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Executing Facial Control During Deception Situations

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Abstract Behavioral countermeasures are the strategies engaged by liars to deliberately control face or body behavior to fool lie catchers. To date research has not shown whether deceivers can suppress elements of their facial expression as a behavioral countermeasure. This study examined whether participants could suppress facial actions such as eyebrow movements or smiles on command when under scrutiny by a lie catcher. The results derived from micro momentary coding revealed that facial actions can be reduced, but not eliminated, and that instructions to suppress one element of the expression resulted in reduction in all facial movement, regardless of veracity. The resulting implications for security contexts are discussed.

Keywords Behavior suppression · Control · Countermeasures · Deception · Facial expressions

Facial Control During Deception Situations

Deception is a part of everyday life, with most people telling lies every day to smooth social interactions (DePaulo and Kashy 1998). Politeness dictates that we should not try to detect these lies when they occur, lest we embarrass the teller and upset normal social functioning (Goffman 1963). There are other types of lies that are important to detect,

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which are more rarely told, and have greater implications for public safety and national security. Individuals with hostile intent tell these lies in high stakes scenarios such as criminal investigations, airport and mass transit checkpoints, counter terrorism, and so forth (Frank et al. 2007). Detecting these lies has assumed particular prominence since the terrorist events of September 11, 2001.

After September 11, 2001, a number of television shows depicting law enforcement agents fighting crime and terrorism sprung forth, all presenting 'inside' information about forensic investigative techniques, interviewing and interrogation, and detecting lies. Although these shows employ poetic license and are ostensibly fictional, many of the techniques discussed in these television shows are based upon techniques and behavioral indicators actually employed by professionals in the field. This information is presented to the general public in such a palatable form that it raises a serious question as to whether an individual with nefarious intent would try to confound or defeat a security officer by deliberately adjusting, concealing, or manipulating his or her own behaviors in a manner consistent with what he or she learned from these programs. In the security world, a person who deliberately alters his or her behavior to fool a lie catcher is said to be engaging in behavioral countermeasures.

To be effective, the behavioral countermeasure has to be directed at the lie catcher's beliefs about deception, not necessarily the reality. If a security officer stops and questions every person wearing a blue shirt, then not wearing a blue shirt would be an effective countermeasure, even though we can safely assume no link between shirt color and hostile intent. The most prevalent beliefs about clues to deception involve the human face. Within the top 9 clues reported by individuals in 75 different countries and 43 different languages, 4 of them involved the face in some capacity—eye movements, as reflected in gaze aversion, nervousness, facial expressions, and facial color (The Global Deception Research Team 2006). Therefore, we would assume that individuals employing countermeasures would attempt to control the face and eyes. The idea that one can detect deception from the face is not only represented in television programs, but also forms an important element of current government programs to detect individuals with hostile intent.[1]

We can certainly assume that hostile groups or nations have been developing behavioral countermeasures against our screening/security procedures, and that their agents would receive specific, detailed, and intensive training. But our question is more mundane: As people learn about the behaviors they are supposed to do or not do through television, newspaper articles, and friends, would an individual not affiliated with a hostile group or nation, who has had no specific training, be capable of successfully executing the behavioral countermeasures regarding facial expressions by suppressing them when requested to do so in an interrogation context?

Theoretical Overview

Although there is a strong history of countermeasure research in psychophysiological detection of deceit (Ben-Shakhar and Dolev 1996; Rosenfeld et al. 2004), to date no studies have examined facial countermeasures, although one study tested whether individuals

[1] For example, the Transportation Security Administration's Screening of Passengers by Observation Techniques, as described in a Time Magazine article entitled: *A New Tack for Airport Screening: Behave Yourself* By Sally B. Donnelly, published on Wednesday, May, 17, 2006, describes a government program to analyze behaviors in public spaces reputedly associated with hostile intent.

could engage in nonverbal countermeasures. This study trained participants on behavioral and verbal cues to deception, and instructed them to manage either hand and leg movements or their verbal strategy (Caso et al. 2006). The results indicated that verbal countermeasures were more successfully employed than the nonverbal countermeasures involving the frequency of hand and leg movements.

