Deception in Context: Coding Nonverbal Cues, Situational Variables and Risk of Detection

Abstract

There are many situations in which deception may arise and understanding the behaviors associated with it are compounded by various contexts in which it may occur. This paper sets out a coding protocol for identifying cues to deception and reports on three studies, in which deception was studied in different contexts. The contexts involved manipulating risks (i.e., probability) of being detected and reconnaissance, both of which are related to terrorist activities. Two of the studies examined the impact of changing the risks of deception detection, whilst the third investigated increased cognitive demand of duplex deception tasks including reconnaissance and deception. In all three studies, cues to deception were analyzed in relation to observable body movements and subjective impressions given by participants. In general, the results indicate a pattern of hand movement reduction by deceivers, and suggest the notion that raising the risk of detection influences deceivers' behaviors. Participants in the higher risk condition displayed increased negative affect (found in deceivers) and tension (found in both deceivers and truth-tellers) than those in lower risk conditions.

Keywords: nonverbal cues, deception detection, cognitive load, reconnaissance

1. INTRODUCTION

Behavioral cues related to deception include both verbal and nonverbal markers (DePaulo *et al*., 2003; Vrij, 2008) exhibited by deceivers who deliberately conceal their intent (e.g., Kirchhuebel & Howard, in press; Lawson *et al.*, in press). The study of these factors is complex and compounded by the various contexts in which these behaviors may occur (Vrij, 2008), as well as individual differences (e.g., personality traits) that may influence fundamental psychological processes of deception (Vrij, 2008) and perceptions of risk of being detected (Rhodes & Pivik, 2011). Previous research has revealed three fundamental processes of deception: emotion, cognitive effort, and attempted behavioral control (Vrij, 2008; Zuckerman *et al*., 1981). Nonverbal and verbal deception cues are linked to these psychological processes underlying acts of deception.

While it has been argued that nonverbal cues are not as stable as some verbal indicators (e.g., Vrij & Granhag, 2012), cues presented by deceivers are determined to some extent by the context in which they occur. For example, a terrorist may not have to speak to anyone when passing through a public space, thus only nonverbal cues may be available to be assessed by others. We considered that the contextual variables such as risk of being detected could not only influence decisions of deception (Sip *et al.*, 2010), but also alter the cues presented by deceivers. Given the possible effect of contextual variables, we conducted three studies in different deception contexts (see details in section 1.2). In addition, research in the field of deception cues is still at the exploratory stage and the current approaches point towards research assessing deception cues from different channels (DePaulo & Bond, 2012; Porter & ten Brinke, 2010). With this in mind, it is useful to gain further understanding of nonverbal cues via the present research that focuses on cues that are observable to other

people, so as to assess what nonverbal deception cues could be spotted where detailed behavioral analyses are not feasible. Such cues should ideally be observed from a distance, as it is not always possible to approach suspects in public crowded spaces.

It has been argued that no single cue can reliably identify deception due to the lack of developed coding schemes that have generated poor results in previous studies (Vrij, 2008). Therefore, in the current research, a coding protocol (detailed in section 2) was developed as an elaboration of a previous scheme related to cues identified across different sections of the body (Vrij *et al.*, 1996). Impressions given by deceivers based on the fundamental processes of deception (e.g., negative affect in relation to negative emotions) were also coded and analyzed.

1. 1. Psychological Processes Underlying Deception

In the literature, there are many nonverbal cues related to the underlying psychological processes of deception. Some are negative emotions such as fear or guilt, whilst others are positive emotions, such as excitement, relief and pride (Ekman, 1992; Ekman & Frank, 1993; Porter & ten Brinke, 2008). There are macro negative emotional cues such as reduced hand and arm movements during speech (Vrij, 2008) and positive cues such as smiling (Memon *et al*., 2003).

The process of lying may require extra cognitive effort as liars suppress true information whilst forming lies and remembering false information (Langleben *et al*., 2002; Spence *et al.*, 2001; Vrij *et al*., 2008; Walczyk *et al*., 2005). Liars also need to monitor their own behavior (Vrij & Mann, 2005) and their target's reactions (Burgoon *et al*., 2008), which places a high demand on the liar's cognitive processing (Carrión *et al*., 2010). Visible cues to

cognitive effort are, for instance, fewer hand and/or arm movements (Ekman, 1997; Memon *et al*., 2003), less blinking (Bagley & Manelis, 1979), more gaze aversion (Ekman, 1997; Doherty-Sneddon & Phelps, 2005). Attempted behavioral control varies at an individual level and can be influenced by emotional demands and cognitive load. However, deliberate behavioral self-regulation can sometimes make a liar's behavior appear contrived, tense, and over-controlled (DePaulo & Kirkendol, 1989; Vrij, 2008).

1. 2. Cues to Deception and Contextual Variables

Cues related to the fundamental processes of emotion, cognitive effort, and attempted behavioral control are not consistently presented by liars. For example, fewer hand or arm movements can be an indication of cognitive overload (Ekman, 1997; Memon *et al*, 2003), negative emotions (Vrij, 2008), or an intention to deceive (Lawson *et al*, in press). Therefore, it is widely believed that no single cue can reliably identify deception (DePaulo *et al*., 1985; Vrij, 2008; Vrij *et al*., 2001). In addition, according to Interpersonal Deception Theory (IDT) (Buller & Burgoon, 1996) liars adjust their behavior and may try to avoid 'dishonest' behaviors (Burgoon *et al*., 1996), which increases the difficulty to spot deception cues reliably. The inconsistencies of the psychological processes involved in deception supports the view that deception cues may vary in different contexts (Vrij, 2008). Therefore, we consider context as a crucial factor in detecting deception cues. We investigated deceptive behavior in different forms and situations so as to broaden the established understanding of nonverbal deception cues.

