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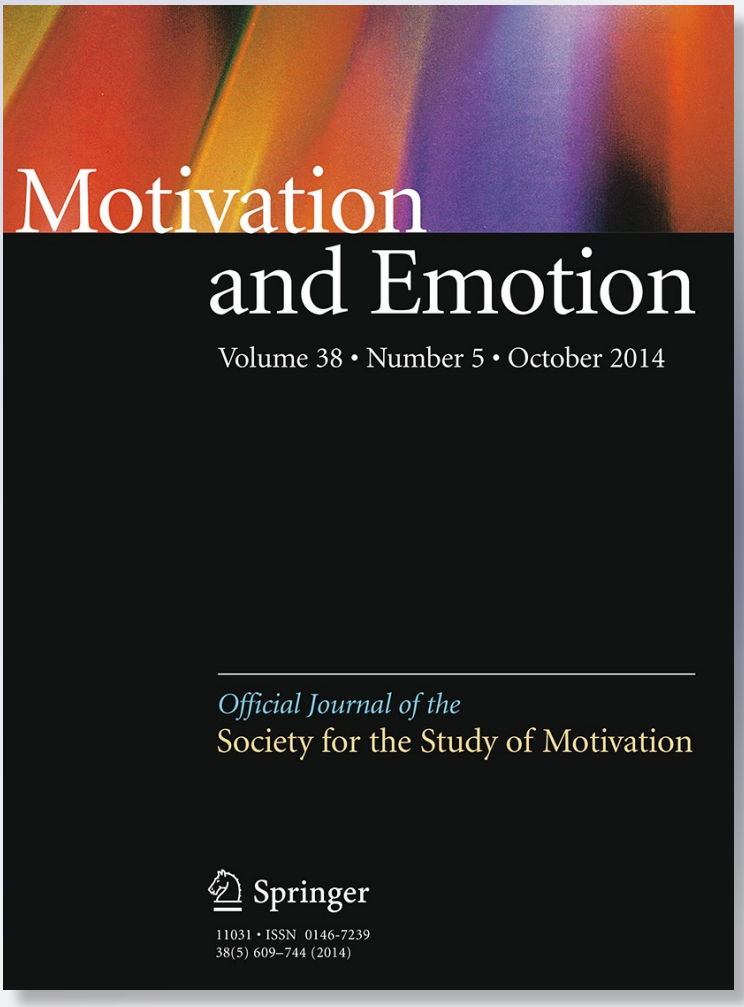
Motivation and Emotion

ISSN 0146-7239
Volume 38
Number 5

Motiv Emot (2014) 38:700-714
DOI 10.1007/s11031-014-9410-9



Springer

Motiv Emot (2014) 38:700–714
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ORIGINAL PAPER

Background factors predicting accuracy and improvement in micro expression recognition

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Published online: 4 June 2014

Abstract Micro expressions are brief facial expressions displayed when people attempt to conceal, hide, or repress their emotions. They are difficult to detect in real time, yet individuals who can accurately identify micro expressions receive higher workplace evaluations and can better detect deception. Two studies featuring college students and security officers examined background factors that may account for accuracy differences when reading micro expressions, both before and after training. Study 1 revealed that college students who were younger and high in openness to experience were better at recognizing micro expressions. However, individual differences did not predict improvement in micro expression recognition gained through training. Study 2 revealed experiential factors such as prior facial expression training and lack of law enforcement experience were more predictive of micro expression recognition than personality or demographic factors. Individuals in both studies showed recognition improvement with training, and the implications of the ability to improve at micro expression recognition are discussed in the context of security and interpersonal situations.

Keywords Micro expression · Personality · Confidence · Facial expression · National security

Introduction

In many interpersonal contexts, individuals must make judgments as to the thoughts, feelings, and reactions of others in order to evaluate their emotions and intentions. For particular professional contexts—such as national security—the ability to quickly and accurately interpret nonverbal signals of such emotions may provide clues as to the hostile plans of others; specifically, an officer who can identify these clues when they first emerge would be in a better position to prevent an attack or other hostile action.

Emotions are of particular interest because they are transient, involuntary, and unconscious bio-psycho-social reactions (Matsumoto et al. 2013), and thus, are a major source of motivation and action by providing the impulse for behavior (Frijda et al. 1989; Matsumoto et al. 2013; Tomkins 1962, 1963). Emotions are primarily expressed through the face (Darwin 1872/1998; Ekman 2003; Izard 1994) and most people can accurately interpret these expressions when they are openly displayed (Biehl et al. 1997). When these expressions become shortened—as in the case of a *micro expression* (henceforth ME)—then such signals can be very difficult to detect.

Individuals who are skilled at identifying hidden or concealed emotions can better interpret a target's behavior

Part of this work was submitted in partial fulfillment of a Doctor of Philosophy degree at the University at Buffalo by the first author. The fourth author is a co-author of the Micro Expression Training Tool used in both studies. This tool is currently available from Humintell, which receives a financial benefit from its sales. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the Transportation Security Administration, the Department of Homeland Security, or the United States of America.

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and possibly understand intentions the target does not wish to communicate. Prior research demonstrates that accurate identification of MEs is related to the ability to detect deception (Ekman and O'Sullivan 1991; Frank and Ekman 1997), although it is not clear whether recognition of full or partial expressions (called subtle expressions) are more helpful for deception detection (Warren et al. 2009). ME training has also been linked to social skills, in that individuals trained to detect MEs have received better evaluations from supervisors in corporate settings (Matsumoto and Hwang 2011) and ME training has improved the social outcomes of specialized groups such as Autistic children (Clark et al. 2008).

Given the apparent advantages successful ME detection presents, it is important to identify the traits or personality factors, if any, that may contribute to their superior recognition. It may be the case that ME recognition ability is an inherent skill that is well-developed and solidified by adulthood, or it may be a flexible skill that can be improved through targeted training. Such findings, of course, would have implications for training law enforcement or other sensitive security positions. The present study seeks to identify the association between a series of internal and experiential factors with accurate ME recognition by individuals with varied training experiences.

Micro expressions of emotion

The idea of MEs has its roots in the research of Darwin (1872/1998) who suggested that facial expressions were part of an overall emotional response and they might be triggered through nerve force beyond a person's volitional control. Later research confirmed that expressions can be both involuntarily triggered—in the subcortical area of the brain—as well as voluntarily controlled—originating in the cortical motor strip (Meihlke 1973; Myers 1976; Tsschiassny 1953). The expression of basic emotions, such as anger, contempt, disgust, fear, happiness, sadness, and surprise, can trigger involuntary facial expressions, as well as unique physical and physiological changes to muscular tonus, voice, autonomic nervous system patterning, and brain activity (e.g., Christie and Friedman 2004; Damasio et al. 2000; Ekman et al. 1983).

