychological arousal (Zhang, Hu, Chao, Luo, Farr & Li, 2012). Because SC is a reaction of the sympathetic nervous system it is less likely to be influenced by the deceiving person. Measurements of SC can be divided in two components: a tonic and a phasic component. These components differ from each other regarding to their recorded time scales. Zhang et al. (2012) described this distinction clear in their research: 'Tonic skin conductance, commonly measured by the skin conductance level (SCL), reflects the overall conductivity of the skin over a period of tens of seconds to minutes. The phasic component—SCR—represents a discrete fluctuation in skin conductance that lasts several seconds, as can

be elicited by effort, environmental stimuli, and/or emotional responses*'*. If we can connect the theory of cognitive load to measurements of SC we might be able to develop a more reliable and objective way to detect deception. In this study we focus on the tonic component SC because of the broad time interval of this measure compared to the phasic component of SC.

Present study

In this study we examine the level of skin conductance while people have the intention to deceive. This study is based on the 'increasing cognitive load' approach which is developed by Vrij et al. (2008) and gained (little) empirical evidence in earlier studies. We explore the tonic component of skin conductance while people are instructed to tell the truth and we compare this tonic component with other situations. We expect this component when people are telling the truth to have a lower value compared to the condition in which participants are instructed to lie and the condition in which participants have the intention to lie. The expected difference in tonic EDA between the condition in which participants are instructed to tell the truth, and the condition where participants have the intention to lie, is the most important comparison in present study. This because of the reasons of de Vrij (2012) which we give chance to occur in a situation of a deceptive attempt. These reasons are discussed earlier in this introduction. The tendency of continuously doubting whether to lie or respond truthfully to a question within the deceptive attempt, might also contribute to a higher level of skin conductance.

According to this possible difference in these three conditions, we expect to establish a difference in SC between the condition in which people have to lie and in which people have the intention to lie. We hypothesize that telling the truth while having the intention to lie is more cognitively demanding than a situation in which people have to lie the entire time. Thus,

we expect that measures of SC will reach a higher value in a situation of an intended lie, compared to a situation of entirely lying. For example, in a situation of entirely lying, people do not have to choose whether they should lie on a specific question. These people just have to lie. In a situation with the intention to lie, people are considering every question whether to lie or not to lie. Thus, we expect tonic EDA to be higher in the intention condition compared to the lie condition.

Another interesting subject of research is to include a secondary task in the conditions. As stated above, our first hypothesis is that we expect the level of SC to be lower in the truth condition compared to the lie condition. Second, we assume that the level of SC in the intention condition will be higher compared to the lie condition (truth < lie < intention). We expect relative differences hypothesized above to be higher in the secondary task condition compared to the condition where no secondary task is included. Interference between the two tasks might occur which causes a higher level of EDA (Hartley, Maquestiaux, Brooks, Festini, & Frazier, 2012). There could be a difference between the two secondary task conditions. This because a calculation might be more cognitively demanding than recognizing emotions which would then result in a higher level of SC (Hartley et al., 2012).

When combining the veracity -(lying / truth / intention to deceive) and task –(single task / double task), we expect the possible difference in SC between the intention to deceive and the control condition in which participants are telling the truth, to be higher when a double task is included compared to the condition where no double task is inserted. We assume that the same tendency should occur when we compare the lie condition with control condition when a secondary task is included. We hypothesize that the difference in measures of SC would be more striking compared to the condition in which no secondary task is included. This because the fact that humans have only limited cognitive resources and it would require a lot more mental effort to manage these tasks. Thus, including a secondary

task is expected to magnify the hypothesized difference between the truth condition on the one hand, and the lying an intention condition on the other hand.

Method

Participants

A total of 60 subjects gave written informed consent to participate in the present experiment. The data of six of the participants were removed for technical reasons, leaving 54 participants. The data of 54 mixed male (27.8%) and female (72.2%) subjects were used for further analysis. The mean age of the 54 participants was 20.98 years (*SD* = 2.66) with a range of 18 – 32 years. The nationality of the subjects was either Dutch (57.4%) or German (42.6%). All of the subjects were students and most of them were required to participate in studies to earn credits for the progress of their bachelor study.