Given that context can determine deceivers' behavior, we investigated deception-related behaviors in settings that are relevant in the fields of terrorism prevention, criminal

investigation and promotion of public safety. The present research sought to investigate situations both inside and outside traditional laboratory settings, where participants usually remain seated throughout experiments with an interviewer. Three studies were designed to assess deception in different contexts:

- Lying in front of peers in a semi public space (a classroom).
- Lying during interaction with another person in a private space (in a laboratory).
- Lying and reconnaissance whilst passing through a security control point in a public space (the corridor of a building).

The first goal of the present research was to investigate observable nonverbal cues in relation to deception. We did not target specific cues, but tested a number of nonverbal body movements across body sections, as observed by people using the coding protocol, as specified in section 2. This is due to the fact that nonverbal cues are unstable and inconsistent across contexts. In addition, we investigated impressions given by deceivers, based on the fundamental processes of deception.

From the above approach, four general hypotheses assessing nonverbal cues related to deception were proposed. Hypothesis 1, deceivers will present different amounts of observable body movements, as compared to truth-tellers. Hypothesis 2, impressions related to emotional process of deception (e.g., negative and/or positive affect) will be presented by deceivers as compared to truth-tellers. Hypothesis 3, impressions related to cognitive effort of deception will be presented by deceivers as compared to truth-tellers. Hypothesis 4, impressions related to attempted behavioral control processes of deception will be presented by deceivers as compared to truth-tellers.

Deception cues can be influenced by contextual variables such as the degree of stakes of deception (i.e., the extent of the positive or negative consequence of deception) (e.g., Hartwig *et al*., 2006; ten Brinke & Porter, 2012) and task complexity (Lancaster *et al.*, 2012; Vrij *et al.*, 2011). Contextual variables can introduce variance with regard to specific deception cues. When faced with higher stakes, liars tend to illustrate more behavioral reductions and signs of increased cognitive activity (i.e., they appear to be 'thinking hard') (Porter & ten Brinke, 2010; Vrij & Mann, 2001). Considering that deceiving is often a risk-taking behavior, factors that influence it could be related to those that influence risk-taking behavior as well. According to cognitive psychologists, people who engage in risk-taking behaviors do not only consider the extent of the negative outcome if they are detected (in relation to stakes), but also weigh the probability of being detected (Breakwell, 2007; Sip *et al.*, 2010). The probability of deception detection is therefore important as well as the extent of the consequences of deception (i.e., stakes). Both of these may influence the involvement of the underlying psychological processes of deception such as fear and cognitive effort. In the present paper, we refer to the risk of deception detection in describing the probability of being detected. Therefore, our research manipulated the degree of risk in order to assess how it might influence deception cues.

In Study 1, this was achieved through the introduction of evaluated and non-evaluated deception conditions, since introducing evaluation of truthfulness increases the possibility of being detected. In Study 2, the degree of risk was manipulated by altering the evaluators: that is, evaluations performed by security staff were designed to elicit a higher level of risk of deception detection, compared to evaluations performed by a lay person. Given the discussion above, we proposed that higher risks might result in a higher extent of

involvement of psychological processes. We therefore propose another two general hypotheses (regardless of specific cues) in testing the effect of risks of deception detection. Hypothesis 5, there will be a greater extent of observable nonverbal cue(s) (either body movement(s) and/or impression(s)) exhibited in deceivers when the risk of detection is higher, compared to lower risk levels. Hypothesis 6, the extent of such observable cues will be positively correlated with the level of risk of deception detection; the higher the risk the more cues will be observed.

Deceiving does not usually happen as a single event but often entails multiple deceptions resulting in increased cognitive effort to remember scripts, control behavior and monitor the target's responses (Vrij, 2008). It has been found that increasing cognitive loading can elicit deception cues (e.g., Lancaster *et al.,* 2012; Vrij *et al.,* 2009). In order to investigate this, in Study 3, a duplex lying and reconnaissance task was designed to provide higher levels of task difficulty than single deception tasks. From this, a final hypothesis was developed. Hypothesis 7, deceivers performing a reconnaissance task in addition to lying will display more observable nonverbal cues than deceivers performing only one task.

Demographic characteristics (age, gender, and cultural differences) related to individual differences may influence nonverbal (Vrij, 2008) and risk taking behavior (Byrnes *et al.,* 1999; Rhodes & Pivik, 2011). They are not the focus of this study, but they were included as covariates in the data analysis so as to prevent a significant influence on the results.

2. A CODING PROTOCOL FOR IDENTIFYING CUES TO DECEPTION

Across all three studies, behavior data were collected and edited into video clips. There were 337 clips in total (32 clips in Study 1, 210 clips in Study 2, and 95 clips in Study 3) that were

then assessed using a coding system based on the nonverbal cues literature (DePaulo, *et al*, 2003; Vrij, *et al*., 1996; Vrij, 2008) (Table I). The specific movements coded were slightly different according to study settings (e.g., participants were seated in Study 2, but were standing/walking in Studies 1 and 3). Hand and arm data were scrutinized in more detail (Table II).