MEs are actually a special case of basic facial expressions of emotion that occur more quickly and can often appear in fragments (Matsumoto et al. 2008a; Porter and ten Brinke 2008). Haggard and Isaacs (1966) first noted their existence—which they called micro momentary expressions—by studying clinical interviews. They believed these quick expressions of emotion were caused by unconscious repression of conflict that could not be seen in real time. Haggard and Isaacs created the first procedure to detect brief expressions, in which participants viewing psychiatric interviews pressed a button whenever they saw a change in facial expression. They found that—for the most part—people had great difficulty detecting micro momentary expressions (used by Garwood et al. 1970; Taylor et al. 1969). Later, Ekman and Friesen (1969, 1974) studied MEs using a frame-by-frame examination of recorded psychiatric interviews. Ekman and Friesen (1969, 1974) suggested instead that MEs were due to conscious suppression and concluded that MEs were brief expressions of emotion that 'leaked' when individuals tried to deliberately suppress their emotional expressions. Given that Ekman and Friesen (1982) reported that spontaneous, uninhibited facial expressions of emotion lasted between 0.5 and 4 s—a duration confirmed by subsequent research (Frank et al. 1993; Hess and Kleck 1990; Yan et al. 2013)—the current study followed that premise and conceptualized MEs as fleeting emotional expressions, lasting ½ or less a second in duration, and presumed to reflect concealment of one's true emotional state.

Concealed or managed expressions can occur on a daily basis—often for benign reasons such as embarrassment or propriety—as individuals attempt to conform to cultural or societal norms (Clark et al. 1996; Hayes and Metts 2008). These examples of facial management (called 'display rules,' Ekman and Friesen 1969) are most often used to effect polite discourse, and thus, cause little harm to the recipient of the communication. Less often, individuals attempt to conceal or neutralize their expressions in order to succeed in some nefarious act—such as when lying about the intent to commit a robbery or conceal an illegal object—that could have devastating effects. In such high-stakes situations, the ability to detect quick, hidden, or concealed emotions may be vital to effective law enforcement or security, as meta-analytic research has shown that emotion clues significantly predict deception, but only in these high stakes situations (DePaulo et al. 2003; Frank and Svetieva 2012).

Emotional expression recognition

Several tests have been created to examine the specific ability of ME recognition. The Japanese And Caucasian Brief Affect Recognition Test (JACBART, Matsumoto et al. 2000) was the first such test to utilize scientifically coded expression items shown at tachistoscopic speeds and collect extensive validity and normative information on ME recognition ability. The JACBART was converted into the Micro Expression Training Tool (METTv1, Ekman et al. 2003), which featured higher image quality in a digital format. Versions of the METT have been used to evaluate ME recognition for university students (e.g., Hall and Matsumoto 2004), department store employees and trial consultants (e.g., Matsumoto and Hwang 2011), those detecting deception (e.g., Warren et al. 2009), and

individuals with Schizophrenia (e.g., Russell et al. 2006). While individuals can easily classify facial expressions when displayed for nearly 10 s (e.g., typically resulting in close to 90 % agreement on emotion labels; Biehl et al. 1997; Ekman et al. 1987), ME recognition appears to be more difficult (e.g., typically ranging from 45 to 59 % accuracy for individuals without training or perceptual deficiencies; Hall and Matsumoto 2004; Matsumoto and Hwang 2011; Russell et al. 2006).

While the ideal test for ME recognition would utilize naturally occurring spontaneous ME stimuli to mimic real life, several studies have demonstrated validity of posed stimuli by linking recognition to external ratings of social skills (Matsumoto and Hwang 2011), subordinates' ratings of leadership (Rubin et al. 2005), and greater well-being (Carton et al. 1999). Further, in clinical samples ME recognition via the METT has been linked to ability to identify dynamic expressions (Marsh et al. 2010), as well as to produce changes in visual attention (Russell et al. 2008).

More globally, there have been a number of experimental studies examining the ability to judge affective states through nonverbal perception. Tests such as the Diagnostic Analysis of Nonverbal Accuracy (DANVA; Nowicki and Duke 1994) and the Profile of Nonverbal Sensitivity (PONS; Rosenthal et al. 1979) present multichannel (face, voice, and body) tests of emotion recognition. In such studies, accurate perception of emotion was significantly related to a number of personality traits such as empathy, affiliation, extraversion, conscientiousness, openness, tolerance, and internal locus of control, as well as social competencies in interpersonal domains (Hall et al. 2009). Although this research paints a rich understanding of factors affecting decoder skill for gross nonverbal movements, it is not clear if the same psychosocial variables that predict more subjective global nonverbal interpretation generalize to more subtle skills like ME recognition, as that was not directly tested in the above work.

Background factors and expression recognition

The following internal and experiential factors have been linked to superior emotion expression recognition, and in some cases ME recognition. Regardless, given the small number of studies in this area, it is important to replicate and extend those findings to different participant groups within a training environment.

Sex

It's well established that females have a slight natural advantage over males when decoding nonverbal behaviors (Hall 1978, 1984; Hall et al. 2000). This finding has been extended into facial expression research (e.g., Buck et al. 1972; Cunningham 1977), and more specifically, into the domain of identifying MEs (Hall and Matsumoto 2004; Mufson and Nowicki 1991). Such findings reveal that women are generally more accurate at identifying MEs than men, even after accounting for age and personality differences. It is unknown why females may have this advantage, but some hypotheses focus on differing socialization patterns, alternate cognitive processing capabilities, or varied confidence in ability to identify MEs between men and women (Hall and Matsumoto 2004).

Any sex differences in ME recognition would be important to note, as the national security field tends to be more heavily staffed by males. However, individuals in the security field are provided with substantial training to identify threats, which may overcome any small natural advantages held by women. Consistent with previous research, we predict:

H1: Females will outperform males in terms of ME recognition.

Age

Research has revealed a negative relationship between age and emotion recognition, especially for negative emotions (Mill, Allik, Realo, & Valk, 2009). When examining uninhibited emotional displays, older adults are less accurate at recognizing negative emotions like anger, sadness, and fear (Isaacowitz et al. 2007). It stands to reason that this pattern will be repeated in recognition of MEs. Thus:

H2: Age will be negatively related to ME recognition.

Personality traits

One of the most widely studied dimensions along which people vary systematically is personality, which can be defined as "the dynamic organization within the individual of those psychophysical systems that determine his unique adjustments to his environment" (Allport 1937, p. 48). Personality traits are useful for approximating people's behaviors as they are a relatively stable set of characteristics. Certain personality traits also relate to our interest in others (e.g., openness), which may lead individuals to pay greater attention to others in conversation.

The most studied model of personality describes five primary personality traits: neuroticism, extraversion, openness to experience, agreeableness and conscientiousness (Costa and McCrae 1989). Several of these traits offer interesting ideas regarding ability to detect emotional expressions. *Extraversion* is a measure of activity level,

assertiveness, excitement seeking, positive emotions, gregariousness, and warmth, suggesting that extraverts may be more interested in interacting and learning about others' feelings (Costa and McCrae 1989). Individuals who are *open to experience* tend to be curious about others and willing to engage in novel experiences (Costa and McCrae 1989). Open individuals are usually inquisitive and analytical. Thus, like extraverts, those who are open to experience may be more attentive and responsive to others' emotions. *Conscientious* individuals tend to be more attentive to details, which may be an important skill for ME recognition, where details of the face must be observed in a short fraction of time.