Apparatus

To conduct research and gathering information two laptops were used. One laptop was used to run the experiment on which the participant performed the experiment and the other laptop was used to gather the data of the Skin Conductance and markers which were set at each experimental event. The laptop on which the participant performed the experiment is a HP probook 6570b Intel i3 dual core with processing speed at 2.40 GHz and 4 GB working memory. The distance between the display of the experiment laptop and the participant was approximately 1 meter. The other laptop which was used to gather the data was an HP Probook 4710s Intel dual core with processing speed at 2.0 GHz and 4GB working memory. Skin conductance was measured exodermally using Thought Technology skin conductance sensors (Thought Technology Ltd., 2012), attached to the distal phalanx of the non-dominant index and ring fingers. Stimulus presentation was achieved using E-prime 2.0 experimental

software (Psychology Software Tools, 2012) on the experimental laptop. To record SCR, BioGraph Infinity 5.1.0 was used and the gathered data was further analyzed in Matlab (Mathworks, 2012).

Experimental setting

The signal of the skin conductance sensors was amplified using ProCompInifiniti (Thought Technology Ltd., 2012). Another essential component which was used to forward data of the markers through a serial port cable is the Voltage Isolator. This was done because of the lack of a dedicated interface for experimental events in e-Prime. These markers were set whenever a question occurred. E-Prime sent a signal via the serial port to the ProCompInifiniti amplifier via the Voltage Isolator. A marker caused the reduction of the resistance of the VI-channel. Thus, fluctuations on the VI-channel marked experimental events. Due to these markers a preferred time window can be made. The amplifier was connected to the SCR laptop by using a TT-USB device.

Pre-processing of Electro Dermal Activity (EDA) and statistical analyses were performed using MATLAB (Mathworks, 2012) and SPSS 20 (IBM SPSS, 2012). Continuous Decomposition analysis was executed using MATLAB custom code from Ledalab (Benedek & Kaernbach, 2010). The experimental setting is visualized in the figure below (figure 1).

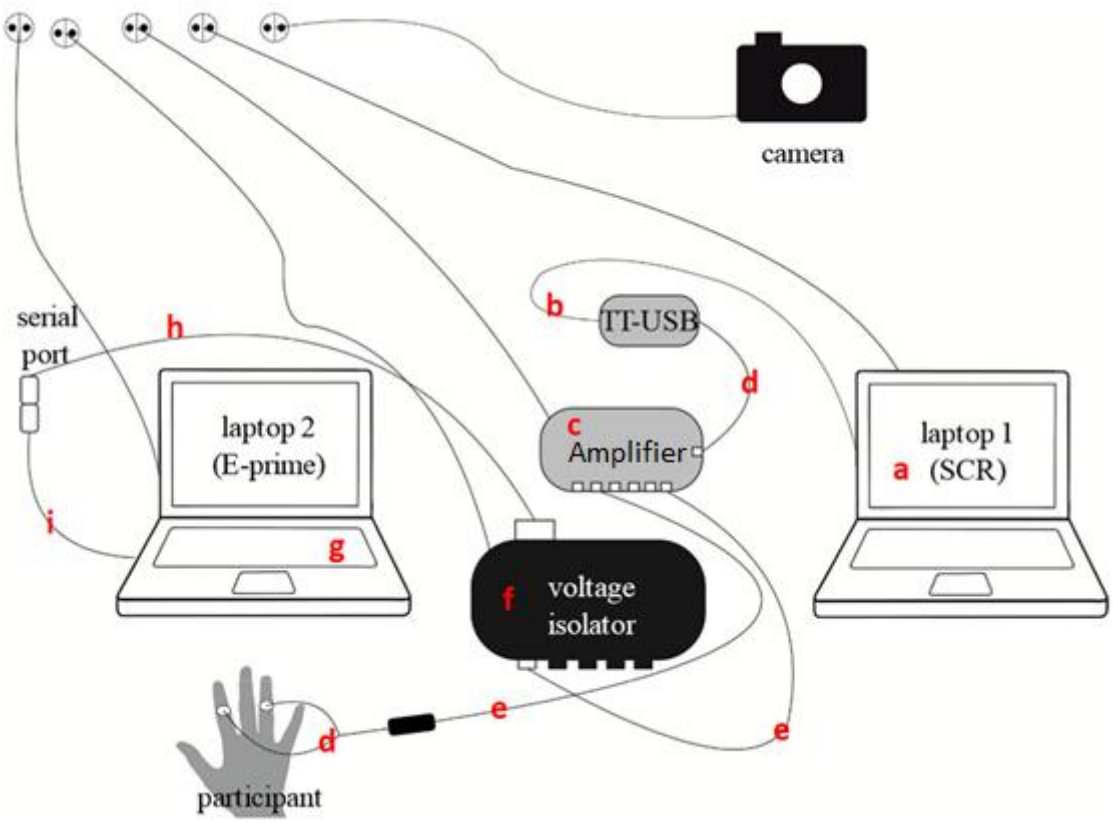

Figure 1. Experimental setting derived from Risthaus (2012)