A related avenue of research examined the suppression of emotionally expressive behavior (Gross 1998; Gross and Levenson 1993; Schmeichel et al. 2008). In these studies adult participants were instructed to act as though they were feeling nothing even though they were watching emotion eliciting videos. Similarly, children have been asked to control their facial expressions while being amused by a clown (Ceschi and Scherer 2003). Another study took the paradigm one step further and requested adult participants to not only suppress their emotional expression but to disguise or neutralize their true feelings (Porter and ten Brinke 2008). All these studies are similar in that they required participants to consciously monitor and restrain their spontaneously occurring expressive behavior. They are also similar in their findings—that basic instruction to suppress or conceal their emotions reduced, but did not eliminate completely, the emotional expressions of the participants.

However, none of those emotion control studies provided specific instructions on what elements of the facial expression to hide or mask in order to appear non-emotional. The previously published countermeasure study did ask subjects to conceal specific actions such as word choice and hand/leg movements (Caso et al. 2006), but these movements are under considerably more voluntary control than facial movements like those associated with emotion (reviewed by Ekman 2003; Rinn 1984). This is related to what Ekman and Friesen (1969) called the "leakage hierarchy"—that is, some behavioral channels are more difficult to control than others, despite efforts to conceal them. Ekman has now argued that the face leaks more than the body or voice due to the involuntary nature of human emotion (Ekman 2001; Ekman et al. 1988). Even within the face itself, the lower face seems under more control than the upper (reviewed by Rinn 1984), particularly for positive emotion (although this may not be true for negative emotions; Porter and ten Brinke 2008). This is consistent with findings that a smile is the most frequent expression used to mask negative emotions, or portray positive emotions that one does not feel (e.g., Ekman 2001). Of all the facial movements or expressions shown by people, we would expect that the smile would be the most readily managed.

A person who chooses to engage in a countermeasure to not look nervous may adopt strategies ranging from global emotional control, such as "just try to look relaxed," to more specific instructions like "don't smile." The former strategy is more similar to the previous research paradigms, whereas the latter two have not been tested on specific facial movements. This approach—to control specific elements of facial movement—will be in all likelihood be the approach taken by individuals intent on fooling security personnel who learn about the supposed signs of deception identified in television programs, as they typically identify features such as smiles or eyebrow raising movements associated with the emotion of fear (e.g., Ekman 2001).

Current Study

Given the significance of observing nonverbal behavior in security strategies it is important to determine whether people can control elements of their facial behavior during an investigative interview on command. This may turn out to be easier to do than the global

strategies of simply concealing one's emotion because it is a very specific movement instruction (c.f. Ceschi and Scherer 2003; Gross 1998; Gross and Levenson 1993; Porter and ten Brinke 2008; Schmeichel et al. 2008). On the other hand, it may be harder to do than the management of gross body movements and words spoken as reported in previous research (Caso et al. 2006), because of the relatively more involuntary nature of facial expressions compared to body movements and word choice (Rinn 1984).

However, one element of the Caso et al. (2006) study that made it different from the emotional control studies was that it directly examined the effect of these countermeasures while subjects were actively speaking words to conceal their involvement in a mock theft. This would seem to add to the cognitive load of the individual trying to manage his or her expression—and even more so to a liar compared to a truth teller (e.g., Ekman 2001; Hocking and Leathers 1980; Zuckerman et al. 1981). The cognitive load involved with fabricating a story while managing behavior would seem to be considerably higher than simply observing emotion eliciting photos and concealing or fabricating the one's emotional expression while not having to generate any spoken behavior (e.g., Porter and ten Brinke 2008).