The current study explored three of the big 5 traits that previous research has uncovered consistent relationships with facial expression recognition. Matsumoto et al. (2000) found that traits of openness and conscientiousness were significantly positively related to ME recognition, regardless of scale used (e.g., Big Five Inventory, John 1989; or NEO Personality Inventory-Revised, Costa and McCrae 1992). While Mill et al. (2009) found that open and conscientious individuals were more skilled at identifying macro emotional expressions, these findings did not hold for every emotional expression. Thus, based on past research, we predict:

H3: Extraversion will be positively related to ME recognition.

H4: Openness to experience will be positively related to ME recognition.

H5: Conscientiousness will be positively related to ME recognition.

Experience and training

Individuals who scrutinize nonverbal behavior as part of their job are often more accurate judges of how others are feeling than those who lack such experiences (Ekman and O'Sullivan 1991; Ekman et al. 1999). For example, in a study of emotional lie detection, Ekman and O'Sullivan (1991) found that Secret Service Officers—who had experience with protection work and scanning crowds—focused more exclusively on emotional signals and significantly outperformed other observers such as polygraphers, judges, and psychiatrists, on emotional identification tasks. Similarly, having 'people-oriented' occupations has been significantly related to nonverbal decoding ability (Hall et al. 2009). In the related field of lie detection, several studies have shown that law enforcement officers are also skilled lie detectors when higher stakes are involved (see O'Sullivan et al. 2009), suggesting they are able to identify subtle behavioral cues in interpersonal situations.

In addition to demographic and personality factors, our second study examines the role of experiential factors—such as prior training, relevant job or observation experience, and law enforcement experience—on the ability to read MEs. Professional experiences should provide repeated exposure to situations involving identification of MEs, as well as repeated practice of such tasks, resulting in an increased skill at recognizing MEs (Hurley 2012). Thus we predict:

H6a: The length of time performing behavior observation work will be positively related to ME recognition.

H6b: Prior law enforcement experience will be positively related to ME recognition.

In addition to general on-the-job experience, relevant experience in recognition of emotion could also include exposure to training tools providing instruction of ME recognition that advance one's observational skills. Today, ME training tools are available online, through expert workshops, and are taught within security agencies. The purpose of these trainings is to improve one's ability to detect MEs. Therefore, exposure to such materials should improve one's ability to detect MEs. In our second study, a subsample of security officers received prior training (6–20 months prior) in facial expression identification. The available research shows retention of ME training (e.g., Hurley 2012; Matsumoto and Hwang 2011), thus we predict that:

H7: Prior facial expression training will be positively related to ME recognition.

Background factors and training

Given the accessibility of nonverbal training tools, it is important to understand if individual factors relate to both ME recognition ability as well as changes in ability after training. Studies reveal that diverse groups of people can be quickly trained to read MEs (e.g., Matsumoto and Hwang 2011; Russell et al. 2006); however, the role of individual differences in these studies is unknown. It's possible that individual-level characteristics make one person better equipped to learn than another. For example, *open* individuals are usually inquisitive and analytical, which might lead them to be interested in learning about human emotion in a training setting. Examining individual level characteristics associated with ME recognition accuracy prior *and* subsequent to ME training will provide substantial insight regarding types of individuals with a natural ability to identify MEs, as well as individuals who can improve recognition with training.

In the current studies, participants were randomly assigned to training conditions during which they were

exposed to ME training using versions of the METT (Ekman and Matsumoto 2007; Ekman et al. 2003). The METT has been used to train individuals with and without emotion recognition deficiencies to more accurately read faces with lasting effects (e.g., Hurley 2012; Matsumoto and Hwang 2011; Russell et al. 2006). In the following two studies, we explicitly measure both individual differences—such as personality and experience—as well as effect of training to understand the role of individual differences in a training environment. While individual differences have been predictive of innate abilities to identify MEs, more recent studies have shown that ME training tools can be used to improve the recognition ability of large groups of people in a short period of time, questioning the role of individual differences. Thus, we propose the following research question:

RQ1: What is the effect of individual differences on ME recognition training outcomes?

Regardless of whether responsibility lies with individual differences or training, it seems apparent that having good behavioral recognition skills bestows benefits such as improved deception detection (Ekman and O'Sullivan 1991; Frank and Ekman 1997) and social skills (Matsumoto and Hwang 2011). Thus, we designed two studies to examine the relationship between individual characteristics and experience and ME recognition both prior and subsequent to training. A previous analysis of the data collected in Study 1 showed the effects of training techniques on accuracy of ME detection (Hurley 2012). Our first study [1] examines the personality and demographic correlates of the initial (i.e., untrained or native) accuracy scores for those participants. Our second study [2] extends this research into a more experienced sample.

Study 1

Method

Participants

Three hundred thirty-four participants (56.2 % female) were recruited from introductory communication courses at a large Northeastern university. Participants were primarily Caucasian (70.9 %) and approximately 20 years old ($SD = 2.99$). Other racial backgrounds included African or Caribbean (9.0 %), Asian or Pacific Islander (11.4 %), Hispanic (5.7 %), or other groups (e.g., Native American, Middle Eastern, 'other'; 3.0 %). Approximately 87 % of the sample was native born.

Stimulus materials

The Micro Expression Training Tool version 2 (METTv2, Ekman and Matsumoto 2007) was used for testing ME recognition. The ME stimuli available in this tool are laboratory produced, providing the necessary consistency and reliability of expression to scientifically test recognition ability. These stimuli differ slightly from naturally occurring MEs in that they are not affected by natural changes in intensity or angle and the observer knows when each ME will occur. Two 14-item ME tests were created using test items from the METT pre- and post-tests. In each test there were two examples of each emotional expression (anger, contempt, disgust, fear, happy, sad, and surprise), which were presented in an identical order to each subject. No participants had received prior micro or facial expression training.

Measures

Extraversion, openness to experience, and conscientiousness were evaluated using standardized scales (NEO-FFI; Costa and McCrae 1989). Items associated with each scale were evaluated on a 1 (*strongly disagree*) through 5 (*strongly agree*) response scale with some items reverse coded. Responses were re-coded as necessary and summed such that higher scores indicate more of the personality trait in question. Reliability of the *extraversion* ($\alpha = 0.77$), *openness to experience* ($\alpha = 0.74$), and *conscientiousness* ($\alpha = 0.84$) scales were acceptable.