Procedure

The study took place in the experiment lab of the faculty Behavioral Sciences at the University of Twente. The room was specially furnished to conduct experiments by which is meant a room without distractions except the equipment which was needed to conduct the experiment.

After arrival of a participant, he or she was asked to carefully read and sign informed consent (see Appendix A) when they agreed. After a participant signed informed consent, two electrodes for measuring SC were connected to the participant's non-dominant hand (mostly the left hand). The electrodes were fastened on the dorsal side of this hand One electrode was connected to/on the middle phalanx of the ring finger, and one electrode was connected to the middle phalanx of the forefinger. After the electrodes were fastened correctly, participants

were asked to fill in a survey about personality[1]. When a participant completed the survey, they were instructed about the procedure of the experiment. After the instruction participants were asked if they did understand everything or needed some additional explanations. Additionally, a prize of – 100 € and 50 €, respectively - was promised to those who would perform the 'best' on deception, although no explanation was given for this criterion. This was to be judged by a 'deception expert', which did in fact not really exist. This incentive was thought to increase motivation by increasing the relevance of the deception attempts.

When participants were ready, the video recorder was turned on and the experimenter started a trial round to confirm whether a participant was performing as intended. After this trial round the experimenter left the room and the experiment began. When a participant has run through all the blocks, the experiment was finished and the participant was thanked.

Task

Participants were randomly assigned to one of the three conditions: 'Neutral', 'Emotion' and 'Calculate'. In all of these three conditions, participants had to respond to yes/no questions regarding the appearance of shown stimuli (e.g. the color of the eyes, hair color and gender). Questions were shown on top of the screen. The stimuli were pictures of one human per stimuli and were presented on a white-colored background in the middle of the screen (for an example of the shown stimuli see Appendix A).

Each condition consisted of three different blocks versions ('truth', 'deceive' and 'intention to deceive') which all participants had to perform three times. The blocks were separated due a small pause of 9 seconds. At the start of each block, instructions were presented on the screen for 7 seconds. For example: "Lie to none of the questions". In the truth block, participants had to give a truthful answer to all the questions. In the deceiving

[1] The personality survey was for the purpose of another study and therefore not used.

block, participants had to lie on all questions that block consisted which was represented on the screen by “Lie to all of the questions” and last, in the intention block, participants were instructed to only lie on the blue-colored question which will be discussed later.

In the Emotion and Calculate condition, a secondary task was included. In the Emotion condition participants were instructed to answer the questions dependent on the block and additionally had to judge the emotion of the stimuli presented. All six basic emotions existing of happiness, anger, disgust, surprise, sadness and fear were used in the experiment (Mohn, Argstatter & Wilker, 2011).

In the Calculate condition the procedure was similar to the Emotion condition, but instead of judging the emotion of stimuli, participants were instructed to count freckles and make a specific calculation. The freckles were presented on the stimuli ranging from 1 to 6. The total of freckles must be added or deducted with a specific number, ranging from 1 to 6. All stimuli in the Calculate condition had neutral expressions.

All stimuli were presented for 5 seconds and after that a response window emerged which lasted for 6 seconds. A schematic view of the construction of trial is shown below (figure 2).