TABLE I ABOUT HERE

TABLE II ABOUT HERE

Three raters (MSc and PhD students in social sciences at a UK university) subjectively coded 10% of the video clips, taken as a random sample, for inter-rater reliability test purposes. A selection criterion for inter rater reliability (Cronbach's alpha > .70) was applied across Studies 1, 2 and 3 for each body section and impression category. Since adequate values for inter-rater reliability tests were obtained, numerical data obtained from the three raters were averaged and combined under each item with the remaining video clips that were then rated by two of the three raters. The raters were blind to the experimental conditions and hypotheses and coded the frequency and duration of movements across the body sections using separate 7-point scales ranging from 1 = *exists (frequency) or brief (duration)* to 7 = *always (frequency) or whole session (duration).*

As introduced in sections 1 and 1.2, detailed categorizations of impressions given by participants were also coded (Table III). In Studies 1 and 2, raters coded impressions elicited by participants in the video using a 5-point Likert scale ranging from 1 = *not at all* to 5 = *to a great extent*. The rating scheme was extended by using a 7-point scale across the same

descriptors in Study 3 to increase the sensitivity of the data.

TABLE III ABOUT HERE

Two filtering steps were performed on the dependent variables before data analyses were conducted:

- In order to filter out movements that seldom occurred in the participant pool, descriptive statistics were obtained and movement variables that were shown by fewer than 30% of the participants were excluded from the data analysis.
- As the cut-off point filtered out different variables across the three studies, the common items of dependent variables in the three studies were retained.

A series of Analysis of Covariance (ANCOVA) were conducted within each study for movement and impression variables. Bonferroni corrections were employed to reduce the chance of Type I errors (Field, 2005) and demographic information including age, gender, nationality (western and non-western) were assessed as covariates. The missing values in body movement variables were coded as '0', representing the 'absent' status of movements.

3. STUDY 1: LYING IN FRONT OF PEERS

3.1. Method

3.1.1. Participants.

For this study, 34 University students were recruited. Participants with invalid data (e.g., incomplete/unclear video footages) were excluded. Valid data from 32 participants (17

males, 15 females, M_{age} = 22.86 years, *SD* = 3.89) were included in the analyses. To participate, students were required to have normal, or corrected to normal, vision and hearing, normal ability of body movement and communication.

3.1.2. Apparatus.

The experiment, conducted by three researchers, took place in a University lecture room. An envelope for each participant contained an instruction sheet, an evaluation sheet, and a token. The token was a small card with one of nine possible combinations of its features based on three colors (e.g., red, blue or yellow) and three shapes (e.g., heart, square or triangle). A short self-rating manipulation check questionnaire assessing e.g., levels of nervousness, perception of levels of task difficulty and motivation, and a demographic information completion sheet (e.g., age, gender and nationality) were included. Two high-definition video cameras were used to record behaviors. Each participant received a confectionery reward for completing the study.

3.1.3. Design and procedure.

In this study the independent variables of deception and degree of risks were manipulated in a 2 (veracity) × 2 (risk level) between-subjects design and participants were randomly assigned to the four groups. Veracity was manipulated by instructing participants to deceive or tell truth about the color and shape of the token they received. Risk levels were manipulated by whether or not asking peers of the participants to evaluate whether the participants were being deceptive about the token they had. Upon receiving an envelope containing task instructions and a token, participants were instructed not to expose the token

during the experiment. Each participant stood at the front of the classroom and gave a short presentation to the audience, including their student number, name, a curious fact about themselves (e.g., "I run five miles every day") and a description of their token containing its color and shape (e.g., "I have a blue triangle"). The content of the presentation, as related to participants themselves, was designed with the purpose of enhancing motivation to perform well by introducing self identity-related tasks (DePaulo *et al*., 2003).

The group 'deceiver & evaluated' (DE) lied about the token and were evaluated by their peers. Then the group 'truth-teller & evaluated' (TE) performed the task and did not lie about the token but were also evaluated by their peers. Participants in these two groups were told that the overall group ranking was to be announced later to the class members; however, this was designed purely as a mechanism to manipulate the level of risk involved in the evaluated presentations. Groups of 'deceiver & non-evaluated' (DN) and 'truth-teller & non-evaluated' (TN) participated similarly as DE and TE but were not evaluated by their peers. After their presentations, participants completed the questionnaire pack together with the manipulation check questions and then received their confectionery reward for their participation. Behavioral data were recorded using video cameras and transferred into numerical data through the coding processes.

3.2. Results

ANCOVAs were conducted for all dependent variables, Bonferroni corrections were performed (six tests ran in total, Corrected $\alpha = .01$). Age, gender and nationality (western/non-western) were retained as covariates. Based on the coding of video data, the results of ANCOVAs for the significant dependent variables are presented in Table IV. Inter

rater reliability for the significant dependent variables in the overall coding are Cronbach's α = .70 (hand holding); and α = .64 (hand/arm).

TABLE IV ABOUT HERE

By controlling for the covariates including age, gender and nationality (see details in Table IV), a significant effect of veracity emerged for holding of hands: $F(1, 21) = 4.75$, $p < .05$, $\eta_p^2 = .18$, with Cohen's $d = 0.83$. This illustrated that hand holding was higher for liars ($M = 4.74$, $SE = 1.13$) than truth-tellers ($M = 1.36$, $SE = 1.05$). Holding of hands was classified under hand/arm movements and indicated movement reduction and moderately tense behavior (Mehrabian, 1968). These findings support Hypothesis 1, that deceivers would present different amounts of observable body movements, when compared to truth-tellers.

There was a trend towards significance for hand/arm movements for the evaluation variable (risk of detection): $F(1, 21) = 4.29$, $p = .051$, $\eta_p^2 = .17$, Cohen's $d = -0.80$. The evaluation condition yielded fewer hand/arm movements ($M = 2.19$, $SE = 1.12$) than the non-evaluation condition ($M = 5.90$, $SE = 1.39$). As decreased limb movement is one of the recognized cues to deception, this finding leads to further consideration of Hypothesis 5, that there will be a greater extent of observable nonverbal cue(s) (either body movement(s) and/or impression(s)) exhibited in deceivers when the risk of detection is higher, compared to lower risk levels. Nonetheless, the finding of a trend of effect for risk across veracity conditions indicates that the same magnification effect applies for truth-tellers as well. No covariates were statistically significant in relation to level of risk.