This higher cognitive load might trigger an ironic effect, as described by Ironic Process Theory (IPT; Wegner 1994). IPT has demonstrated that under higher cognitive load conditions, an individual may ironically think more often about a *thought* he or she is asked to suppress than about the thoughts not asked to suppress (e.g., Wenzlaff and Wegner 2000). The reason is that the individual is monitoring his or her own thought pattern is to make sure that the suppressed thought or image does not emerge, which ironically means the thought or image becomes omnipresent in one's monitoring memory, enabling it to intrude more frequently into one's regular memory. By analogy from thoughts to behavior, IPT may suggest that when an individual is asked to suppress a specific behavior, he or she may be more likely to exhibit that behavior due to the excessive monitoring of this behavior. Thus, telling people not to smile or not to raise their eyebrows may ironically cause them to increase movements in both.

This is even more likely to occur when someone is telling a lie, because research has shown that lying raises the cognitive load (e.g., Zuckerman et al. 1981). This raised cognitive load is a necessary condition for IPT to exhibit its effects (Wegner 1994). This is consistent with another finding in the emotional suppression literature—that the act of suppressing expressive behavior harms one's interpersonal functioning by reducing his or her ability to successfully and naturally engage in interaction with others (Gross and John 2003).

The current study examines control of the face, as facial expression is one element of nonverbal behavior that most individuals report as being a location for clues to deceit (The Global Deception Research Team 2006). In this study we specifically instructed participants to suppress upper face activity, manifested through eyebrow raising actions that mimic the expression of fear, and lower face activity, manifested through smiling. This is the first study to examine facial countermeasures, and these two expressions were chosen because they represented two autonomous regions of facial musculature. Although facial movements such as smiling and eyebrow actions are not necessarily indicators of deception, expression suppression is clearly one of the more popular strategies used by liars to fool others regardless of its validity as a clue to deception. What we don't know is how well individuals can do this when lying or telling the truth.

The emotion suppression research findings suggest that individuals will be able to suppress their facial actions when requested, but in all likelihood will not be able to suppress them entirely—although this previous work did not ask participants to specifically

conceal elements of their expression. The IPT research would suggest the opposite pattern—such that individuals will not be able to suppress their facial actions when requested, and under higher cognitive load, such as when lying, may increase the amount of those behaviors that they are asked to suppress—although the IPT work focused more on concealing thoughts rather than actions, thus we are dubious. Finally, research on human facial expression would suggest that individuals are better able to manage their lower face compared to their upper face (Rinn 1984), particularly for positive emotions (Porter and ten Brinke 2008). Moreover, individuals have shown difficulty controlling their eyebrows during startle (Ekman et al. 1985) and pain (Craig et al. 1991; Hill and Craig 1998) experiments, thus we would expect to see greater management for smiles than for eyebrow raises.

Based upon the research literature on the nature of facial expressions of emotion, the neuroanatomy of the face, the emotional suppression research, and the IPT research, we predict that in an interrogation where deception is a possibility, individuals will be able to significantly reduce their rate and intensity of smiling and brow movements when requested, but that they will be able to do so to a lesser degree when telling a lie. And given that the lower face—and smile in particular—is easier to control than the upper face (Rinn 1984), we would also predict that individuals will more greatly reduce their rate of smiling as compared to the rate of brow movement when requested to suppress these actions.

Method

Participants

The participants were 33 female and 27 male undergraduates recruited from an introductory communication course. On average participants were 20.28 (SD = 3.34) years old. Participants were mostly Caucasian (72.9%), but there were also participants who identified themselves as Asian or Pacific Islander (11.9%), African or Caribbean (8.5%), Hispanic (3.4%), Middle Eastern (1.7%), or another ethnic background (1.7%). These demographic variables were evenly distributed among the six conditions.