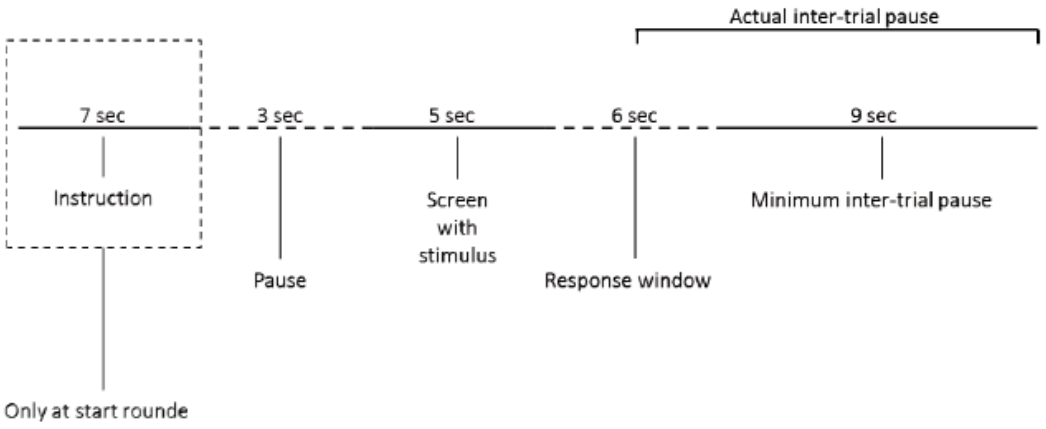

Figure 2: Schematic view of each trial

Each task (calculate, Emotion, neutral) again contains three sequence versions in which blocks (lie, truth, intention) were ordered differently. Each block consisted of a question which was colored blue. Either the fourth, fifth or sixth question was randomly blue-colored in each sequence version of all conditions. Thus, every participant performed each sort of block three times in which the blue question was ordered differently compared to the other two sequence versions. The participants did not know when they reached the blue question. The reason why a blue-colored question is included in all sequence versions is to control prospective memory. McDaniel & Einstein (2007) define prospective memory as a form of memory that involves remembering to perform a planned action or intention at the appropriate time. Thus, if differences are found in EDA between the three blocks, this cannot be due the fact of the idea to perform an action (lying) in the future. This difference should then represent the process of the intention to deceive, because all sequence versions includes a blue-colored question.

Measures of skin conductance

Skin conductance was recorded at 256Hz and down-sampled to 16 Hz (well above the 10 Hz after which increases in sample frequency do not significantly alter the EDA parameters computed with continuous decomposition analysis (CDA). We used a minimum amplitude threshold criterion of .01 μS and iterated the parameter optimization three times. The skin conductance is separated into a phasic and tonic signal, each containing 54 trials per subject. SCR's usually have a delay between one and four seconds (Roth et al., 2012). We were interested in the stimulus and response window. We chose a time window ranging from 2 till 13 seconds after stimulus onset. For each window the mean tonic signal (μS) and the integrated phasic signal (μS*s) is calculated. For this study, only the tonic signal was used.

Statistics

The process of statistical analysis was conducted with SPSS Statistics 21. Means for each condition (Intention, Lie and Truth) have been calculated by calculating the mean of the first three events (T1-T3) of each sequence version. This is because the 'blue question' in the experiment was on either the fourth, fifth or sixth stimulus. Thus, by including only the data of the first three stimuli, we can make a reliable comparison between all the three conditions and purely measure the cognitive load during the 'intention to deceive'. Logarithmic transformations have been performed on the average tonic EDA of each condition (Intention, Lie and Truth). This because the assumption of normality was violated in the distribution of the conducted data.

Results

To analyze the data in order of testing the hypothesis an ANOVA was performed on the Tonic EDA T1-T3 with Condition (3: Truth, Lie and Intention) and Task (3: no secondary task, emotional secondary task and calculating secondary task) as independent variables. The method of Greenhouse-Geisser was used because the sphericity was violated, which results in different degrees of freedom.

Although the ANOVA showed a Condition main effect [$F(1.8, 89.4) = 17.23$, $p < .001$], contrary to the prediction, Tonic EDA (T1-T3) was not significant higher in the Intention condition compared to the control condition "Truth". Table 1 shows confidence intervals for all three of the conditions. The confidence intervals show a significant difference between the Lie condition compared to the Intention condition and the Truth condition, respectively $p < .001$ and $p < .001$.

The same ANOVA showed no Task main effect [$F(2, 51) = .08$, $p = .924$], indicating that Tonic EDA did not differ in the three variants of task (no secondary task, emotional

secondary task and calculating secondary task). No Condition x Task interaction was found [F(3.5, 89.4) = .425, p = 766]. Thus, the found difference in Tonic EDA between the 3 Condition variants is not dependent on the level of Task. Results of Condition combined with the level of Task are shown in figure 3. In table 2 detailed descriptive statistics are shown. Besides the absence of a Condition x Task interaction, each level of Task is analyzed separately in the next paragraph in order to examine possible relative influences of Task on the three conditions more in detail.