3.3. Discussion

This study revealed that risk (i.e., probability of deception detection) might have a similar effect as deception in altering nonverbal behavior (e.g. a reduction in hand movements). The finding suggests that not only the stakes (i.e., the extent of consequences of deception) as found in previous studies, but also risks (i.e., the possibility of being detected) might magnify the effect on deceivers' behaviors. However, similar to stakes, enhancing risks can lead to misjudgment as to whether or not someone is lying, since truth-tellers under higher risks can present similar reduced hand movements as deceivers. In addition, it is unknown whether there are individual differences in perceiving risk levels of deception detection. To further understanding these questions, Study 2 used a within-subjects design to compare behavior exhibited by the *same* person across *different* conditions of veracity and risks of deception detection. Different levels of risks (low, moderate, and high) were assessed to investigate if the extent of cues presented by the same individual were affected by increased risk levels.

4. STUDY 2: LYING DURING INTERACTION WITH ANOTHER PERSON

4.1. Method

4.1.1. Participants.

For this study, 40 University students were recruited. Participants with invalid data (e.g., incomplete/unclear video footages) were excluded. Valid data from 35 participants (7 males, 28 females, M_{age} = 27.40 years, SD = 7.91) were included in the analyses. To participate, students were required to have normal, or corrected to normal, vision and hearing, normal ability of body movement and communication.

4.1.2. Apparatus.

Each participant received a folder containing either one article (about education) or two articles (one about education and another about deception). The same covariate and manipulation check questions were used from Study 1. Two high-definition video cameras were used to record behaviors. This study was conducted by three researchers, two of whom took on the roles of confederates (e.g., 'student' and 'security guard'). Each participant received a £5 voucher as well as a confectionery reward for completing the study.

4.1.3. Design and Procedure.

In this study the independent variables of deception and risk were manipulated in a 2 (veracity) × 3 (level of risk) within-subjects design, and the assignment of the six conditions was counterbalanced. Participants either deceived or told truth about the articles they had in each condition. The level of risk of deception detection was manipulated with the confederates engaging in face-to-face evaluations regarding the veracity of participant statements about the article. There are three levels of the risk variable, the lowest, moderate, and highest risk of being detected.

In the deception conditions participants were provided with a folder containing two written articles and instructed to conceal and lie about having the deception article throughout the tasks. The deception article gave a non-detailed introduction of deception. It did not include any information about nonverbal cues of deception, in order to prevent influencing participants' nonverbal behavior. Participants were first left alone in the room to read the articles whilst their behavior was video recorded (condition 'deceiving & alone' = lowest risk). This condition involved no social interaction and therefore there was the lowest risk of

being detected amongst the three levels of the risk variable. In this section, participants' behavior was analyzed so as to identify whether they demonstrated any specific cues in relation to deception. This was based on previous work (Lawson *et al.*, in press), which indicated that individuals intending to lie would behave differently to those intending to tell the truth. Although no statement was involved, deceivers were experiencing concealed intention of deceiving whereas truth-tellers were not. After five minutes, a confederate who assumed the appearance of a student entered the room and interacted with the participant (condition 'deceiving & layperson' = moderate risk). During this phase of the experiment the participant was encouraged to act normally and not to draw attention to him/herself or raise suspicions of having the deception article. After five minutes the student left and a 'security guard' entered the room and conducted a mock security interview (condition 'deceiving & security guard' = highest risk). The participants were instructed that the guard was skilled in deception detection and had the authority to remove them from the study if they were caught lying. For experimental consistency, the guard interviewed all participants and purposefully 'failed' to detect any deceptive cues in any participants.

In the truth-telling conditions ('truth-telling & alone', 'truth-telling & layperson', and 'truth-telling & security guard') the task was identical to the deception conditions except that participants did not have the deception article and thus did not have to lie about it to the confederates. Since truth-tellers would still be evaluated in two of the sections, we intentionally removed the deception article from what they would be reading so as to prevent the impact of the deception contents on truth-tellers (e.g., the deception contents might lead to task-irrelevant nervousness while being asked about deception during the security interview). The time between the sessions ranged from one to two minutes. After each set of

three conditions participants completed the manipulation check questions. They then completed the covariate battery followed by a debrief session and were given a £5 voucher and an extra confectionery reward for their participation. Behavioral data were recorded using video cameras and transferred into numerical data through the coding processes.

4.2. Results

Repeated-measures ANCOVAs were conducted for all dependent variables, Bonferroni corrections were performed (12 tests ran in total, Corrected $\alpha = .00$). Covariates of age, gender and nationality (western/non-western) were retained in the tests. The results of ANCOVAs for the significant dependent variables are presented in Table V. Inter rater reliability for the significant dependent variables in the overall coding are Cronbach's $\alpha = .64$ (hand holding); $\alpha = .65$ (negative affect); and $\alpha = .81$ (tension).

TABLE V ABOUT HERE

By controlling for the covariates including age, gender and nationality the results revealed no significant effects of deception for either movement or impression variables. Hand holding movements were significant for risks, $F(2, 56) = 3.46$, $p < .05$, $\eta_p^2 = .11$. The risk level 1(i.e., alone in room) ($M = 3.66$, $SE = 0.27$), 95% CI [3.10, 4.22] and level 2 (i.e., with layperson) ($M = 5.93$, $SE = 0.71$), 95% CI [4.47, 7.38]; and level 3 (i.e., with confederate security guard) ($M = 7.23$, $SE = 0.72$), 95% CI [5.76, 8.70]. The results showed a significant main effect of risks on hand holding, where such movements were increased in the two conditions with social interactions (level 2 & level 3), compared to the condition when participants were

alone (level 1). However, the difference between level 2 and level 3 did not reach the significance level, according to Bonferroni corrected post-hoc tests (paired t-test).