Procedure

The participants entered the laboratory where they met an experimenter, completed an informed consent document, and then read an instruction sheet detailing the experiment. All participants were involved in a crime scenario (adapted from Frank and Ekman 1997) in which they were randomly assigned to either take (Lie) or not take (Truth) a pair of movie tickets from an envelope, and then were interviewed about the theft of these tickets. Participants in the Truth condition were told to simply tell the truth about what happened; participants in the Lie condition were told to deny the theft of the tickets. The participants were told that if they were able to convince the interrogator of their honesty they would be given one (in the Truth condition) or both (in the Lie condition) of the movie tickets as a bonus. They were told that if they were unable to convince the interrogator of their honesty, then they would receive no reward and would have to fill out a long and boring questionnaire as a punishment. Participants viewed this consequence as a moderate punishment ($M = 5.03$, on a 0–10 scale). The punishment was actually a mild deception used to raise the stakes and in reality no participants had to endure the punishment and all

participants received one movie ticket for their participation in addition to class research credit.

Next the participants read a second set of instructions based on their suppression condition that were adapted from Wegner et al. (1987) IPT study in which participants were asked to not think of a white bear. For one third of the participants their instructions directed them not to smile as that could be used by the interrogator to identify happiness (*smile suppression condition*), for one third of participants their instructions directed them not to raise their eyebrows as that could be used by the interrogator to identify fear (*brow suppression condition*), and these instructions went on to describe what these facial movements looked like. They also stated that the interrogator viewed whatever movement they were asked to suppress as an indicator of deception, and thus all participants—truthful or not—should not show them during the interview. The remaining one third of subjects did not receive any instruction on facial movements but were simply told the importance of convincing the interviewing of their honesty (*control condition*).

Next participants completed a questionnaire asking them to indicate the magnitude of the emotion they experienced. They were then instructed to drop off the questionnaire in a box in the next room when complete. The movie tickets were in a clearly marked envelope next to the questionnaire box. When the participants dropped off their questionnaires they either took or did not take the movie tickets according to their veracity condition. All participants followed the instructions for the condition to which they were assigned.

After the participants took or did not take the tickets they were directed to a soundproof room where all interviews were conducted. Two video cameras that were placed in a bookcase behind the interrogator's head captured the participants' face (from shoulders to top of head) and body behaviors (full body shot). The cameras were surrounded by black felt to reduce their salience. All participants agreed to be filmed during the consent process. The interrogator was a retired community member with prior military and interviewing experience, and was blind to conditions. He was previously trained to control his demeanor and act the same way for all subjects. The interview featured a baseline period, where participants were asked: "Did you find this room easily?", "What was the best thing to happen to you this week?", "What was the worst thing to happen to you this week?" It also featured a critical interrogation period in which all deceptive subjects told a confirmable lie to at least one of these three or four questions: "Did you remove the movie tickets from the envelope?", (If they said yes) "Did you put them back?",[2] "Is there anything else you wish to tell me about the movie tickets or what you did?", "Is everything you have told me about the tickets the truth?" All participants were given the same interview regardless of condition. At the conclusion of the interrogation, the interrogator excused himself and told the participants that he would give his judgment to the Experimenter.

After the interview the participants completed a demographic questionnaire. The participants were then provided with the interrogator's judgment. Regardless of judgment, no participants were given the punishment (completing a long and boring questionnaire), and all participants were provided with one movie ticket (in addition to their 1 h of research credit) as an additional compensation for their participation.

Participants were then asked a set of open-ended questions about their participation in the experiment. Finally participants were debriefed about the experimental procedures and the deception, and were asked to not discuss this experiment with anyone for the next few

[2] One truth teller admitted "yes", to removing the movie tickets from the envelope, but also responded "yes" to the follow up question, "Did you put them back?" No liars admitted to taking the movie tickets from the envelope.

weeks, and given a chance to erase their videotape now that they were fully informed. No participants chose to have their videotape erased.

