Detecting Intentional Errors Using the Pressures Applied to a Computer Mouse

Curtis Ikehara and Martha E. Crosby

University of Hawaii at Manoa, 1680 East-West Road, Honolulu, HI 96822, USA
{Crosby,Cikehara}@hawaii.edu

Abstract. Intentional errors are considered a form of deceit. In this pilot study, the pressures applied to a computer mouse will be analyzed to determine if it is possible to detect intentional errors. Twenty participants ranging in age from 18 to 21 years performed a task involving intentionally making errors when instructed. A comparison will be made between the pressures applied to a computer mouse when answering the questions with the intention of being correct and with the intention of making an error. The data will need to be normalized for each individual to obtain accurate results. The analysis of the pressures may indicate that there are detectable variations within some individuals. Due to the preliminary nature of this study further research will be required.

Keywords: Intentional errors, deceit, pressure sensitive computer mouse.

1 Introduction

Deception is a broad category of acts to convince another to believe false information. Within the category of deceitful acts, a lie can be a statement one knows as false with the intention of the statement being taken as the truth. Studies using functional magnetic resonance imaging show that different areas in the brain are active during deceptive acts [1, 2]. Evidence that mental acts of deception can influence physiological factors include a variety of physiological measures used to detect deception (e.g., polygraph – breathing, electro-dermal activity and cardiovascular activity), but other emotions unrelated to lying can cause physiological responses that confound the detection of deception [3]. Facial expressions, derived from the facial muscles, have been used to detect deceit [4]. The pressures, derived from finger and hand muscles, applied to a pressure sensitive computer mouse has been used to evaluate the mental activity of a user's cognitive load [5, 6]. In this pilot study, a comparison will be made between the pressures applied to a computer mouse when answering questions with the intention of being correct and with the intention of making an error.

For this study, an intentional error is when a person purposefully provides the wrong answer when instructed. Being instructed to make an error reduces the emotion associated with trying to deceive another person, but the intent of making an error, or lying, is still present.

Walczyk, Roper, Seemann and Humphre [8] posited three cognitive stages of lying which are activation (i.e., question is received and truth accessed), decision to lie, and

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construction of lie. The three stages typically are in sequence. For this pilot study, questions are being presented on a computer-based multiple choice response system that instructs the person when to lie and provides the person with false answers fixing the time spent on these stages.

A person can approach making an intentional error in several ways. An example would be after the person determines the correct answer in the activation stage and following the instruction to lie in the decision stage the person would select the first wrong answer, but this may not necessarily be the order of mental activity. The person may first follow the lie instruction in the decision stage, which could then interfere with the activation stage (i.e., determining the correct answer) making the task of finding a solution more cognitively difficult and possibly increasing the time spent in the activation stage.

A comparison will be made between the pressure patterns applied to a computer mouse when answering the questions with the intention of being correct and with the intention of making an error. It is hypothesized that the instruction to give the wrong answer (i.e., to lie) can for some people increase their cognitive load which can be detected in the patterns of pressures applied to a pressure sensitive computer mouse.

2 Method

Twenty participants performed a task involving intentionally making errors when instructed on a computer system. They used a pressure sensitive computer mouse (PSCM) to answer the questions. Data from the PSCM was recorded along with the participant responses.

2.1 Participants

Twenty volunteers, 18 males and 2 females, from the US Air Force Academy ranging in age from 18 to 21 years, participated in the study. Each volunteer was tested individually during an approximately one hour session where the task for this experiment was conducted after two previous unrelated experimental tasks.

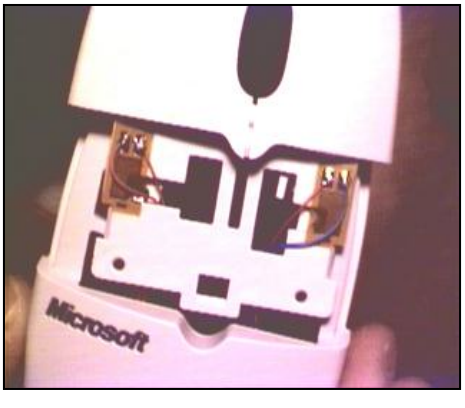

Fig. 1. Computer mouse with pressure sensors on buttons

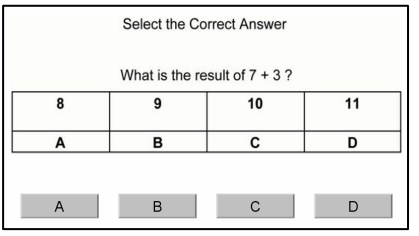

Fig. 2. A sample view of a question presented to the participant. Buttons to select the correct answer are at the bottom of the screen.

Table 1. An example of one of the three sets of questions

	Instruction	Question	A	B	C	D
1	Select the Correct Answer	What is the result of 7 + 3?	8	9	10	11
2	Select the Correct Answer	What word that has the same meaning as "jump."	bean	leap	rope	tool
3	Select the Correct Answer	What is the result of 7 + 17 + 3 + 5?	31	32	33	34
4	Select your Best Guess	What is the result of 1472 times 27?	20000 to 30000	30000 to 40000	40000 to 50000	50000 to 60000
5	Select your Best Guess	What word has the same meaning as "hold"?	grip	clasp	keep	contain
6	Select the Wrong Answer	What is the result of 7 + 3?	8	9	10	11
7	Select the Wrong Answer	What word that has the same meaning as "jump"?	bean	leap	rope	tool
8	Select the Wrong Answer	What is the result of 7 + 17 + 4 + 5?	31	32	33	34

2.2 Equipment

A custom designed computer mouse equipped with pressure sensors inside the body and the buttons of the mouse was used to detect the pressures applied during task performance. Data of the pressures applied to the computer mouse while clicking on answers during the task was collected (see Figure 1).