A significant main effect of risks emerged in the impression of negative affect (unpleased impression), $F(2, 56) = 4.24$, $p < .05$, $\eta_p^2 = .13$. There was greater negative affect associated with higher risk levels with 95% CI [1.55, 1.85] for level 1 ($M = 1.70$, $SE = 0.07$), 95% CI [1.67, 1.98] for level 2 ($M = 1.82$, $SE = 0.08$), and 95% CI [1.84, 2.21] for level 3 ($M = 2.03$, $SE = 0.09$). The subsequent Bonferroni corrected post-hoc test showed a significant difference of negative affect between level 1 and level 3, $t(34) = -3.10$, $p < .01$; and level 2 and level 3, $t(34) = -2.60$, $p = .01$. However, such significant difference was only found in deceivers and even then not between level 2 and level 3. The impression of tension was mainly influenced by risks as well, $F(1.63, 45.52) = 3.92$, $p < .05$, $\eta_p^2 = .12$, level 1($M = 2.56$, $SE = 0.06$), 95% CI [2.43, 2.69], level 2 ($M = 2.78$, $SE = 0.10$), 95% CI [2.58, 2.97], and level 3 ($M = 3.18$, $SE = 0.06$), 95% CI [3.05, 3.30]. Tension impression was significantly different between level 1 and level 3, as well as level 2 and level 3. The subsequent Bonferroni corrected post-hoc tests showed a significant difference of tension impression between level 1 and level 2, $t(34) = -3.37$, $p < .01$, in truth-tellers but not in deceivers.

These findings of the main effect of risk partially support Hypothesis 5, that there will be a greater extent of observable nonverbal cue(s) (either body movement(s) and/or impression(s)) exhibited in deceivers when the risk of detection is higher, compared to lower risk levels. The significant difference in the extent of nonverbal cues between levels of risks was not found in all comparisons. Therefore the results did not completely support Hypothesis 6, that the extent of such observable cues would be positively correlated with the level of risk of deception detection; the higher the risk the more cues that would be observed.

Notably, although the findings suggest that higher risks can lead to increased nonverbal cues presented by deceivers than in lower risk conditions, a main effect of risk combines both deceivers and truth-tellers.

4.3. Discussion

Study 2 revealed a main effect of risk that led to reduction in hand movements (hand holding is categorized as a reduced hand movement). Hand movements significantly decreased while participants engaged in interaction with confederates compared with when they were alone. However, it is possible that engaging in conversation changed participants' hand holding movements irrespective of the risk variable. Study 2 also showed that impressions of negative affect and tension increases under higher risks. Deceivers showed significant increased negative affect in the highest risk condition, compared with the two lower risk conditions. Truth-tellers did not show a similar pattern of negative affect. In addition, there was also a significant increase in extent of tension impression in the highest risk condition. However, both deceivers and truth-tellers were influenced, suggesting that risk has strong influences on tension impression regardless of deception. The difference of such nonverbal cues was not significantly different between risk level 1 and level 2. However, the highest risk of detection (i.e., evaluated by a security confederate) did significantly influence nonverbal cues, compared to the other two lower risk levels.

Given the literature suggesting that increased cognitive loading can enhance the detectability of deception indicators (Vrij & Granhag, 2012), Study 3 was designed to assess dual deception tasks in order to increase cognitive loading in individuals. This was done to investigate if cognitive loading can be more effective in magnifying the difference between

deceivers and truth-tellers than risk of detection. The tasks took the form of simulating a security identity check as well as a reconnaissance task that could be conducted by terrorists, in order to investigate cues that could be observed in such contexts.

5. STUDY 3: LYING AND RECONNAISSANCE WHILST PASING THROUGH A SECURITY CONTROL POINT

5.1. Method

5.1.1. Participants.

For this study, 100 University students were recruited. Participants with invalid data (e.g., incomplete/unclear video footages) were excluded. Valid data from 94 participants (22 males, 72 females, M_{age} = 26.53 years, *SD* = 8.66) were included in the analyses. To participate, students were required to have normal, or corrected to normal, vision and hearing, normal ability of body movement and communication.

5.1.2. Apparatus.

The experiment was conducted in the corridor of a university main building. Each participant placed an adhesive label over their name on their university ID card. The same covariate and manipulation check questions were used from Study 1 and Study 2. Two high-definition video cameras were used to record behaviors. This study was conducted by three researchers, one of whom took on the role of a ‘security guard’. Each participant received a £5 voucher as well as a confectionery reward for completing the study.

5.1.3. Design and Procedure.

In this study the independent variables of duplex deception were manipulated in a 2 (deception about identity) × 2 (reconnaissance) between-subjects design. Participants were randomly assigned to one of the four groups. Deception about identity was manipulated by instructing participants to either lie or tell the truth about their name. The reconnaissance task was manipulated by instructing participants to either covertly memorize objects in the environment (e.g., how many chairs in the room) or not to memorize objects. The context of this study aimed to simulate a public security checkpoint scenario and typical reconnaissance activities conducted in public spaces.

