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Deception effects on standing center of pressure

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ABSTRACT

Accurate deception detection is a desirable goal with many applications including credibility assessment, security screening, counter-terrorism, and homeland security. However, many deception detection methodologies involve intrusive sensors or other limitations that preclude their use in a covert manner. Posturography may overcome these limitations by using minimally invasive force platform technology. In this study, we tested the hypothesis that posturography would reveal deception-related increases in postural rigidity similar to those observed with previous methodologies. Participants were randomly assigned to a control (CG) or experimental group (EG), and interviewed about the contents of a backpack in their possession while standing on a force platform. EG participants were asked to conceal the presence of several "prohibited" items in the backpack from the interviewer. Center of pressure (COP) measures from the force platform were used to characterize postural sway during participants' verbal responses. We observed a significant deception-related increase in sway frequency, an effect primarily occurring during longer responses that is likely related to increased cognitive load. These findings suggest deception-related increases in postural rigidity as reported in previous work, and demonstrate the feasibility of using posturography as a deception detection tool.

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1. Introduction

Accurate deception detection is a much sought-after goal that has potential applications in many fields, including credibility assessment, security screening, counter-terrorism, and homeland security. Commonly used deception detection techniques, which typically capitalize on deception-related physiological changes, include the polygraph, voice stress analyzers, brain activity analysis, and thermal scanning (Jensen, Meservy, Burgoon, & Nunamaker, 2008). However, such techniques are intrusive in that they often require sensors to be attached to the body, thus limiting their use in identification of deceptive behavior in natural environments.

An alternative to physiological techniques is video-based deception detection, which is focused on identification of human motion associated with deceptive behavior. Video-based deception detection techniques have shown that distinctive movements differentiate truth-telling from deceit and that such behavioral indicators can be captured and tracked automatically with computer vision techniques (Burgoon et al., 2009; Meservy et al., 2005; Michael, Dilsizian, Metaxas, & Burgoon, 2010). Still, video-based techniques can be insensitive to small or occluded movements, difficult in terms of data reduction and feature extraction, and prone to image processing errors in real-world scenarios.

Computerized static posturography (CSP) has the potential to overcome the limitations of, or augment, video-based deception detection. CSP involves analysis of the body's center of pressure (COP), which is defined as the point of application on the ground of the body's net resultant force vector (Murray, Seireg, & Scholz, 1967). CSP has been used in clinical settings to evaluate balance deficiencies caused by age- or disease-related factors such as peripheral neuropathy (Corriveau et al., 2000; Horak, Dickstein, & Peterka, 2002; Lafond, Corriveau, & Prince, 2004), stroke (Corriveau, Hebert, Raiche, & Prince, 2004; Laufer, Schwarzmann, Sivan, & Sprecher, 2005), and Parkinson's disease (Horak, Dimitrova, & Nutt, 2005; Schmit et al., 2006).

CSP has also been used on a limited basis in classification of human movement patterns. For example, researchers have applied pattern recognition analyses to COP parameters in order to successfully discriminate between persons who are and are not prone to falling (Hewson, Singh, Snoussi, & Duchene, 2010), healthy controls and those with Meniere's disease (Tossavainen et al., 2006), and between persons with good and poor postural stability (Rasku, Joutsijoki, Pyykkö, & Juhola, 2012). Given previously observed deception-related effects on body kinesics (Burgoon, 2005; Burgoon et al., 2009; Meservy et al., 2005; Michael et al., 2010), such classification techniques have potential utility in posture-based deception detection as well. For instance, recent research using computer vision techniques have identified postural rigidity as a promising behavior cue associated with deception (Twyman, 2012; Twyman, Elkins, & Burgoon, 2011), a result confirming the large body of work citing reduced movement as a common deception-related finding on deception scoring instruments (Granhag & Strowall, 2002; Stromwall & Granhag, 2003; Vrij, 1995; Vrij & Mann, 2001; Vrij, Semin, & Bull, 1996). However, to our knowledge, no researchers have successfully discriminated between COP parameters of truthful and deceptive persons. As a preliminary step in achieving this goal, we applied traditional statistical methodology to investigate deception-related differences in COP parameters. We hypothesized that deceptive participants, compared to truthful ones, would exhibit COP patterns associated with increased postural rigidity when providing deceptive responses to interview questions. A positive result for this hypothesis would provide support for our future goal of identifying deceptive participants based on COP patterns.

2. Methods

2.1. Participants

A total of 48 young adult participants were recruited for this study from the University of Missouri – Kansas City Department of Psychology and university community. All participants were in good health, able to comply with study requirements, and provided written informed consent prior to test-