Covariates

There has been some debate regarding the ability of individuals to read expressions from persons of other cultures (Scherer et al. 2011), as some researchers suggest subtle variations in expressions across cultures decrease recognition accuracy (Elfenbein and Ambady 2002; Elfenbein et al. 2007). This study did not set out to test in-group detection, hence the METT was an ideal recognition tool given its racially diverse set of stimuli (specifically 6 ethnic groups are represented in the METT: Caucasian, Asian, Indian/Pakistani, Latino, African and Middle Eastern) with an even distribution of posers among expressions. While use of the METT should reduce any in-group 'advantage' (Elfenbein and Ambady 2002), we have included participants' self-reported racial background as well their birth country as covariates. Given the limited racial diversity in our sample, individuals from a Caucasian background ($N = 236$) were compared to those from a non-Caucasian background ($N = 97$) and individuals born in the United States ($N = 288$) were compared to those born outside of the United States ($N = 45$). Racial background was

dummy coded such that Caucasian participants were coded '1' and non-Caucasians were coded '0.' Thus, a positive correlation between racial background and ME recognition ability would represent higher accuracy in ME recognition for Caucasians.

Judgment or recognition studies generally measure *confidence* as an independent variable, even though it often has little relation to actual ability (DePaulo et al. 1997). Confidence in one's ability to detect MEs was measured prior to the ME test using a 1 (*Very poor*) to 7 (*Very well*) rating scale associated with the question: *How well do you think you will do at recognizing the upcoming facial expressions of emotion?* The results of the confidence measure were reported in prior work (Hurley 2012); however, the measure is included as a covariate in the current study given its unique contribution to the variance in ME recognition ability.

Procedure

Students participated in a study "evaluating students' nonverbal communication skills" in small groups and received 3 h of research credit in partial fulfillment of their 5-h departmental requirement. Participation began with informed consent, followed by completion of a demographic questionnaire and personality measures. Then, the experimenter provided instruction on the ME test.

Before the test, participants were asked to indicate their confidence in their ability to perform well on the ME task. Then, participants viewed the fourteen ME items at the direction of the instructor. Each item consisted of a person with a neutral facial expression, followed by an image of the same person posing an emotion expression for $1/15^{th}$ of a second, followed immediately by the same neutral image that preceded the ME. Each item was projected on a blank wall in the research room. Participants were given approximately 10 s between the presentation of items in which to judge each expression by circling the word *anger, contempt, disgust, fear, happy, sad, surprise,* and *none of the above* from a provided response form.

After the initial ME test, participants were randomly assigned to one of three training conditions or a control condition (see Hurley 2012). Across the three training conditions, participants were trained using the same stimulus materials, but their training was either moderated by an instructor, utilized computer-based instruction, or focused solely on practice with feedback (e.g., the correct emotion label), rather than explanation. Training consisted of 25-min of materials including ME examples, description, and practice. After the training, participants completed a second ME test with new stimuli from the METTv2, using the same procedures described above. Participants were dismissed after the post-test. The present study considers the association between all trained participants' demographic and personality traits on innate and trained abilities at ME identification, as well as a supplemental analysis that controls for the effect of particular training style.

Results

Of 334 cases, one case was deleted due to missing data across multiple scales and six outliers based on age were identified and removed from the dataset, resulting in 327 complete cases for analysis. Less than 0.2 % of other cases had limited missing data. In such cases, missing data were replaced with mean or modal response, depending on the scale in question.

Predictors of ME recognition

Participants' initial score on the ME task ranged from 7.0 to 100.0 % of expressions correctly identified ($M = 61.4$ %; $SD = 17.3$ %). Table 1 presents relevant descriptive statistics and zero-order correlations between study variables at baseline. Significant correlations revealed that participants demonstrated greater ability at identifying MEs if they were younger, female, Caucasian, had lower perceived confidence in their ability to identify MEs, and had higher openness to experience.

Multiple regression was utilized to predict initial ability at ME recognition. As indicated in Table 2, the demographic, personality, and perceived confidence variables were able to explain 7.3 % of variance in initial score on the ME task, $F\,(8, 318) = 4.208$, $p < 0.001$. The pattern of findings largely replicated those found in bivariate analyses. Specifically, when controlling for all other predictors, younger age ($\beta = -0.12$, $p = 0.036$), lowered perceived confidence in ability to identify MEs ($\beta = -0.12$, $p = 0.027$), and higher openness to experience ($\beta = 0.14$, $p = 0.009$) remained significant predictors of accurate ME recognition.

Predictors of ME recognition post-training

Multiple regression was utilized to predict post-training accuracy in ME recognition ability for the 231 participants who participated in a training session (rather than a control condition). Given the variations in training conditions (see Hurley 2012), two dummy-coded variables were created to represent training condition. The first dummy-coded variable assigned a value of '1' to the instructor moderated training condition, while assigning a value of '0' to all other

Table 1 Zero-order correlations for initial ME recognition (Study 1)

	M (SD)	1	2	3	4	5	6	7	8	9
1. ME accuracy	0.61 (0.17)		−0.16**	0.16**	−0.14**	0.08	0.14**	−0.06	0.15**	−0.09
2. Age	19.79 (1.54)			−0.23**	0.10*	0.07	−0.03	0.16**	−0.03	0.07
3. Sex	–				−0.11*	0.17**	−0.02	0.03	0.10*	−0.11*
4. Perceived confidence	4.77 (0.98)					0.04	0.12*	0.03	−0.08	0.04
5. Extraversion	43.16 (5.80)						0.08	0.23**	0.11*	−0.02
6. Openness to experience	39.59 (6.20)							−0.12**	−0.01	−0.10
7. Conscientiousness	43.77 (6.62)								0.001	−0.02
8. Racial background	–									−0.51**
9. Birth country	–									

* $p < 0.05$; ** $p < 0.01$; sex (1 = male, 2 = female), racial background (0 = non-Caucasian, 1 = Caucasian), birth country (1 = United States, 2 = other)

Table 2 Multiple regression of ME recognition on individual predictors (Study 1)

Predictor	Accuracy in ME recognition baseline		Accuracy in ME recognition after training		Improvement in ME recognition ability after training	
	Unstd *b* (95 % CI)	*p*	Unstd *b* (95 % CI)	*p*	Unstd *b* (95 % CI)	*p*
Age	−0.013 (−0.026, −0.001)	0.036	−0.003 (−0.016, 0.011)	0.680	0.013 (−0.002, 0.029)	0.089
Sex[a]	0.037 (−0.002, 0.075)	0.062	0.052 (0.008, 0.096)	0.020	−0.013 (−0.063, 0.037)	0.617
Perceived confidence[b]	−0.021 (−0.040, −0.002)	0.027	0.040 (0.021, 0.059)	<0.001	0.008 (−0.014, 0.029)	0.481
Extraversion	0.002 (−0.002, 0.005)	0.317	0.000 (−0.003, 0.004)	0.815	0.000 (−0.005, 0.004)	0.915
Openness	0.004 (0.001, 0.007)	0.009	0.004 (0.000, 0.007)	0.034	0.000 (−0.004, 0.004)	0.944
Conscientiousness	−0.001 (−0.004, 0.002)	0.462	−0.002 (−0.005, 0.001)	0.189	−0.001 (−0.005, 0.003)	0.523
Racial background[c]	0.046 (−0.001, 0.093)	0.056	0.066 (0.014, 0.118)	0.013	0.008 (−0.052, 0.067)	0.793
Birth country	0.004 (−0.058, 0.067)	0.888	−0.018 (−0.086, 0.050)	0.606	−0.001 (−0.079, 0.077)	0.980
Instruction vs. Feedback[d]			0.035 (−0.015, 0.085)	0.168	0.067 (0.010, 0.123)	0.022
Computer vs. Feedback[e]			−0.021 (−0.073, 0.030)	0.417	−0.016 (−0.075, 0.043)	0.596