Participants were asked to pass through a security door set up at the entrance of an office. While monitoring the security door a confederate security guard asked for and checked each person's name on the label of their student ID card. Groups of 'deceiver & reconnaissance' and 'deceiver & no-reconnaissance' put a fake name on the label of their student ID card and lied about their real names. These groups were informed that they would lose entitlement to an extra reward if they were caught lying; this was not applicable for the truth tellers. For experimental consistency, the guard interviewed all participants and purposefully 'failed' to detect deceptive cues in any participants. The 'deceiver & reconnaissance' group also covertly memorized the notable objects while passing through the space. After completing the deception task, they were required to identify observed objects on a list and then complete the questionnaire pack.

The 'truth-teller & reconnaissance' group followed the same process but told truth about their names. The 'truth-teller & no-reconnaissance' group neither lied about their names nor performed the reconnaissance task. When the study was completed, the researcher debriefed and rewarded each of the participants with a £5 voucher and an extra confectionery

for their participation. Behavioral data were recorded using video cameras and transferred into numerical data through the coding processes.

5.2. Results

ANCOVAs were conducted for all dependent variables, and Bonferroni corrections were performed (six tests ran in total, Corrected $\alpha = .01$). Age, gender and nationality (western/non-western) were retained as covariates in the tests. The results of ANCOVAs for the significant dependent variables are presented in Table VI. Inter rater reliability for the significant dependent variables in the overall coding are Cronbach's $\alpha = .84$ (trunk); $\alpha = .94$ (hand/arm); $\alpha = .88$ (positive affect); and $\alpha = .74$ (eye/eye brow).

TABLE VI ABOUT HERE

By controlling for the covariates including age, gender and nationality there was a trend towards significance in deception with trunk movements: $F(1, 85) = 3.82$, $p = .054$, $\eta_p^2 = .05$, Cohen's $d = -0.41$, revealing that liars presented fewer trunk movements (M = 1.69, SE = 0.25) than truth-tellers (M = 2.40, SE = 0.25). A similar trend of decreased hand and arm movements emerged, $F(1, 85) = 3.85$, $p = .053$, $\eta_p^2 = .04$, Cohen's $d = -0.41$, with fewer such movements for deceivers ($M = 2.41$, $SE = 0.45$) than truth-tellers ($M = 3.68$, $SE = 0.45$). These findings indicate a trend of decreases in limb movements providing support towards Hypothesis 1, that deceivers would present different amounts of observable body movements, when compared to truth-tellers. Subjective impressions of positive affect were significantly influenced by deception, $F(1, 85) = 5.94$, $p < .05$, $\eta_p^2 = .07$, Cohen's $d = 0.51$. Liars displayed

more positive affect (M = 3.01, SE = 0.16) compared to truth-tellers (M = 2.45, SE = 0.16) supporting Hypothesis 2, that more impressions related to emotional process of deception (either negative and/or positive affect) would be presented by deceivers than truth-tellers.

Eye/eyebrow movements were significantly influenced by reconnaissance, $F(1, 85) = 5.68$, $p < .05$, $\eta_p^2 = .06$, Cohen's $d = 0.51$. Covert information collection conditions yielded more eye/eyebrow movements (M = 3.79, SE = 0.15) than conditions where there were no reconnaissance activities (M = 3.28, SE = 0.15).

5.3. Discussion

The trend for hand movement reduction found in this study reflected the similar findings in Studies 1. In addition, positive affect was observed as an indicator associated with the underlying emotion process. The replicated trend of hand movement reduction suggests it might be a consistent cue across the two contexts assessed in Studies 1 and 3. The only cue found in relation to reconnaissance was the increased eye/eyebrow movements. However, this is considered a task-related result since participants looked around as part of the reconnaissance activity. This does not support Hypothesis 7, that deceivers performing a reconnaissance task in addition to lying would display more observable nonverbal cues than deceivers performing only one task. The failure to find significant cues in relation to the dual deception tasks suggests that nonverbal cues we have investigated might not be as sensitive as verbal cues (e.g., as found in Vrij *et al.*, 2011) in relation to cognitive loading. Hypotheses 3 and 4 were not supported by any of the three studies.

6. GENERAL DISCUSSION

The present research consisted of three studies assessing different deception contexts. The contexts ranged from a private space to a public space, involving both manipulations such as risks of deception detection and reconnaissance, and contexts that cannot be manipulated (e.g., passersby as an audience when the deception is conducted in a public space). In addition to investigating deception that can happen in regular life (Study 1), we simulated deception tasks that may occur in specific instances and could violate public safety (e.g., deceiving a member of security staff in Study 2 and the reconnaissance task in Study 3) in order to compare the findings from such different settings.

The findings (shown as either significant or a trend of significance) from Studies 1 and 3 in relation to deception suggest the involvement of the fundamental psychological processes related to deception. The trend in trunk and limb movement reductions indicates nonverbal cues in relation to negative emotions (Vrij, 2008), cognitive overload (Ekman, 1997; Memon *et al*., 2003), and behavioral control (Meservy *et al*., 2005; Vrij *et al*., 1997), whereas the increased positive affect observed in liars provides evidence of positive emotions associated with deception (Memon *et al*., 2003). In addition, the present research indicates that the deception cue of limb reduction is found for situations under which deceivers are standing (in Study 1) or moving around (in Study 3) and therefore extends the traditional paradigm of using seated participants with an interviewer in laboratory settings.