No secondary task

In order to analyze the results of participants which solely performed the main task in which was answering yes or no questions to specific questions in specific conditions (Intention, Lie, Truth), an ANOVA was performed on the Tonic EDA T1-T3 of these participants with Condition (3: Truth, Lie and Intention) as independent variables.

The ANOVA indicated a marginally significant main effect of Condition [F (2, 34) = 2.83, p = .073] which results in a marginally significant difference between the Intention- and Lie condition (p = .072), 95% CI [-.036, -.001]. Confidence intervals are shown in Table 3. Tonic EDA appears to be higher in the Lie condition compared to the Intention condition (M_{diff} = -.02, SD_{diff} < .01). Difference between the Lie and Truth condition was not significant (p = .26).

The pattern in the three conditions shows that participants in the lie condition have the highest value of tonic EDA, followed by the Intention condition. Participants in the Truth condition tend to have the lowest value of tonic EDA, although no significant difference was found between the Truth and Intention condition (p > .99).

Emotion task

For examining the results of participants which performed an emotion task concurrently with the main task, an ANOVA was performed on the TONIC EDA T1-T3 of these participants. Because here, sphericity was violated the method of Greenhouse-Geisser was used.

There was found a significant Condition main effect [F (1.3, 23) = 6.81, p = .006] Confidence intervals of the differences between the three conditions are shown in table 4. Differences were found between the Lie- and Truth- condition, p = .025 (95% CI [.002, .056]). Tonic EDA is higher in the Lie condition compared to the Truth condition (M_{diff} = .03, SD_{diff} = .01). The difference between the Intention and the Lie condition was not significant, p = .11. No difference was found between the Intention and the Truth condition (p > .99).

Again, the same pattern seems to be suitable according to the values of tonic EDA in the three conditions. Participants in the Lie condition have the highest value of tonic EDA, followed by participants in the Intention condition. Participants in the Truth condition seem to have the lowest value of tonic EDA, although only a significant difference was found between the Lie and Truth condition.

Calculate task

To analyze the results of participants which performed a calculating task simultaneously with the main task, an ANOVA was performed on the Tonic EDA T1-T3 of the participants which performed a calculating task with Condition (3: Truth, Lie and Intention) as independent variable.

As predicted, the test of Condition was significant [F(2, 32) = 10.43, p < .001], thus Tonic EDA differed over the three conditions. When observing confidence intervals between the three conditions, the difference between the Truth and the Lie condition is significant 95% CI

[.009, .058]. Tonic EDA is higher in the Lie condition (M_{diff} = .034, SD_{diff} = .009) compared to the situation in which participants had to give truthful answers to all of the questions (p = .006). The difference between the Intention and the Lie condition was also significant 95% CI [-.054, -.011]. Tonic EDA was higher in the Lie condition compared to the Intention condition (M_{diff} = -.032, SD_{diff} = .008), p = .003. These results of all of the three conditions are presented in table 5.

Here we see the following pattern: Participants in the Lie condition showed the highest values of tonic EDA, followed by the Intention condition. Participants in the Truth condition showed the lowest values of tonic EDA, although no significant difference was found between the Intention- and Truth condition (p > .99).

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Table 1

Confidence intervals for the three conditions (Intention, Lie and Truth)

(I) Condition	(J) Condition	Mean Diff (I-J)	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Intention	Lie	-.025*	.005	-.038	-.012
	Truth	.003	.004	-.008	.013
Lie	Truth	.028*	.006	.013	.043