[a] Sex (1 = male, 2 = female)

[b] The perceived confidence variable employed the measure taken immediately prior to the test time in question. The tests of accuracy in ME Recognition and Time 1 Improvement employed a measure of perceived confidence completed immediately before the Time 1 post-test

[c] Racial background (0 = non-Caucasian, 1 = Caucasian)

[d] Instruction v. Feedback (instruction = 1, feedback = 0, computer = 0)

[e] Computer v. Feedback (instruction = 0, feedback = 0, computer = 1)

conditions. The second dummy coded variable assigned a value of '1' to the computer-based training condition, while assigning a value of '0' to all other conditions. Thus, the practice with feedback training condition acted as a reference category.

Results indicated the series of variables significantly predicted performance on the post-test measure, F (10, 220) = 4.446, $p < 0.001$, explaining 13.0 % of the variance in post-test ME recognition ability. Specifically, greater ability at ME recognition in the post test was associated with being female ($\beta = 0.15$, $p = 0.020$), higher in perceived confidence ($\beta = 0.27$, $p < 0.001$), higher in openness to experience ($\beta = 0.14$, $p = 0.034$), and of a Caucasian racial background ($\beta = 0.18$, $p = 0.013$). Post-hoc analyses[1] of the trained participants revealed the African American group ($N = 23$, $M = 63.7$ %, $SD = 22.9$) did not perform as well as the Caucasian ($N = 159$, $M = 78.1$ %, $SD = 15.3$) or Asian ($N = 30$, $M = 76.9$ %, $SD = 16.9$) racial groups, which decreased the overall average success rate for the non-Caucasian sample.

Regression analyses were repeated on the *accuracy change scores* computed by deducting the participants'

[1] A one-way analysis of variance of racial group on post-test accuracy was conducted, F (4, 226) = 4.045, $p = 0.003$. Tukey's post hoc tests revealed the African American racial group was significantly different from the Caucasian group ($p = 0.001$) and the Asian group ($p = 0.032$).

baseline ME recognition scores from their post-training ME recognition scores. Multiple regression results indicated no significant effect of the series of predictor variables on improvement in ME recognition ability post-training, F (10, 220) = 1.385, p = 0.188.

Discussion

Initially, individuals who were younger, of higher openness to experience, and of lower perceived confidence in ability to identify MEs demonstrated greater natural ability at identifying MEs. Thus, our hypotheses for age [H2] and openness to experience [H4] were supported, as these individual differences predicted innate ME recognition ability (i.e., without training). The finding that age played a significant role in ability to detect MEs was particularly interesting, given the range tested was between the ages of 18 and 26 (M = 19.79, SD = 1.54). However, after training, age was no longer a significant predictor, while perceived confidence had an opposite effect (i.e., greater perceived confidence had a negative relationship with ME recognition ability at pre-test and a positive relationship at post-test). After training, individuals from a Caucasian racial background emerged as having higher ME accuracy scores than their non-Caucasian counterparts. Post-training, sex also emerged as an important predictor of ME accuracy, such that being female was associated with higher ME accuracy scores. Thus, after training, only our hypotheses regarding sex [H1] and openness [H4] were supported.

In this study, extraversion and conscientiousness did not significantly predict accuracy on the ME task, revealing no support for H3 and H5. However, the average scores for these variables were higher than the mean for openness to experience. The majority of participants were highly extraverted and conscientious, but had slightly lower openness to experience (Table 1). Thus, there may have been an insufficient range for testing trait differences with respect to conscientiousness and extraversion.

While age, sex, and openness held predictive ability either prior to or immediately after training, these variables were not related to improvement from the pre- to post-test. This suggests that while training may not equalize individual differences in the ability to recognize MEs, it can lead to improvement in most individuals regardless of age, sex, race, and personality. However, some participants who did well pre-training may have not improved due to ceiling effects, and this may have reduced any effect of training.

The finding that racial background significantly contributed to post-training accuracy was surprising, as the stimulus materials were evenly balanced across different racial backgrounds to mitigate possible in-race effects. Our post hoc analyses uncovered that this effect was driven primarily from data from African American participants, who did improve with training, but not to the same degree as others. While the size of this sample raises questions as to the validity of these findings, perhaps the findings are reflective of a case of *stereotype threat*. Several studies have found that African American students underperform on cognitive assessments due to self-handicapping behavior associated with awareness of a negative group stereotype (e.g., Aronson et al. 2002; Steele and Aronson 1995), which has been recently extended to neuropsychological performance (Thames et al. 2013). In our study, we presented the ME tasks as *tests* of students' *ability*, thus, the stereotype of poor performance on tests could have been activated in the African American group and impaired their performance.

Study 2

In addition to innate factors—such as sex, ethnicity, and personality—experiential factors should be considered when examining ME detection. In fact, having a 'unique' background such as a troubled childhood (Bugental et al. 2001; O'Sullivan and Ekman 2004) or experience listening to emotional stories or scanning faces (Ekman and O'Sullivan 1991), or having organic brain damage that disables verbal processing (Etcoff et al. 2000) has been linked to superior nonverbal reading skills. It's possible that similar experiences and training in reading nonverbal behavior also translate to one's ability to analyze MEs.

Study 2 was designed to replicate and extend the findings of Study 1 by examining individuals outside of the college population with unique experience relevant to assessing nonverbal behavior. In 2006, the Transportation Security Administration (TSA) established the Screening of Passengers by Observational Techniques (SPOT) program to observe passenger behavior and detect those with potential malicious intent. Behavior detection requires extreme attention to detail, the ability to maintain focus for long periods of time, and the ability to conduct improvised casual conversations. As a result, TSA has developed a specialized position, the Behavior Detection Officer (BDO), whose main objective and primary focus is to identify behavior patterns of individuals during the security process who might pose a security risk.

BDOs learn about verbal and nonverbal signals and then spend time on the job observing and engaging with passengers. During their career cycle, BDOs may receive training in advanced types of nonverbal analysis such as facial expression recognition. Regardless of whether BDOs receive formal facial expression training or learn from experience, it's clear that ability to understand a person's feelings and intentions from observing behavior is critical to these officers' success.