The findings in Studies 1 and 2 suggest that reduction in hand movements related to the cognitive effort and attempted behavioral control processes might be magnified when the level of risks are raised. However, since there is no significant difference in Study 1 and across levels of risks in Study 2, this needs to be assessed in future studies. Nonetheless, Study 2 partially supports our proposition that risks can enhance differences in nonverbal

behavior between deceivers and truth-tellers. The difference in nonverbal cues was not significant across the three levels of risks, but the extent of impression of tension was greater in the highest risk (security evaluation) level than the other two lower risk levels. This might be due to the fact that higher risks place greater self-regulation demands on a person, subsequently leading to depletion in self-regulation. The self-depletion results in one's failure of regulating such behaviors properly (Carver & Scheier, 1998; Muraven & Baumeister, 2000). Notably, the cues associated with induced risks were also presented by truth-tellers, suggesting a need for future research endeavoring to solve the dilemma of discriminating liars from truth-tellers who might behave like deceivers (DePaulo, 1992; Ofshe & Leo, 1997). Similarly, the impression of negative affect was also significantly increased in the highest risk level, compared to the other two levels. This trend was only significant in deceivers, suggesting a possible solution to discriminate deceivers from truth-tellers by observing the extent of negative affect across risk levels. However, since the results did not show a robust difference across all three levels, further studies are needed for testing this nonverbal impression. Nonetheless, the findings about the significant increase in nonverbal cues in the highest risk overwhelming the other levels suggest that a security check (as simulated in Study 2) might influence deceivers' and/or truth-tellers' behavior. We thus suggest this should be brought to the attention of security/public safety practitioners.

In relation to the controlled covariates, age and gender were found to be significantly related to reduction in hand movement whilst telling lies. Age also influenced tension impressions related to risks. An explanation is that age and gender can influence nonverbal behavior exhibited by individuals and in line with evidence of age and cultural influences on nonverbal behavior (Vrij, 2008; Vrij & Winkel, 1991), our result suggests that the effect of

such variables should not be neglected in future research and failing to take these into account may adversely impact the validity of results.

This research may have limitations regarding the stakes of deception introduced in experiments, which are not as dramatic as those in real life deception situations such as terrorist activities. However, the risk assessed in this study concerns the probability of being detected. Participants were aware that the confederate they met in the highest risk level was good in detecting lies. This had introduced a higher probability of detection than the other two levels (either no evaluator or no evaluation was performed). A further limitation is that in Study 2, deceivers read an extra article about deception. Although the article did not include information about nonverbal cues to deception, it might still have had an effect on the psychological processes that deceivers experienced and thus might indirectly influence deceivers' behavior. Researchers conducting future deception studies might want to consider such potential effects while designing their own experimental materials. The ecological validity of lies performed in laboratory studies is a recognized limitation in deception research (Koning *et al*., 2011). Nevertheless, when deception tasks in laboratories are assigned to participants, the cognitive processes still influence behavioral control and shapes behavior (Hadar *et al.,* 2012; Ito *et al.*, 2012; Kozel *et al*., 2005).

No significant deception cues were found in Study 2 whilst in the other studies these were apparent. This was possibly because participants were seated throughout this study, reducing the presence of visible nonverbal cues (e.g., trunk movements). If this is upheld in more studies there is evidence from these findings that it is important to consider a range of situational variables including the context where deception happens. The nonverbal cues assessed in the present research could be observed by people without relying on any detection

techniques. However, the nonverbal cues found in these studies require further testing in in order to investigate if such differences could be identified easily.

7. CONCLUSIONS

Taken as a whole, the findings demonstrate and contribute to both theory and practice by extending the existing evidence base with regard to deception-related behaviors across three situations. This work is another step forward in identifying more clearly the difference between deceivers and truth-tellers in settings other than interview situations. The implications of this research could be important for security stakeholders in many settings as they continually strive to make improvements to methods of deception detection. A focus on observable nonverbal cues could benefit security officials who are not able to directly interact with suspect individuals and who do not use detailed behavioral analysis when a judgment of deception is needed immediately. In addition, the present research provides evidence of nonverbal deception cues, and sheds light on effective manipulations, which may further help to increase deception detection accuracy.

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CAPTIONS

Table I. Coding of nonverbal cues - Body sections excluding hand/arm

Table II. Coding of nonverbal cues - Hand/arm

Table III. Coding of nonverbal cues – Impressions

Table IV. ANCOVA results for Study 1[a]

Table V. ANCOVA results for Study 2[a]

Table VI. ANCOVA results for Study 3[a]

Table I

Body sections[a]	Variable name[a] (movements)	Coding Details (frequency/length)
Head	Head movement (all studies)	All types (e.g. nod, shake, turn, tilt, etc)
Eye	Aversion/shifts (all studies)	Brief change of gaze direction
	Staring at other places (Study 1 and 2)	Fixed gaze direction
	Staring at folder (Study 2)	Fixed gaze in the direction of the folder
	Eye contact aversion (Study 3)	Avoiding eye contact with passersby
	Eye/eyebrow (all studies)	**Other eye movements to those above**
Trunk	**Indirect orientation while standing (Study 1)**	**Tilting at waist while being spoken to**
	Lean towards other people while seated (Study 2)	Body moving toward people being talked to
	Lean back while seated (Study 2)	Body moving away from people being talked to
	Position shift (Study 2)	**Changes to the way of sitting that involve multiple body parts**
	Sway (Study 3)	**Waist moving slowly or rhythmically from side to side**
Foot/Leg	Feet and legs (all studies)	Movements of legs and feet together
	Foot only (all studies)	Movements of feet without moving legs
	Leg only (all studies)	Movements of legs without moving feet

Note. [a]Body sections/movements in Bold were included in the analysis (according to the filtering steps stated in section 2).

Table II

Body sections[a]	Variable name[a] (movements)	Coding Details (frequency/length)
Hands/arms	**Hands and arms (all studies)**	**Movement of hands and arms together**
	Hands only (all studies)	Movement of hands without moving arms
	Crossing arms (all studies)	Arms crossed in front of chest
	Hand(s) in pocket(s) (all studies)	Gesture of hand(s) in pocket(s)
	Hand holding (Study 1 and 2)	**Two hands hold together in front/behind trunk**
	Hand hiding and legs (Study 2)	Holding hands between knees
	Hand and objects (Study 3)	Movements of hands holding bag or objects

Note. [a]Body sections/movements in Bold were included in the analysis (according to the filtering steps stated in section 2).