* $p < 0.001$

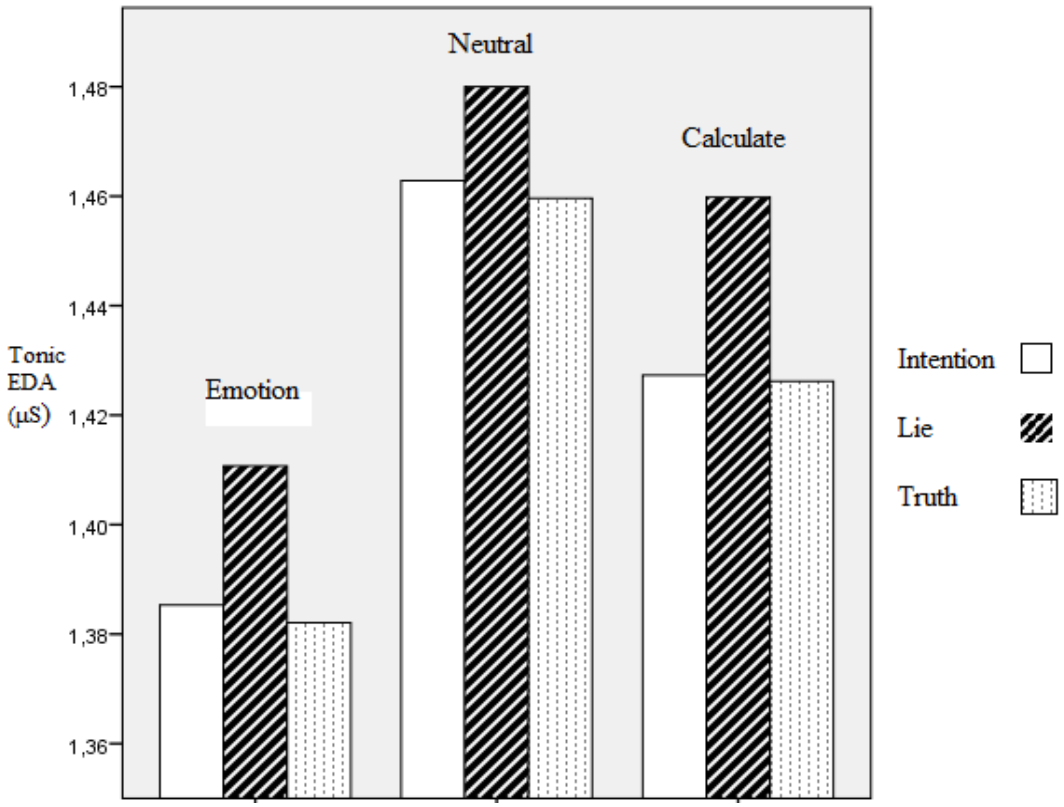

Figure 3. Mean Tonic EDA in the three different conditions, combined with three levels of Task.

Table 2.

Descriptive statistics for all three conditions, divided in 3 different tasks

	Truth		Lie		Intention	
Task	M	SD	M	SD	M	SD
Emotion	1.38	.53	1.41	.52	1.39	.53
No secondary task	1.46	.46	1.48	.47	1.46	.47
Calculate	1.43	.72	1.46	.72	1.43	.72

Table 3

Confidence intervals for the three conditions (Intention, Lie and Truth) when no secondary task was performed

(I) Condition	(J) Condition	Mean Diff (I-J)	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Intention	Lie	-.017	.007	-.036	-.001
	Truth	.003	.009	-.021	.027
Lie	Truth	.020	.047	-.009	.050

Note: the difference between the Intention- and Lie condition was marginally significant (p = .072)

Table 4

Confidence intervals for the three conditions (Intention, Lie and Truth) in the emotion task

(I) Condition	(J) Condition	Mean Diff (I-J)	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Intention	Lie	-.025	.011	-.055	.004
	Truth	.003	.005	-.009	.016
Lie	Truth	.029*	.010	.002	.056

* $p < 0.05$

Table 5

Confidence intervals for the three conditions (Intention, Lie and Truth) in the calculate task

(I) Condition	(J) Condition	Mean Diff (I-J)	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Intention	Lie	-.032*	.008	-.054	-.011
	Truth	.001	.008	-.020	.022
Lie	Truth	.034*	.009	.009	.059

* $p < .05$

Discussion

Hypotheses

The aim of present study was to examine the possibility of measuring cognitive load during the intention to deceive. Although no clear significant results are found which in fact could support our hypothesis that intention to deceive requires more mental effort than truth-telling, still there are found some interesting results. These results might contribute to forthcoming research.

First, we expected that tonic EDA was higher in the Intention condition compared to the other two (Lie and Truth) conditions. This hypothesis could not be supported. Tonic EDA was higher in the Lie condition compared to the Intention- and Truth condition. The argument for this hypothesis was that participants might be in in a state of continuously doubting whether to lie on a question or not. This ‘doubting’ was expected to cause a higher level of tonic EDA in the Intention condition. Results indicate that the ‘doubting’ state does not cost more cognitive effort compared to state of entirely lying. Another possibility could be that this doubting was not simulated correctly in present study. In the Intention condition, participants did only have to observe whether a blue question appeared on their screen. This observation

resulted in a decision to lie, or respond truthfully to a question and this might not suit with the doubting tendency of real-life situations in an attempt to deceive. The other factors provided by Vrij et al., (2012) which could also occur while intending to deceive appear to have a limited effect on cognitive load. These factors, 'monitoring their own behavior in a deceptive attempt' and 'reminding of role-playing', did not resulted in a difference between a situation of truth-telling and a situation of intention to deceive. The other factor, monitoring the interviewer's behavior was not relevant in present study, because of the absence of an interviewer.