Design

This study examined two between subject independent variables—the *veracity* of a participant (truth vs. lie) and the instructions to *suppress* an element of their facial movement (smile-suppression vs. brow-suppression vs. no suppression control conditions). Because individuals vary greatly in their abilities to manage their expressions, particularly in deception situations (Ekman 2001; Frank and Ekman 2004; Vrij 2008), we measured smile and brow movements as *within subject* variables, where we compared the smiles and brow actions that occurred in a baseline period to the smile and brow actions that occurred in a critical moment in the interview when the participant was accused of lying (we'll call this within subject variable the *change from baseline*). In order to control for the length of response, our dependent variables were the percentage of time that the participant showed the smile or showed the brow movement (number of videotape frames of movement divided by the total number of videotape frames in the response) during a baseline period versus the percentage of time they showed these movements during the critical accusation period of the interrogation. We also measured the intensity of the brow or smile actions according to the rules of the Facial Action Coding System (FACS, Ekman and Friesen 1978).

Given that all deception researchers agree that lying activates both emotional and cognitive processes (e.g., Zuckerman et al. 1981), and that the increased cognitive load caused by deception is essential to activate IPT, we measured indicators of cognitive load (e.g., response latency, speech rate) in order to confirm that they were sufficiently engaged in the task, which also served as a manipulation check.

Reliability of Coding

Videos were coded using the FACS (Ekman and Friesen 1978). FACS is the only comprehensive system for scoring facial movement—it quantifies all visible facial actions into Action Units (AUs) and not just those presumed to be associated with emotion. FACS takes at least 100 h to learn, and to be FACS certified one needs to pass a final test scored by an independent source for reliability. In this study facial movements were scored using FACS at a frame by frame level of detail (30 frames per second) by two blind, independent FACS certified coders who each had over 1 year of experience coding on other projects.

Both coders analyzed the complete videos of 9 participants (48,416 frames) to assess intercoder reliability. The AUs were also coded for intensity of the smile (AU 12) or brow action (AU 1) using the A (low) to E (high) intensity scoring of FACS; these letter intensities were converted to numbers for analyses with A through E being converted to 1–5, respectively. If the two blind, independent coders had overlap on their smile (AU 12) or eyebrow judgments (any combination with AU 1), that was considered as an agreement between the coders. Although all interviews were fully FACS scored (overall agreement = .71); the scoring of interest for this project was the occurrence of smile (FACS AU 12) or brow-raising movements (any movement that included FACS AU 1). The inter coder agreement for AU 12 was .88; the inter coder agreement for any combination featuring AU 1 was (disregarding other upper face AUs) .87. Discrepancies between the two coders were adjudicated by the first author and the adjudicated complete codes were then used for analysis.

In order to check for the increase in cognitive load, we also scored two variables that respond to increases in cognitive load—response latency and speaking rate. Given the

automated precision of our video/audio recording, we could identify to 1/30th of a second the response latency and speech rate, and thus did not need to subject those measures to independent blind coding.

Results

Cognitive Load in Deception

We measured response latency and speech rate, two reliable indicators of cognitive load to ensure that the lying we induced increased cognitive load (Vrij et al. 2006; Walczyk et al. 2003). A two-way MANOVA was conducted to examine the effect of veracity and suppression instructions on the change in response latency and speech rate for the critical part of the interrogation—when deceptive participants told a confirmable lie—compared to the same variables in the baseline interview. We examined two of the questions in the critical part of the interview separately. A significant main effect was found for veracity for both open-ended questions (Wilks' $\lambda = .88$, F (2, 53) $= 3.5$, $p < .04$, $\eta^2 = .12$; for the first question, and Wilks' $\lambda = .85$, F (2, 53) $= 4.5$, $p < .02$, $\eta^2 = .15$, on the second question). Univariate ANOVAs revealed that when participants were asked "Did you remove the movie tickets from the envelope?", liars took significantly longer to respond ($M = 0.87$ s, SD $= 0.86$) than truth tellers ($M = 0.49$, SD $= 0.38$), F (1, 54) $= 5.0$, $p < .04$, $\eta^2 = .08$. During this same question liars also spoke significantly slower ($M = 2.98$ words per second, SD $= 2.04$) than truth tellers ($M = 3.95$, SD $= 1.55$), F (1, 54) $= 4.20$, $p < .05$, $\eta^2 = .07$. ANOVAs also revealed significant differences for speech rate when participants were asked, "Is there anything else that you wish to tell me about the movie tickets or what you did?", F (1, 54) $= 9.0$, $p < .01$, $\eta^2 = .14$. Liars spoke significantly slower ($M = 3.13$, SD $= 1.23$) than truth tellers ($M = 3.99$, SD $= 1.07$), for this question as well, which is suggestive of greater cognitive load.