Table III

Three Processes	Variable Name (impressions)	Coding Details (the degree of impressions)
Emotion	Positive affect	Being pleased in general throughout the session
	Negative affect	Being unpleased in general throughout the session
	Tension[a]	Being tense and not being relaxed in general throughout the session
Cognitive effort	Thinking hard	Being considering carefully while talking (about the card/folder/name)
Attempted behavioral control	Attempted control	Attempting to manipulate behavior
	Rigid	Being stiff and rigid while moving
Task-related	Looking around (Study 3)	Observing the environment

Note. [a]Tension was calculated by averaging the score of 'being tense' and the reverse score of 'being relaxed.' All variables listed were included in data analyses.

Table IV

	Deception				Level of Risks			
	F	*df*	*p*	η_p^2	*F*	*df*	*p*	η_p^2
Movements and Covariates[a]								
Hand and arm*	1.14	1, 21	.30	.05	**4.29**	**1, 21**	**.51**	**.17**
Age	1.58	1, 21	.22	.07	1.58	1, 21	.22	.07
Gender	1.23	1, 21	.28	.06	1.23	1, 21	.28	.06
Western/Non-western	0.63	1, 21	.44	.03	0.63	1, 21	.44	.03
Hand holding**	**4.75**	**1, 21**	**.04**	**.18**	2.24	1, 21	.15	.10
Age	5.62	1, 21	.03	.21	5.62	1, 21	.03	.21
Gender	6.98	1, 21	.02	.25	6.98	1, 21	.02	.25
Western/Non-western	0.01	1, 21	.94	.00	0.01	1, 21	.94	.00

Note. [a]Insignificant dependent variables were not listed. η_p^2 = effect size estimate – partial eta squared. **Significant effect of variables: $p < .05$ states in Bold; *trend of significant effect of variables: $P < .055$ states in Bold.

Table V

	Deception				Level of Risks			
	F	*df*	*p*	η_p^2	*F*	*df*	*p*	η_p^2
Movements and Covariates[a]								
Hand holding**	0.10	1, 28	.75	.00	**3.46**	**2, 56**	**.04**	**.11**
Age	0.60	1, 28	.45	.02	0.44	2, 56	.65	.02
Gender	1.40	1, 28	.25	.05	0.18	2, 56	.84	.01
Western/Non-western	1.15	1, 28	.29	.04	1.83	2, 56	.17	.06
Impressions and Covariates[a]								
Tension**[b]	0.52	1, 28	.48	.02	**3.92**	**1.63, 45.52**	**.04**	**.12**
Age	0.11	1, 28	.74	.00	4.74	1.63, 45.52	.02	.15
Gender	0.38	1, 28	.54	.01	2.31	1.63, 45.52	.12	.08
Western/Non-western	0.00	1, 28	1.00	.00	0.64	1.63, 45.52	.08	.09
Negative affect**	0.91	1, 28	.35	.03	**4.24**	**2, 56**	**.02**	**.13**
Age	1.67	1, 28	.21	.06	0.18	2, 56	.84	.01
Gender	0.05	1, 28	.82	.00	1.08	2, 56	.35	.04
Western/Non-western	0.00	1, 28	.99	.00	1.10	2, 56	.34	.04

Note. [a]Insignificant dependent variables were not listed. η_p^2 = effect size estimate – partial eta squared. **Significant effect of variables: $p < .05$ states in Bold. [b]Greenhouse-Geisser correction figures presented for the condition of level of risks.

Table VI

	Deception				Reconnaissance			
	F	*df*	*p*	η_p^2	*F*	*df*	*p*	η_p^2
Movements and Covariates[a]								
Eye/eye brow**	0.07	1, 85	.80	.00	**5.68**	**1, 85**	**.02**	**.06**
Age	2.29	1, 85	.13	.03	2.29	1, 85	.13	.03
Gender	0.08	1, 85	.78	.00	0.08	1, 85	.78	.00
Western/Non-western	0.62	1, 85	.44	.01	0.62	1, 85	.44	.01
Trunk*	**3.82**	**1, 85**	**.05**	**.04**	3.62	1, 85	.06	.04
Age	0.00	1, 85	.99	.00	0.00	1, 85	.99	.00
Gender	0.03	1, 85	.86	.00	0.03	1, 85	.86	.00
Western/Non-western	1.67	1, 85	.20	.02	1.67	1, 85	.20	.02
Hand and arm*	**3.85**	**1, 85**	**.05**	**.04**	0.60	1, 85	.44	.01
Age	3.93	1, 85	.05	.04	3.93	1, 85	.05	.04
Gender	4.76	1, 85	.03	.05	4.76	1, 85	.03	.05
Western/Non-western	0.03	1, 85	.87	.00	0.03	1, 85	.87	.00
Impressions and Covariates[a]								
Positive affect**	**5.94**	**1, 85**	**.02**	**.07**	0.36	1, 85	.55	.00
Age	1.39	1, 85	.24	.02	1.39	1, 85	.24	.02
Gender	0.44	1, 85	.51	.01	0.44	1, 85	.51	.01
Western/Non-western	0.35	1, 85	.56	.00	0.35	1, 85	.56	.00

Note. [a]Insignificant dependent variables were not listed. η_p^2 = effect size estimate – partial eta squared. **Significant effect of variables: $p < .05$ states in Bold; *trend of significant effect of variables: $P < .055$ states in Bold.