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Development of a FACS-Verified Set of Basic and Self-Conscious Emotion Expressions

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In 2 studies, the authors developed and validated of a new set of standardized emotion expressions, which they referred to as the University of California, Davis, Set of Emotion Expressions (UCDSEE). The precise components of each expression were verified using the Facial Action Coding System (FACS). The UCDSEE is the first FACS-verified set to include the three "self-conscious" emotions known to have recognizable expressions (embarrassment, pride, and shame), as well as the 6 previously established "basic" emotions (anger, disgust, fear, happiness, sadness, and surprise), all posed by the same 4 expressers (African and White males and females). This new set has numerous potential applications in future research on emotion and related topics.

Keywords: nonverbal expression, self-conscious emotion, FACS

In the late 1960s, researchers discovered that a small set of emotions have distinct, cross-culturally recognized, nonverbal expressions (Ekman, Sorenson, & Friesen, 1969; Izard, 1971). Since this pioneering work, emotion expression research has become increasingly central to psychological science (see Matsumoto, Keltner, Shiota, O'Sullivan, & Frank, 2008). One of the most important and generative advances was the development of nonverbal coding systems for assessing distinct emotion expressions, including Izard's (1979) maximally discriminative facial movement coding system (MAX) and Ekman and Friesen's (1978) more widely used Facial Action Coding System (FACS).

FACS is an anatomically based system that delineates every facial muscle movement, or action unit (AU), relevant to the expression of anger, contempt, disgust, fear, happiness, sadness, and surprise. Over 20 years of research has demonstrated that certain AUs are reliably associated with each distinct emotion (see Ekman, 2003, for a review). On the basis of these findings, researchers have developed guidelines showing which AUs are associated with which emotions (e.g., Ekman & Friesen, 1978); these guidelines can be used to create standardized posed emotion expressions that accurately and reliably convey each emotion. Resultant expressions do not suffer from many of the problems associated with emotion expression stimuli developed without a standardized system (e.g., by asking expressers to pose according to their own intuitions or those of the researcher about the appearance of particular expressions). Expressions posed without a standardized system (e.g., Mandal & Rai, 1987; Wang & Markham, 1999) may suffer from problems of validity—not accurately reflecting the intended emotion—and reliability—lacking consistency across perceivers or across different expressions presumed to reflect the same emotion.

In contrast, using FACS, Ekman developed the Pictures of Facial Affect (POFA; Ekman, 1993), a valid and reliable set of posed emotion expressions that generate high recognition rates across cultures. The POFA has been used in a wide range of studies, including developmental, cross-cultural, neuroimaging, and behavioral research (see Matsumoto et al., 2008). By utilizing these FACS-verified expressions, researchers ensure that observed effects can be attributed to the targeted emotions. In contrast, researchers who use nonstandardized stimuli risk basing their findings on expressions that do not actually portray the emotions of interest. Posed expressions have their own limitations, such as potential threats to mundane realism given that FACS-posed expressions are prototypes, or ideal exemplars, of each emotion, which may be shown infrequently in everyday life (Russell, 1994). However, posing expressions with a standardized system such as FACS is the only way to ensure morphological equivalence of expressions across expressers and studies (Beaupré & Hess, 2005).

Extant FACS-Verified Sets

To our knowledge, three sets of FACS-verified expressions are currently available for use in research. First, the original POFA set (Ekman, 1993) includes White male and female individuals posing expressions of anger, contempt, disgust, happiness, fear, sadness, and surprise. All photos are black and white and were taken several decades ago, so hairstyles and facial hair appear dated. The expressions were posed using FACS-based instructions and then FACS-coded to confirm that they included the correct configuration of AUs. As is typical for FACS-verified stimulus sets, the precise configuration of AUs varies slightly across stimuli because, for some emotions, there are several subtly different AU configurations that reliably convey the emotion.

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Second, the Japanese and Caucasian Facial Expressions of Emotion (JACFEE; Matsumoto & Ekman, 1988) includes full-color photos of Japanese and Caucasian male and female individuals posing the same seven expressions included in the POFA. The JACFEE photos also were posed with FACS-based instructions and verified to portray AU configurations prescribed by Ekman and Friesen (1978).

Third, the Montreal Set of Facial Displays of Emotion (MSFDE; Beaupré, Cheung, & Hess, 2000) includes black and white photos of five of the seven POFA/JACFEE expressions (anger, disgust, fear, happiness, sadness) plus shame, portrayed by Chinese, French Canadian Whites, and sub-Saharan African male and female individuals. Photos were posed by directing individuals to perform AUs associated with each expression, following Ekman and Friesen's (1978) guidelines; however, in contrast to the POFA and JACFEE, the MSFDE expressions were not verified to show the AUs prescribed by Ekman and Friesen (1978). Instead, they were matched to AU configurations identified by Wiggers (1982). The resulting expressions are similar to the expressions portrayed in the POFA and JACFEE, but there are several differences.