Method

Participants

One-hundred-fifty BDOs (36 % female) from 11 airports across the United States participated in a study regarding micro expression recognition. Eleven were removed due to incomplete personality data and listwise deletion of 12 cases occurred due to missing values, resulting in a total of 127 cases for analyses. A subset of the 127 participants had received a two-day facial expression recognition training between 6 and 20 months prior (59 %). Most BDOs had more than 2 years experience (65 %); however, some BDOs with 6–12 months (5 %), 12–18 months (12 %) and 18–24 months (18 %) experience also participated. The participants were primarily Caucasian (54.3 %), with an average age of 42.40 ($SD = 12.03$). Participants also self-identified as African American (15.0 %), Hispanic (14.2 %), multi-racial (7.9 %) or 'other' racial background (8.7 %). Forty-six (35.9 %) BDOs reported prior law enforcement experience.

Stimulus materials

Participants accessed and completed the METTv2 used in Study 1 through one of two secure online websites,[2] using a unique username and password. After logging in, participants saw a welcome/introductory screen, followed by five sections: (1) pre-test, (2) training, (3) practice, (4) review, and (5) post-test. For the purpose of this study, the pre-test (14-item) was used as a baseline ME recognition measure and the post-test (28-item) was used to measure post-training recognition. Participants were instructed to select the speed of 1/15th of a second, which was verified by the experimenter. Each of the seven basic emotions—anger, contempt, disgust, fear, happy, sad, and surprise—was presented an equivalent number of times and presented in a random order for each viewing. ME recognition scores were produced by dividing the number of correctly identified items by total items.

Measures

Study 2 employed the same personality scales as Study 1. As in Study 1, measures of openness to experience ($\alpha = 0.70$) and conscientiousness ($\alpha = 0.80$) were reliable. Initial reliability estimates related to the extraversion scale were unacceptable ($\alpha = 0.58$). Removal of one problematic reverse-coded item improved the reliability estimate ($\alpha = 0.69$). Thus, all analyses related to extraversion are based on the sum of responses to the remaining 11 items. Age, sex, length of time as a BDO, prior law enforcement experience, and prior facial expression training were also measured.

Covariates

Racial background and confidence in ability to identify MEs were recorded using the same scales as Study 1. For analyses considering racial group, BDOs were divided into those from a Caucasian ($n = 69$) or non-Caucasian background ($n = 58$), as various racial groups had low representation in the dataset precluding more nuanced comparisons between racial groups. These measures were included as covariates given their predictive value in previous studies. The confidence measure was of particular interest, given that confidence of professional lie detectors is often uncorrelated with accuracy (DePaulo et al. 1997). The current study examined a unique group of behavior experts (i.e., BDOs) who encounter a higher proportion of 'truth tellers' in their daily interactions then traditional law enforcement officers.

Procedure

All airports followed the same structure to ensure uniformity in administering the ME identification task and associated questionnaires. Each administration took place in the host airport's local training site, where each participant could utilize an Internet-accessible computer. Participants were scheduled in groups of 2–10 based on the operational needs of the host airport. Participants were randomly assigned to each training tool.

The experimental procedure was similar to Study 1. When participants arrived at the research space, they completed an oral consent and a demographic questionnaire. After experimenter instruction, participants were asked to indicate their confidence in their ability to accurately identify MEs. Then, participants viewed fourteen ME items on a personal computer screen at the speed of 1/15th of a second. After each ME, the screen reverted to the stimulus item's neutral expression and participants took approximately 10 s to judge each expression—although this was not regulated—by clicking the appropriate response on the screen. Unlike Study 1, the 'none of the above' option was removed leaving 7 response options—*anger*, *contempt*, *disgust*, *fear*, *happy*, *sad*, and *surprise*. Next, participants assigned to the training condition were instructed on the nature of MEs, through description, example, and practice. Training was conducted at a self-directed pace and lasted approximately 30 min. After the

[2] At the time of this study, the CD version of METTv2 (utilized in study one) was unavailable, as it had been revised into two web-based training tools (the METT Advanced, http://face.paulekman.com/, and the Micro Expression Recognition Training, http://www.humintell.com/).

training, participants completed a 28-item post-test using the same procedures described above.

Several months after the ME identification task, the officers completed a personality inventory that was linked to their subject ID, which was then matched to their ME scores. Given that personality is defined as a stable set of characteristics (Allport 1937), the difference in time between administration of the ME identification tasks and personality inventory should not have affected the officers' responses.

Results

Predictors of ME recognition

BDOs' initial scores on the ME task ranged from 14 to 100 % of expressions correctly identified ($M = 68$ %; $SD = 18.9$ %). Table 3 demonstrates zero-order correlations between demographic characteristics, personality characteristics, experiences (i.e., facial expression training, law enforcement experience, length of BDO service), and perceived confidence in identifying emotional expression with BDOs' initial ME recognition score. Results demonstrated that BDOs who were younger, had greater confidence in their ability to identify emotions, and had engaged in previous facial expression training tended to score higher on the ME test.

Multiple regression was utilized to predict initial score on the ME identification task on the basis of 11 independent variables. Results were significant, $F\ (10,\ 115) = 3.88$, $p < 0.001$, with predictors explaining approximately 18.7 % variance in initial score on the ME task. As demonstrated in Table 4, when controlling for all other variables, having prior facial expression training ($\beta = 0.33,\ p < 0.001$), greater perceived confidence in recognizing emotional expressions ($\beta = 0.27, p = 0.002$), and no law enforcement experience ($\beta = 0.19, p = 0.046$) predicted initial score on the ME task for the BDO group.

Predictors of ME recognition post-training

Multiple regression was utilized to predict post-training accuracy in ME recognition ability for the 119 BDOs who participated in a training session. Results indicated the series of variables significantly predicted performance on the post-test measure, $F\ (10,\ 108) = 6.24,\ p < 0.001$, explaining 30.7 % of the variance in post-test ME recognition ability. Specifically, being younger ($\beta = -0.24$, $p = 0.011$), more confident ($\beta = 0.40,\ p < 0.001$), and having no law enforcement experience ($\beta = 0.21$, $p = 0.020$) significantly predicted ME recognition ability immediately following training.

Table 3 Zero-order correlations for initial ME recognition (Study 2)

	M (SD)	1	2	3	4	5	6	7	8	9	10	11
1. ME accuracy	0.68 (0.19)		0.28**	−0.18*	0.02	0.33**	−0.01	0.07	0.08	0.17*	0.07	−0.09
2. Facial expression training	–			0.06	−0.06	0.00	−0.08	−0.20*	0.08	−0.19*	0.07	0.12
3. Age	42.40 (12.03)				−0.07	−0.15	−0.09	−0.02	−0.06	−0.23**	0.29**	0.27**
4. Sex	–					−0.03	0.11	0.06	0.05	0.34**	0.05	−0.17*
5. Perceived confidence	3.12 (0.78)						0.08	0.24**	0.10	0.07	0.02	−0.16*
6. Extraversion (11-item)	39.26 (4.75)							0.24**	0.29**	−0.01	−0.10	−0.01
7. Openness to experience	39.22 (5.66)								−0.04	0.05	−0.06	−0.13
8. Conscientiousness	49.41 (5.02)									0.10	−0.01	0.06
9. Law enforcement experience	–										0.03	−0.08
10. Racial background	–											0.11
11. Length of BDO experience	–											