Taken together, these measures suggest that the liars were showing patterns of increased cognitive load activity, compared to truth tellers, that is consistent with virtually all theorizing about interpersonal deception (e.g., Zuckerman et al. 1981).

Facial Analyses: The Smile

Regardless of veracity, or suppression instructions, all participants showed at least one smile in their baseline period and at least one smile in their critical period—thus none were completely successfully in fully suppressing their smiles despite being specifically requested to do so.

We then compared the percentage of time spent smiling during the critical accusation phase to the baseline phase for each subject. A 3 (suppression) by 2 (veracity), with repeated measures for change in baseline (2; baseline versus critical period), mixed model ANOVA for the time spent smiling revealed a marginal main effect for veracity (F (1,54) $= 3.7$, $p = .06$, $\eta^2 = .06$), but more importantly to our hypothesis we found a significant interaction of change in baseline and suppression instruction (F (2,54) $= 4.3$, $p < .02$, $\eta^2 = .14$; see Table 1).

Given our predictions for a significant interaction of change in smiling behavior by suppression instruction, we conducted paired-samples t-tests to further break down this interaction. These analyses revealed that the control group's smiling behavior did not significantly change between the baseline and critical period (the interrogation;

Table 1 Percentage of time smiling during baseline versus interrogation over veracity and suppression instruction

Smile movement duration		
Condition	Baseline (%)	Interrogation (%)
Control		
Truth	85.7	88.8
Lie	56.1	55.5
Smile suppression		
Truth	81.1	66.5
Lie	83.2	65.9
Brow suppression		
Truth	88.9	76.7
Lie	88.1	78.5

Note: Values reflect percentage of total time spent smiling

t (19) = −.28, p = .78, n.s.), but the smile-suppression groups' behavior did significantly decrease from the baseline to critical period (t (19) = 3.28, $p < .005$; d = 0.73). However, unexpectedly we also found that instructions to suppress the brow movements also seemed to affect the smile action, as participants in the brow suppression condition also showed a significant decrease in smile behavior (t (19) = 3.6, $p < .005$, d = .75). This suggests that a command to control one feature of the facial expression manifested itself as control of both upper and lower halves of the face.

We also found a significant interaction for veracity and suppression (F (2,54) = 4.2, $p < .03$, $\eta^2 = .13$). Although this interaction was an entirely between subject comparison, and thus combined across individual differences and not directly related to the hypotheses, we found that in the no suppression control group, the liars spent less time smiling (M = 56%) than the truth tellers (M = 87%; t (18) = 2.975, $p < .01$). There were no other significant main effects or interactions (all t's < 2).

We also conducted a 3 (suppression instruction) × 2 (veracity) with repeated measures for change in baseline (baseline v. critical period) mixed model ANOVA for the average intensity of the smile action, and did not find the significant interaction of suppression instruction and change in baseline as with the duration of smiles above (F (2,54) < 1, p = *ns*). We did find a significant main effect for *suppression* instruction (F (2,53) = 4.2, $p < .05$, $\eta^2 = .14$). Post hoc LSD tests revealed that the smile suppression group showed less intense smiles (M = 2.34) than the control group (M = 2.81) and the brow suppression group (M = 2.91), although there was no significant difference between the control and brow suppression groups. We also found a significant main effect for the change in intensity of the smiles within subject for *change in baseline* (F (1, 53) = 68.1, $p < .0001$, $\eta^2 = .56$), where the smiles were generally less intense in the critical period (M = 2.34) —when under scrutiny—compared to the baseline period (M = 3.03).