The hypothesis that including a secondary task is expected to magnify the relative difference between the three conditions cannot be confirmed. There was found no interaction effect between Condition and Task. Thus, differences in tonic EDA in the three condition is not dependent of including a secondary task or the absence of a secondary task.

After the absence of an interaction between Condition and Task, the results were analyzed separately for each level of Task. Remarkably, when no secondary task was included there was found no significant difference between the Lie and the Truth condition. In both of the secondary task conditions (Emotion or Calculate), participants did have significant higher values of EDA in the Lie condition, compared to the Truth condition. Thus, a secondary task may still provide a possibility to discriminate more appropriate between lying and truth-telling.

In present study we were not able to obtain results which could support our hypothesis that the intention to deceive requires more mental effort than telling the truth. After all, we are still convinced about the possibility that cognitive load during intention to deceive might be higher and can be measured and can in some way contribute in the process of lie detection.

Recommendations

We will provide some recommendations which might lead to an increase in the overall relevance and reliability in conducting the same sort of research. First, expanding the sequence versions with more stimuli, so a more reliable analysis might be possible. Only the using the first three stimuli of each sequence version might be too short for a detailed analysis and might hinder a reliable outcome. Now, in each sequence version, tonic EDA of participants on question 4 till 6 are not included in the analysis. The data of question 4-6 might provide more useable data which is excluded in this study.

Second, results found in the analysis show that when a secondary task is included, differences between the Intention and Truth condition did not change. Including a more cognitively demanding secondary task might contribute to more significant and observable differences.

Remarkably, as described in the introduction, we expected a calculating task to be more cognitively demanding compared to the emotion task (Hartley et al., 2012). The results do not support the hypothesis that the calculation task is more cognitively demanding than the emotion task. In fact, the calculate condition did not differ from the emotion condition according to the level of tonic EDA. A possible explanation that in this study tonic EDA in the emotion task did not differ from tonic EDA in the calculate task, is that emotional expressions of the stimuli can be judged as ambiguous. This ambiguity might make it more difficult to judge on the emotion of these facial expressions. The used ambiguous stimuli might level the difficulty of the emotion- and calculate task (Vrij, 2008). We recommend more intensive research about this topic, so that the most appropriate secondary task can be used in these kind of experiments.

The last suggestions we will provide is that it might be interesting to include response times in a later experiment. Combining physiological data and response times could provide

more evidence to discriminate between a tendency of a intention to deceive and truth telling. This because latencies in response times on tasks is, similar to skin conductance, a characteristic of deceptive behavior (Duran & Dale, 2012). Last, including a human interviewer instead of a computer might cause more cognitive load in persons which have the intention to deceive (Vrij et al., 2012).

Experimental constraints

In order to conduct research on lie detection and/or the intention to lie, it is important to be cautious on the experimental constraints of this research and consider them carefully. A lot of studies described and reviewed these constraints in detail, and some of these studies obelize the validity of conducted research on lie detection. Doubts exist on the real-life application of results which are conducted in laboratory settings and the way initiating the process of the execution of lies (Sip et al., 2007). Another threat in conducting this research which is also mentioned by Sip et al. (2007) is the emotional involvement of the person participating in the study.

Although examining lie detection requires to reckon the constraints described above, it still can be very valuable to enlarge the knowledge of the concept deceiving and improve the paradigms which underlies this concept.

Conclusion

Present research did not succeed to distinguish between a situation in which participants are telling the truth, and a situation in which they have the intention to deceive. Tonic EDA was not higher when people were attempting to deceive. Thus, cognitive load does not seem to be higher in a situation of having the intention to deceive, compared to a situation of truth-telling. The situation in which people had to lie the entire time could

distinguished easier from truth-telling people, characterized by a higher level of tonic EDA. The same tendency occurs when comparing a state of entirely lying with a state of intending to deceive. Cognitive load seems to be higher in the lying situation compared to a situation where people were intending to deceive.