* $p < 0.05$; ** $p < 0.01$; facial expression training (0 = none, 1 = facial expression training); sex (1 = male, 2 = female); law enforcement experience (1 = yes, 2 = no); racial background (0 = non Caucasian, 1 = Caucasian); length of BDO experience (1 = 0–6 months, 2 = 6–12 months, 3 = 12–18 months, 4 = 18–24 months, 5 = more than 24 months)

Table 4 Multiple regression of ME recognition on individual predictors (Study 2)

Predictor	Accuracy in ME recognition baseline		Accuracy in ME recognition after training		Improvement in ME recognition ability after training	
	Unstd *b* (95 % CI)	*p*	Unstd *b* (95 % CI)	*p*	Unstd *b* (95 % CI)	*p*
Facial expression training	0.064 (0.031, 0.096)	<0.001	0.018 (−0.004, 0.040)	0.102	−0.037 (−0.062, −0.012)	0.004
Age	−0.002 (−0.005, 0.001)	0.154	−0.003 (−0.005, 0.000)	0.011	−0.003 (−0.005, 0.000)	0.025
Sex[a]	−0.016 (−0.085, 0.054)	0.658	0.011 (−0.036, 0.059)	0.634	0.008 (−0.047, 0.064)	0.770
Perceived confidence[b]	0.065 (0.024, 0.107)	0.002	0.064 (0.037, 0.090)	<0.001	−0.042 (−0.072, −0.011)	0.008
Extraversion	0.000 (−0.008, 0.006)	0.799	−0.002 (−0.006, 0.003)	0.506	0.001 (−0.005, 0.006)	0.786
Openness	0.002 (−0.004, 0.008)	0.470	0.001 (−0.003, 0.005)	0.576	−0.002 (−0.007, 0.003)	0.461
Conscientiousness	0.001 (−0.006, 0.007)	0.822	−0.004 (−0.009, 0.000)	0.055	−0.005 (−0.010, 0.000)	0.044
Law enforcement experience[c]	0.073 (0.001, 0.145)	0.046	0.059 (0.009, 0.108)	0.020	−0.025 (−0.083, 0.032)	0.385
Racial background[d]	0.033 (0.032, 0.098)	0.313	0.013 (−0.031, 0.057)	0.558	−0.015 (−0.066, 0.036)	0.559
BDO experience[e]	−0.009 (−0.047, 0.028)	0.617	0.000 (−0.026, 0.024)	0.947	0.016 (−0.013, 0.044)	0.278

[a] Sex (1 = male, 2 = female)

[b] The perceived confidence variable employed the measure taken immediately prior to the test time in question. The tests of accuracy in ME Recognition and Time 1 Improvement employed a measure of perceived confidence completed immediately before the Time 1 post-test

[c] Law enforcement experience (1 = yes, 2 = no)

[d] Racial background (0 = non-Caucasian, 1 = Caucasian)

[e] Length of BDO experience (1 = 6–12 months, 2 = 12–18 months, 3 = 18–24 months, 4 = more than 24 months)

This analysis was repeated utilizing change scores from pre- to post-test accuracy as the dependent variable. Multiple regression revealed a number of significant predictor variables describing BDOs' improvement in ME recognition ability post-training, $F\ (10,\ 108) = 2.823,\ p = 0.004,\ R^2 = 13.4\ \%$. Specifically, not having prior facial expression training ($\beta = -0.26,\ p = 0.004$), being younger ($\beta = -0.23,\ p = 0.025$), less confident ($\beta = -0.25,\ p = 0.008$), and less conscientious ($\beta = -0.19, p = 0.044$) significantly predicted improvement in ME recognition ability after training.

Discussion

In contrast to the first study, Study 2 examined adults with a wide range of ages and experiential backgrounds. Of interest, all individuals in this study worked in behavior detection for a government security agency; thus, they had daily experience with observing and analyzing the behaviors of others. Within this highly experienced group, the only significant demographic or personality characteristic associated with initial ME recognition was perceived confidence in one's ability to identify MEs. In addition, prior law enforcement experience [H6b] and participation in previous facial expression training [H7] emerged as significant experiential factors that were associated with initial skills in ME recognition, however the relationship between law enforcement experience and ME recognition was in the opposite direction as predicted. Similar to Study 1, there was a negative relationship between age and accuracy, but this variable was only a significant predictor of ME accuracy after training, revealing only partial support for H2.

In this sample, prior facial expression training, age and conscientiousness predicted improvement from the initial ME test to the post-training test. While it's no surprise that untrained individuals benefitted the most from ME training; the negative relationship between ME recognition improvement and conscientiousness was opposite our initial predictions [H5]. While conscientious individuals were no more or less able to detect MEs initially, within this sample, the trait of conscientiousness inhibited BDOs' abilities to improve their skill at detecting MEs. When taking ME tests, participants are forced to make quick judgments of emotion. Perhaps conscientious individuals, who are more used to taking their time and deeply processing information, are thus at a disadvantage for improving one's abilities during a short training session.

Although previous facial expression training—even that which occurred up to 24 months prior—was the strongest predictor of ME recognition at the baseline, it was not a significant predictor after training. The ME training provided to BDOs as part of this study appeared to have raised their accuracy such that they faced a ceiling effect—thus, the current training did not have as strong an effect as it did for those without previous training. It's no surprise then that BDOs without previous facial expression training improved the most from the baseline to post-test—as they had the most skill to gain.

With this sample, having law enforcement experience negatively affected an individual's ME recognition. This

may be linked to research in deception, which has uncovered that law enforcement groups have a wide range in skill at detecting deception (O'Sullivan et al. 2009), and their training on lie detection may focus on inaccurate behaviors such as eye contact, and fidgeting, which may decrease their deception detection accuracy (Mann et al. 2004). Additionally, the specific experiences a law enforcement officer faces may be more important than simply having a law enforcement background; for example, some research has shown that patrol officers are not as skilled at recognizing emotion as fraud investigators (Frank and Hurley 2014). While we cannot account for these officers' specific experiences and training prior to TSA, training provided by TSA appears to increase all officers' ability to detect MEs. Further, ME recognition is a highly visual skill, in which younger eyes may actually have an advantage (Mill et al. 2009). On average, participants with law enforcement experience were older ($M = 46.0$, $SD = 10.5$) than others ($M = 40.3$, $SD = 12.4$), which may have contributed to this effect.

The hypotheses that sex [H1], extraversion [H3], openness [H4], conscientiousness [H5], and length of BDO experience [H6a] would predict ability to read MEs in a controlled environment were not supported. It's possible that the influence of prior facial expression training overpowered any individual differences in this sample.

General discussion

The current series of studies examined how demographic, personality characteristics, and experiential factors relate to the ability to detect MEs. Results from these studies revealed different patterns of influence depending on lifetime experience (i.e., college student or BDO), but common themes emerged among both samples as to the importance of confidence and training in detecting MEs.

