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Verbal response time and duration indices of deception in humans interviewed by a computer-generated agent

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ABSTRACT

To examine the relationship between verbal response time, response duration, and deception during an interview with a computer-generated agent, we developed a model using logistic regression conducted on a training group ($n=90$) and cross-validated the model on an additional 127 participants who either did or did not engage in a simulated crime at a mock security checkpoint. Verbal responses during the interviews required simple "yes" or "no" utterances, which examinees were instructed to produce "promptly" but not in a speeded manner. The results showed that, overall, 75 of 127 (59.1%) participants in the cross-validation group were correctly classified ($p < .05$). This result was due to the ability to correctly classify nondeceptive participants (specificity), and we interpreted this finding as being due to the presence of subpopulations of deceptive participants. Group analyses also revealed that response durations to mock crime-relevant questions were shorter when participants believed that a human was controlling the interview ($p < .05$), and that relative changes in response durations among different types of questions during the interview were related to deceptive status. The response duration shortening observed in the present study was attributed to variations in social dominance, motivational systems, or some combination of these factors.

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1. Introduction

Response time (RT) (i.e., latency of response production) has been evaluated for use in assessing the credibility of verbal and nonverbal information provided by individuals during an interview, and systematic studies of this variable have been reported in the scientific literature at least since the 1920s (Crosland, 1929; English, 1926; Goldstein, 1923). However, the results have been equivocal, with researchers reporting increases (Goldstein, 1923; Luria, 1932; Vendemia et al., 2005), decreases (Dulaney, 1982; English, 1926), or no difference in RT between deceivers and non-deceivers (Stiff and Miller, 1986; Verschuere et al., 2004). Reasons for these conflicting results likely include the complicated nature of the interactions that occur as an interview progresses, and the large number of interpersonal variables, including the interviewer's affective state and personality type, which could intervene on the interviewees' RT during the interview process.

This work examines how these reciprocal effects might influence response time measures during a credibility assessment interview. We believe that, in order to isolate and study the effects of attempts to deceive on RT, the interview content and format must be held as constant as possible. One potentially useful way to do this is to substitute a computer-generated (CG) conversational agent for the human interviewer. Unlike human interviewers, CG agents, which are entities entirely controlled by computers, can produce virtually identical verbal and nonverbal behavior during repetitions of the same interview. Studies have shown that humans can interact with and respond socially to CG characters of various sorts (Bailenson et al., 2001, 2005; Brave et al., 2005; Cassell and Bickmore, 2000; Guadagno et al., 2007; Guadagno et al., 2011; Louwerse et al., 2009; Patton, 2010; Payr, 2001; von der Pütten et al., 2010). There is also some evidence that CG agents can effectively conduct credibility assessment interviews with humans (Pollina and Barretta, 2014; Pollina et al., 2008). Programmable CG agents enable the experimenter to automate and standardize specific processes including the interviewer's speech characteristics, facial features, and facial expression changes during an interview, as well as the timing of the interviewer's questions. This degree of standardization is simply not possible in studies where humans are conducting the interviews.

Another way in which the complex nature of the credibility assessment interview process might cloud the interpretation of

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the results obtained is variations in social dominance between the interviewer and the interviewee. When humans conduct credibility assessment interviews, there is usually a sense that the interviewer is in charge and able to control the flow of the interview, but previous studies have rarely examined this issue directly. CG agents are, by definition, entirely controlled by a computer. After the human experimenter instantiates the program, everything the CG Agent says, as well as its head, facial, and lip movements, are determined programmatically by the computer during the interview. However, if interviewees are not told that the CG character that is interviewing them is an agent, they may infer that a human interviewer is actually controlling the interview in real time, and that the character on the screen in front of them is a digital representation of the examiner (*vis*., an "avatar"). Research has shown that people's beliefs about whether the digital representations that are interacting with them are being controlled by other humans or by a computer can influence their social evaluations of these CG entities (Guadagno et al., 2011). We predicted that deceptive participants who believe that another human is actively engaged in the process of interviewing them would feel more immersed in the virtual interview environment, and that this perception, called *presence* by artificial intelligence researchers, would increase their RTs and durations at specific times during the interview; thus making their deceptions more detectable (Gerhard et al., 2004, 2005; Groom et al., 2009; Guadagno et al., 2007, 2011).