All three sets have been used in numerous studies and have led to important advances in our understanding of emotion (Beaupré & Hess, 2005; Ekman, 2003; Matsumoto et al., 2008). However, each set has important limitations. First, the POFA—which is the most widely used—includes White expressers only. Second, both the POFA and the JACFEE use different expressers to pose different expressions. Consequently, comparisons across emotions are confounded by differences in expresser appearance and facial physiognomy. Third, the MSFDE does not include one of the original so-called "basic" emotion expressions first identified in the late 1960s and now known to be cross-culturally recognized: surprise.

Fourth, none of these sets includes all three self-conscious emotions—embarrassment, pride, and shame—that are now known to be recognized across cultures, including non-Western, isolated cultures (Haidt & Keltner, 1999; Keltner, 1995; Izard, 1971; Tracy & Robins, 2004, 2008). These expressions are notably different from the original seven emotions in the POFA because they require bodily as well as facial features for reliable recognition, such as upward or downward head tilt. However, they tend to be recognized at rates comparable with the POFA emotions, except for happiness, which is typically recognized at higher rates, and contempt, which is typically recognized at lower rates (Elfenbein & Ambady, 2002). Given increasing research attention on the self-conscious emotions (see Tracy, Robins, & Tangney, 2007), future studies of emotional nonverbal behavior should include these expressions. Neither the POFA nor the JACFEE includes any self-conscious emotion expression; the MSFDE includes shame but not embarrassment or pride.

To address these limitations, we sought to develop a new FACS-verified stimulus set that includes all 10 emotions—the 6 original expressions that Ekman and colleagues identified in the late 1960s (Ekman et al., 1969), as well as contempt and the three self-conscious emotion expressions. All 10 expressions were posed by four individuals, representing both genders and two ethnicities. We developed these stimuli and established their reliable recognition through an iterative process that involved two studies. On the basis of previous research (Elfenbein & Ambady, 2002; Haidt & Keltner, 1999; Tracy & Robins, 2004), we expected recognition for all expressions to be significantly greater than chance and to be relatively higher for anger, disgust, happiness, pride, sadness, and surprise, and relatively lower for contempt, embarrassment, fear, and shame.

Study 1

Method

Stimulus development. We recruited male and female White and West African individuals to "audition." These two ethnicities match the ethnicities of the majority of research participants in North America (White) and of individuals living in a culturally distant part of the world (West Africa) who participated in a cross-cultural study of self-conscious emotion recognition (Tracy & Robins, 2008). In addition, West Africans are physically similar to African Americans (most of whom trace their roots to West Africa) and thus may be perceived as African American to most North American observers.

All expressers wore plain white T-shirts and no jewelry and stood in front of a neutral gray background. Photos were taken from the waist up using a digital camera mounted on a tripod. Expressers were instructed to pose several emotion expressions on the basis of the directed facial action task—a procedure that guides expressers to display each of the AUs associated with a given emotion (Levenson, Carstensen, Friesen, & Ekman, 1991)—and were judged in proficiency (i.e., ability to make and hold each movement as instructed) by Jessica L. Tracy. The most proficient male and female expresser of each ethnicity (four individuals in total) were retained to participate in a posing session guided by Erika Rosenberg, a leading expert in FACS who was trained by Paul Ekman and who teaches FACS certification workshops worldwide. Rosenberg worked directly with expressers, instructing and assisting them on the facial and bodily movements needed for each expression on the basis of FACS and Ekman and Friesen's (1978) guidelines.

Guidelines for posing the self-conscious emotion expressions are available from Keltner (1995); Heerey, Keltner, and Capps (2003); Izard (1971), and Tracy and Robins (2007). The recognizable shame expression portrays a downward head tilt and downward eye gaze, but we asked three of the four expressers[1] to additionally pose a second version that included slumped posture, based on theoretical and empirical associations between shame (or failure) and slumped posture (e.g., Darwin, 1872; Lewis, Alessandri, & Sullivan, 1992; Tracy & Matsumoto, 2008). No previous studies have tested whether slumped posture facilitates recognition of shame. Two versions of the embarrassment expression have previously been validated: one in which the head is turned down and slightly sideways, combined with a small, suppressed smile; and another with the same facial/head expression combined with a hand touching the face (Haidt & Keltner, 1999; Heerey et al., 2003). All expressers posed the version of embarrassment with no face touching, but three of the four expressers also posed the version with face touching. Finally, there are two well-recognized versions of the pride expression; both include the head tilted slightly back, a small non-Duchenne smile, and expanded posture,

[1] We were not able to obtain alternate versions of shame and embarrassment posed by the African female expresser because these expressions were posed after the original session, and she was no longer available.

but one includes arms raised above the head with hands in fists, whereas the other includes arms akimbo, with hands on hips (Tracy & Robins, 2007). Both versions were posed by all expressers.