While Study 1 found a positive relationship between being female and decoding MEs (post-training), this relationship did not exist in Study 2. Perhaps the slight advantage that females have interpreting nonverbal behavior has been ameliorated by the improvement in the males due to previous specific training in ME recognition. It's also possible that officers recruited for or interested in behavior detection work have a natural ability to identify such behaviors, representing males at the higher end of the nonverbal detection ability scale. Additionally, most sex effects have been found using college student populations, suggesting that additional research using adult samples may better represent real life. Similarly, the finding of small racial differences in the college sample, but not the BDO sample, suggests that situational factors like training, motivation, or stereotype threat may overpower individual differences. It's important to note that certain cultural groups, like individualists and U.S. Americans, are generally more expressive than other cultures (Matsumoto et al. 2008b), which may also lead to greater recognition of high-intensity expressions for certain groups, such as those seen in the METT. These results and alternative explanations require additional research before any potential racially based advantage is confirmed.

We found that age contributed to baseline ME recognition in our college sample, providing partial support for H2. This finding is interesting given our small range of ages; perhaps younger individuals are more attuned to others' emotions due to lifestyle issues such as seeking romantic partners, searching for a first job, or eagerness to learn. We examined a wider range of ages in Study 2; however, younger age was only associated with ME recognition post training or post-training improvement. Given the significant relationship between age and ME recognition was only seen at one pre-test (students) and one post-test (BDOs), this finding should be further examined in future research.

This study examined only a small range of personality factors revealing few contributors to ME recognition. While a consistent relationship between openness and ME recognition emerged in our college sample, supporting H4, no relationship was found with our officer sample. Of the three personality characteristics, only conscientiousness appeared to affect BDO ME recognition; but this correlation was weak, occurred post-training, and was in the opposite direction as posed hypotheses. One limitation of our data was the narrow range of personality scores in both datasets, revealing an overall population that was extraverted, open, and—particularly in the BDO set—highly conscientious. Future studies should examine groups with different backgrounds and a wider range of traits to better understand the impact of personality traits on behavior detection. Additional traits may be applicable to ME recognition and should be also tested. In addition to the NEO, emotional recognition has been related to such variables as empathy, affiliation, tolerance, locus of control, femininity, communality, social sensitivity, and family expressiveness (Hall et al. 2009; Mufson and Nowicki 1991).

Although characteristics such as sex, age, and personality are out of one's control, some experience-based factors that individuals or agencies could employ were also linked to ME recognition. Individual differences were not predictive in our sample of security officers with prior facial expression training.[3] Accuracy scores for these

[3] This training did not include use of either web-based training tool (METT Advanced, http://face.paulekman.com/or the Micro Expression Recognition Training, http://www.humintell.com).

officers were high in comparison to previous studies[4] (e.g., Matsumoto et al. 2000), which suggests greater skill for ME recognition for this group. This suggests that if the opportunity and resources for training exist, individual characteristics become less important in predicting accuracy in ME identification.

While previous training significantly affected initial ME recognition in the BDO sample, training provided during Studies 1 and 2 appeared to positively affect all participants, producing global improvement across the samples. In Study 1, individual differences did not affect improvement post training, suggesting that these tools can be used to improve untrained students' abilities to detect MEs. A similar pattern of results was uncovered in Study 2; however, conscientiousness and age appeared to be a hindrance to training in this sample. One reason for this isolated finding might be that the BDO sample was on average, more conscientious ($M = 49.41$, $SD = 5.02$) than the student sample ($M = 43.77$, $SD = 6.62$), as well as contained a wider range of participant ages. Additional studies should examine other adults to confirm this finding.

Perceived confidence played a role in the BDO data, suggesting that confidence in judgment is more clearly linked to ability once the task has been observed (Hurley 2012). Many of the participating BDOs had prior experience making nonverbal judgments of others, be that through their work or through their participation in prior training programs. Thus, it is no surprise that perceived confidence was a significant positive predictor for BDOs at both baseline and post-training assessments.

The analyses presented herein begin to identify individual and experiential factors that may contribute to an ability to identify brief facial expressions—both with and without training. Future studies should continue to examine the factors that may be associated with ME recognition ability. Study 2, which utilized experienced and highly trained officers, as opposed to college students, revealed strong support for experiential factors as compared to individual differences in predicting ME recognition. This suggests that training and experience may have an effect on skill in ME recognition, but the amount and type of training required to produce significant improvements in ability remains unknown. Research has shown that short training sessions can improve ME recognition (Hurley 2012; Matsumoto and Hwang 2011); and this study extends these findings to suggest that training given even 6–20 months prior to an assessment of ME recognition ability has a positive effect. However, transference to detecting naturally occurring MEs is unknown and additional research is required to fully understand the role different types of professional experiences or ME trainings play in identifying MEs.

Another limitation of the current study is that the ME stimuli used were posed and imbedded within a person's neutral baseline (also posed). A naturally occurring ME may be more difficult to detect, as it may morph into another expression, affected by environmental variations such as lighting, angle, vantage point, speech and other background sounds. While this study represents a step towards understanding background characteristics, these tests should be repeated using more ecologically valid stimuli. There is growing interest to test nonverbal perception using spontaneous or naturally occurring stimuli, as it best represents our daily activities. A recent study revealed video imagery can be used to elicit micro expressions in subjects (Yan et al. 2013), which could be reformatted into a ME test. An ideal test should consider the observers' home environment (e.g., security interviews versus interpersonal relationships). For BDOs, this might mean video-recorded interviews with travelers transiting the airport. Given privacy concerns, this might require a simulated environment (e.g., Kraut and Poe 1980), although applicable stakes should be provided to mock travelers.

The stimuli used in this study were presented very quickly (67 ms), perhaps faster than found in naturally occurring MEs (Matsumoto and Hwang 2011; Porter et al. 2012; Yan et al. 2013). Further testing is required to understand whether the ME ability seen in this study is related to perceptual or visual acuity for seeing fast stimuli, regardless of whether or not the stimuli are MEs, although Matsumoto et al. (2000) demonstrated that for videotape based presentations, acuity was not a factor. Given that all participants were cued to the ME, this is likely not the case. But it is possible that visual acuity or perceptual skills become relevant when examining much older populations, using more precise digital images, or when expressions are partial, angled or timed unexpectedly.

The ability to identify nonverbal signals and correctly interpret these signs is a key component of emotional competence. Careful observation of nonverbal behavior allows individuals to better understand how others feel, which can improve understanding of others' emotions in daily interactions. The ability to read MEs has been linked to better socio-communicative skills (Matsumoto and Hwang 2011). These skills are also essential in deception contexts, national security, the medical field, business communications, and cross-cultural relations, where professionals, who can better read their patients, suspects, or business partners, will make better judgments about their feelings and intentions.

[4] Although other studies tested ME recognition at different speeds and provided response scales with greater choices, which may affect ME score.

Conflict of interest Ashley E. Anker, Hyisung C. Hwang, Carolyn M. Hurley and Mark G. Frank have no conflict of interest. David Matsumoto is a co-author of the Micro Expression Training Tool used in both Studies. This tool is used commercially, and he receive a financial benefit from its sales.

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