If response time variables are affected by perceived locus of interview control, this might also help to explain discrepant findings of past studies in which different degrees of interviewer control were manifest. The self-presentation theory postulates that liars experience certain feelings, such as guilt, more than truth tellers and that truth tellers under similar conditions genuinely experience emotions, possibly including anger at being accused, that liars can only attempt to fake (DePaulo et al., 1983, 2003). The model predicts that liars will attempt to present themselves in a manner consistent with the way they believe truth tellers do, and in so doing will increase their response latencies, produce slower speech, and be more apprehensive than truth tellers. DePaulo et al. suggest that reliable changes will occur only when self-presentations are in some way more effortful, such as when they are sustained for long periods of time, are more difficult to produce (e.g., spontaneous rather than rehearsed), and when the liars are highly motivated to generate the truthful presentations. The motivational aspects of the DePaulo et al. (2003) theory also suggest that stable components of the interviewee's personality might be related to their behavioral responses during a credibility assessment interview.

Another of our objectives was therefore to explore the relationship between the motivational systems that are thought to control appetitive and aversive behaviors in humans and the behavioral responses of deceptive and nondeceptive individuals. The use of a CG agent in this context allowed us to explore this relationship without potential confounds stemming from random or systematic changes in the interviewer's behavior during repeated presentations of the interview. We utilized a well-studied theoretical framework (Gray, 1987; Avila, 2001) that postulates the existence of two motivational subsystems; the behavioral inhibition system (BIS) and the behavioral activation system (BAS). In Gray's theory, the BIS system mediates responses to higher order aversive stimuli (i.e., punishment; removal of a positively valued stimulus) and the BAS system mediates responses to higher order appetitive stimuli (i.e., reward; removal of a negatively valued stimulus).

The predictions of DePaulo's self-presentation theory of deceptive behavior suggest that deceptive individuals should increase RTs and response durations when responding deceptively, especially when they don't have time to rehearse their lies and thus have a greater fear of getting caught. Gray's motivational model suggests that individuals with an overactive BIS should also increase their RTs when responding deceptively. Taken together, these theories lead us to predict an interaction between deception and the BIS, such that highly anxious individuals who are responding deceptively should show increased RTs and durations, relative to truthful or less anxious individuals. However, this assumes that any question that is lied to will be treated as an aversive stimulus, which might not be the case. If, for example, the individual interprets a question that must be lied to in order to not be caught as an opportunity to perpetrate the deception, then the individual could interpret the question as a positively valued stimulus (Ekman and Frank, 1993). In that case, we would predict a relationship between an individual's deceptive status and the BAS, although the precise nature of that relationship is less clear. For example, one study failed to find a significant relationship between RT changes to stimuli signaling the possibility of reward and hypomania, which has been related to dysfunction in the BAS (Johnson et al., 2005). The authors suggest that psychomotor skill might be more important than motivational variables for certain kinds of tasks. However, it might also be the case that the participants' motivation to succeed on the study task was simply not high enough. This criticism has also been leveled at credibility assessment (e.g., polygraph and related technologies) research employing mock crime scenarios to simulate field conditions. In these types of studies, low accuracy rates are often seen as a consequence of the lack of psychological stress or motivation experienced by study participants, relative to field conditions (Pollina et al., 2004, 2008).

Our hypothesis was that the nature of these relationships are quite complex, and that the types of questions asked, personality and emotional state of the interviewee, incentives to succeed, and type of social interaction between the interviewer and interviewee are all moderating variables that can cloud specific effects when they are not controlled for. Our first objective was therefore to utilize a CG Agent to precisely control the method of stimulus presentation. We hypothesized that standardized CG interviews using several types of crime-relevant, innocuous, and emotion arousing questions in a pre-specified order, coupled with precise measurements of the duration and RT to these questions would allow us to develop a statistical model that would result in deceptive vs. nondeceptive classification accuracies that were significantly greater than that which would be expected by chance. This would be useful in showing that response time variables are related to deception when an automated, more standardized interview is used. Our second objective was to characterize the relationship between the perceived locus of interview control, personality, and these behavioral measures. This objective could only be realized if the study participants were motivated during the study. This might not have been the case in studies that used a less involved deception scenario. We therefore made an attempt to create an involved scenario which could foster a fascination with the process and a desire to succeed, in order to determine whether RT measures can, at some point in the future, contribute to a definitive theory of deceptive responding.

2. Method

2.1. Research plan

We examined behavioral indices of deception using a CG agent and special purpose software designed to conduct automated credibility assessment interviews. Participant testing and data collection were conducted in Columbus, Ohio by researchers at