What this study does contribute, is a perspective of possible improvements on lie detection according to the intent of deceiving. Measuring cognitive load during the intention to deceive might become a new topic of research within the field of lie detection, and we truly believe this kind of research can have a major contribution to lie detection. Further research is necessary to improve theory and for the execution of new research on this topic.

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Appendix A

Figure A1: Informed Consent (Provided to all of the participants)

GEÏNFORMEERDE TOESTEMMING

GW.07.130

Ik, …….. (*naam proefpersoon)*

Stem toe mee te doen aan een onderzoek dat uitgevoerd wordt door

Ik ben me ervan bewust dat deelname aan dit onderzoek geheel vrijwillig is. Ik kan mijn medewerking op elk tijdstip stopzetten en de gegevens verkregen uit dit onderzoek terugkrijgen, laten verwijderen uit de database, of laten vernietigen.

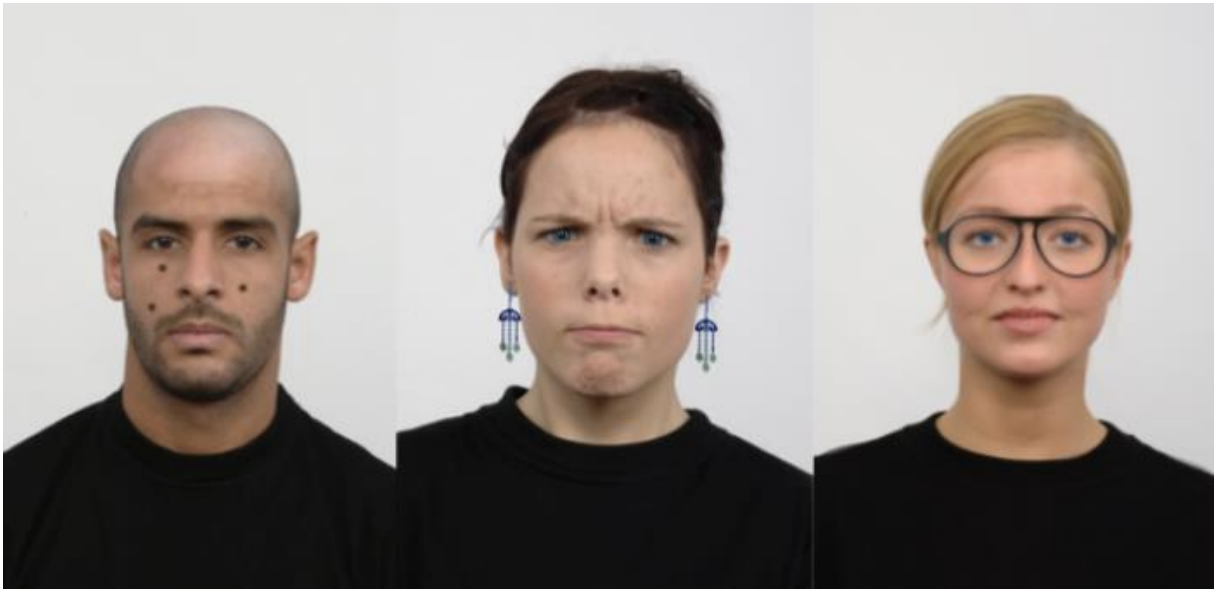
De volgende punten zijn aan mij uitgelegd:

1. Het doel van dit onderzoek is deceptie detectie
   Deelname aan dit onderzoek zal meer inzicht geven omtrent hoe mensen omgaan met deceptie
2. Er zal mij gevraagd worden aan een experiment mee te werken en achteraf een vragenlijst in te vullen.
3. Het hele onderzoek zal ongeveer 45 minuten duren. Aan het einde van het onderzoek zal de onderzoeker uitleggen waar het onderzoek over ging.
4. Er behoort geen stress of ongemak voort te vloeien uit deelname aan dit onderzoek.
5. De gegevens verkregen uit dit onderzoek zullen anoniem verwerkt worden en kunnen daarom niet bekend gemaakt worden op een individueel identificeerbare manier.
6. De onderzoeker zal alle verdere vragen over dit onderzoek beantwoorden, nu of gedurende het verdere verloop van het onderzoek.

Handtekening onderzoeker: …… Datum: ……..

Handtekening proefpersoon: …… Datum: ……..

Figure A2: example of 3 stimuli shown in the experiment



Direved from Utzerath (2012)