2.3 Task

The task involved answering three sets of questions (see Table 1). Each set consisted of eight questions with four possible responses. The first three questions were simple math or language questions. The next two questions are difficult or ambiguous. Note that for question 5 in Table 1, all the answers mean hold in different context. The last three were similar to the first three, but the participant was instructed to give a wrong answer. Each question was displayed individually on the screen (see Figure 2).

3 Results

Analysis: A comparison will be made between the pressures applied to a pressure sensitive computer mouse (PSCM) when answering the questions with the intention

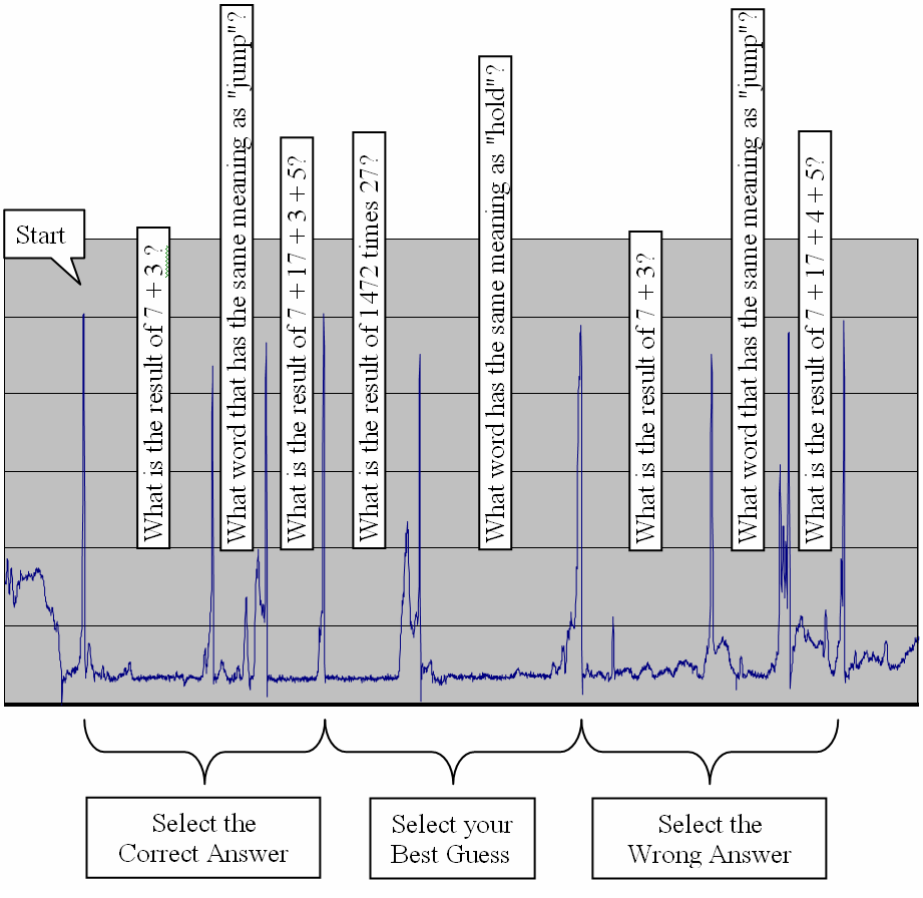

Fig. 3. Shown are the pressures applied to the computer mouse, the instructions to the participant and the questions being asked

of being correct and with the intention of making an error (see Figure 3). Previous pilot studies indicated that minimal difficulty or cognitive load is indicated by a sudden sharp pressure on the mouse button when selecting a response while high difficulty is indicated by a distortion in the shape of the pressure on the mouse button. It is hypothesized there will be a differential between the pressure patterns applied to a PSCM when the intention is to be correct versus the intention of making an error. To obtain the optimal differentiation of patterns, the pressures applied to the PSCM will need to be normalize to the pressure characteristics of each individual. Previous studies have found pressure variations unique to the individual [9, 10].

4 Discussion

Analysis of the pressures on a computer mouse will indicate that there may be detectable variations within some individuals and it is likely that the data needs to be normalized for each individual to optimize categorization of the pressure patterns when a person is giving the correct answer and giving the wrong answer. Should the results of this study support the hypothesis, the pressures applied to a computer mouse could be used for detecting deception.

When detecting deception, an interviewer's personality can affect the response of a person being questioned making it difficult to determine if deception is occurring. Since it is common for people to answer questions on a computer using a mouse it is possible to minimize the variable emotional impact of an interviewer on the interviewee. A pressure sensitive computer mouse (PSCM) that via pressure patterns and cognitive load can detect deceit would be a valuable asset for security screening. Due to the preliminary nature of this study further research will be required.

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