Facial Analysis: The Brow

Only 7 out of 30 participants did not show brow raising movements in the critical period—and only 1 of these 7 participants (assigned to tell a lie) was in the brow suppression instruction condition. So as with the smile, despite specific suppression instructions, all but one of those instructed to suppress their brow raising movements still showed brow raises. There were no significant differences in the pattern across conditions or suppression instructions (all chi-squares (1) < 2, p = *ns*).

Table 2 Percentage of time spent moving brows during baseline versus interrogation over veracity and suppression instruction

Brow movement duration		
Condition	Baseline (%)	Interrogation (%)
Control		
Truth	17.2	16.6
Lie	13.2	10.2
Smile suppression		
Truth	15.9	12.1
Lie	26.7	16.2
Brow suppression		
Truth	16.5	8.3
Lie	15.7	13.0

Note: Values reflect percentage of total time spent raising brows

We repeated the same 3 (suppression instruction) × 2 (veracity) × 2 (baseline v. critical period) analysis strategy with the brow movements. We did not find the predicted interaction of that included change in baseline (F (2,54) < 1, $p = ns$). We again found a significant main effect of *change in baseline* where the rate of brow movements was lower for the critical period (13%) compared to the baseline (18%; F (1, 54) = 5.6, $p < .03$, $\eta^2 = .09$). Table 2 shows the data on the brow suppression. Using Keppel's procedure (1991), we also examined the change in baseline across the 6 conditions (three suppression conditions and two veracity conditions) and found that participants in the brow-truth suppression condition showed a significant decrease in the time spent moving their brows (F (2, 54) = 6.8, $p < .001$), but not in the brow-lie condition (F (2, 54) = 2.3, $p = ns$), nor in the control conditions, irrespective of veracity (all F's (2, 54) < 2.3, $p = ns$). Interestingly, participants in the smile suppression conditions showed significant decreases in their brow actions regardless whether they told the truth (F (2, 54) = 3.1, $p < .05$) or told a lie (F (2, 54) = 8.8, $p < .005$). There were no other significant main effects or interactions (all F's < 1.1).

As far as intensity of the brow movement, we found a significant main effect for change in baseline (F (1, 47) = 6.3, $p < .02$, $\eta^2 = .12$), where participants tended to show less intense brow actions in the critical period compared to baseline (2.8 vs. 2.4). There were no main effects for veracity or suppression instruction (F's < 1, $p = ns$), and no significant interactions between the variables (F's < 1.4, p's = ns), revealing no support for the hypothesis predicting reduction in intensity for the brow suppression instruction.

Finally, we predicted that the lower face would be more amenable to control than the upper face. When we compared the change from baseline for the smile rate to the change from baseline for the brow movement rate, we found that the lower face seemed easier to control such that the rate of smiling decreased more than twice the rate of brow movements (13.4% reduction vs. 6.3%, respectively; t (39) = 2.04, $p < .05$, $d = .32$).

Discussion

Can participants suppress elements of their facial expression on command, as when engaging in countermeasures? The results showed that the answer to this question is yes and no. Instructions to deliberately suppress one element of a facial expression showed that yes, participants did significantly reduce their rates of smiling, but less so for their brow

movement. Moreover, for the smile, there was also a significant decrease in the average intensity of the expressions shown, but not as much for the brow. However, these findings also show that participants could not entirely eliminate these movements during a critical period of a deception interrogation. All participants showed at least one smile in the critical period, regardless of instruction to suppress those smiles. Similarly, almost all participants showed at least one brow movement despite specific instructions to suppress those movements.

There really was only one finding, in the brows, which looked like an ironic process effect—where the truth tellers were able to suppress the brow movements, whereas the liars did not. And, interestingly, requests to suppress the smile resulted in suppression of the brows, and requests to suppress the brows resulted in suppression of the smile. And finally, the reductions in movements upon instruction were stronger for the lower face action compared to the upper face action. One reason that individuals more successfully managed their smiling behavior as compared to brow behavior is likely physiological, in that brows are in the upper part of the face, and research has shown that these movements are harder to control or manage than facial actions involving muscles in the lower part of the face (Rinn 1984). Although smiling is often a voluntary facial behavior that is utilized in polite conversation, some upper face movements—like those associated with the emotion of fear—are not as easily recognized and performed, which makes them more difficult to inhibit. However, the majority of participants in the behavioral suppression conditions reported believing that they controlled all facial movement and remained "poker faced" through the interview. The results of these analyses suggest that their perceptions were incorrect. However, we cannot rule out a floor effect, as the amount of time spent moving brows was considerably less than the amount of time spent smiling.

There may be a number of reasons for why participants reduced, but did not eliminate, their smile or brow movements. First, our manipulation checks showed that subjects showed clues to extra mental effort, as predicted in almost all models of deception (e.g., Ekman 2001; Hocking and Leathers 1980; Knapp and Comadena 1979; Zuckerman et al. 1981). With these cognitive demands, participants were not able to attend to all the minutiae of movement, thus allowing these movements to leak despite their efforts to conceal. It seemed participants adopted a strategy of suppressing all facial movement, not just the specific movements requested, in order to manage the task in light of these additional demands. This makes sense in that facial actions are typically less controllable than more gross body movements, such as hand and finger movements (e.g., Caso et al. 2006). However, despite some ability to suppress the rate of movement, they were not able to fully suppress these actions.

These results should be taken with consideration, as this is the first study to examine behavioral countermeasures in the face, and further validation is required for this paradigm. As a first step this study attempted to examine two independent areas of facial muscle movement, but it is possible that movements with better association to deception or emotion are under less voluntary control. It is also possible that although our study featured some stakes for the liars and truth tellers, and may have engendered a higher level of emotion than is typical in a deception experiment, we cannot know that for sure as we have not done a controlled comparison with other incentives and punishments for the participants. More importantly, we acknowledge that our laboratory context is simply not the same intensity as that which would be found in a real life, counter-terrorism scenario. Thus we urge great caution in generalizing these results to those real world scenarios.

The participants in this study were not actors, were not allowed to practice or receive feedback on their abilities, and received no specific instruction on how best to suppress

these actions. This suggests a person who may learn about a specific facial action from some outside source may not be able to fully suppress that particular facial signal on command. This does not tell us how an individual intent on some nefarious activity, who has received some training, or received practice with feedback, would be able to suppress his or her facial expressions when under scrutiny. Regardless, these findings have important implications for security settings, whether we are dealing with more highly skilled and motivated liars who have practiced managing their nonverbal expression in high-stakes scenarios, or untrained individuals who learn from a television program about a particular brow or lip movement that is allegedly a tell tale sign of deception. We can expand this idea of behavioral management beyond the nonverbal to the verbal behavior as well, as there are numerous techniques purported to detect deception from words, many of which are taught to law enforcement, and from which strong scientific evidence for their effectiveness—above and beyond what an experienced law enforcement officer can do without such training—is not established (e.g., Scientific Content Analysis, or SCAN; Smith 2001; see also Vrij 2008, for a review on verbal techniques to detect deception).

Future research should strive to increase the emotional involvement and realism of the lie scenario and examine management of established indicators of deception. These have become very important questions to national security professionals, as we can assume that malefactors of various sorts will attempt to manage their behaviors based upon what behavioral clues they believe security officers are looking for. We truly don't know whether behavioral countermeasures possess similar success rates to mental countermeasures as seen in polygraph examinations because we did not engage in any specific training, as this was the first study to examine whether untrained individuals could suppress specific elements of their facial expressions. Given the fact that successful countermeasures could have serious implications for national security—as more and more public security programs have begun to emphasize nonverbal behavior as a source of clues to identify those with hostile intent (Frank et al. 2007)—we need further research urgently.

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