Expressers produced several exemplars of each basic and self-conscious emotion expression, and these were later FACS-coded and verified by Rosenberg to show all of the AUs relevant to each expression. For all four expressers, at least one expression failed to achieve verification after the initial posing session, so expressers were recalled for a second session focused on obtaining new versions of these expressions. Photos were again FACS-coded and verified by Rosenberg, and at least one verified photo of each expression was identified for each expresser. All of these expressions were included as stimuli in Study 1; in cases in which several verified expressions were available for a particular expresser, all were included.

Participants and procedure. One hundred seventy-five undergraduate students (65% female, 35% male) participated in exchange for course credit. Participants viewed stimuli presented in a randomized order, projected onto a large 4-ft × 6-ft (1.219 m × 1.829 m) screen. For each of 63 photos, participants were instructed to "decide which emotion, if any, you think is being expressed by the person in the photo . . . Choose the emotion that best matches the emotion expressed by the person in the photo," and were given the response options of "anger," "contempt," "disgust," "embarrassment," "excitement," "fear," "happiness," "pride," "sadness," "shame," "surprise," "no emotion," "none of these terms is correct," and "other," with the last option followed by a blank space where participants could respond in an open-ended manner. The "excitement" option was included to provide an additional positive emotion option and to address concerns that pride (especially when shown with arms raised) might be mistaken for excitement. "None of these is correct" was included to address concerns about the traditional forced-choice response method (e.g., Russell, 1994); inclusion of this option has been shown to reduce the likelihood that agreement on a particular option is an artifact of the response format used (Frank & Stennett, 2001). Specifically, judges choose "none of these is correct" when they believe that the correct response option is not provided or does not exist. The "no-emotion" option and the open-ended option were included to address any remaining concerns with forced-choice methods.

Results and Discussion

We first examined recognition rates for those emotions for which particular expressers produced more than a single viable expression, to determine which was best recognized. Only the best recognized expression of each emotion for each expresser was included in results presented here. Table 1 presents recognition rates for each expresser showing each expression.[2] False alarm rates for each expression, averaged across expressers, are presented in Table 2. On the basis of the binomial test, all expressions except African male disgust, African female shame, and African male and White male and female fear, were recognized at levels significantly greater than chance, set conservatively at 33%, $p < .05$.[3] Mean recognition rates varied considerably across emotions, with means ranging from 39% (fear) to 94% (happiness).

These differences generally replicate previous results; fear—the emotion that was least well recognized here—tends to be least well recognized across cultures (Elfenbein & Ambady, 2002), and embarrassment and shame tend to be recognized at rates similar to those found here, when studies include multiple emotion photos and an open-ended response option, as was done here (Haidt & Keltner, 1999). Given that recognition rates of both versions of the shame expression were somewhat lower but comparable with previous rates, slumped posture seems not to impair shame recognition and may enhance it. In contrast, the version of the embarrassment expression with face touching was clearly recognized at higher rates, and more comparable with those found previously, than the version with no face touching, suggesting that this version may be the more prototypical one; that is, it may be the version that includes all features associated with the expression.[4]

Overall, recognition rates in Study 1 were similar to those found in previous research. However, certain expressers produced versions of certain expressions that were suboptimal, compared with expressions of the same emotion posed by other expressers; specifically, the sad expression shown by the White male and the disgust expression shown by the African male were recognized at lower levels than the comparable expressions shown by other expressers. In addition, none of the fear expressions, except for that produced by the African female, were recognized at rates close to what has been found previously ($M = 58\%$, based on Elfenbein & Ambady's, 2002, meta-analysis). Thus, we conducted a second study to develop additional versions of these expressions that would be more consistent across expressers and more similar to those in previously developed sets.

Study 2

Method

Stimulus development. We developed the new expressions in the same iterative manner as in Study 1. Each expresser was photographed posing several expressions for each problematic

[2] We were not able to develop expressions of contempt that generated above-chance levels of recognition in either study (highest recognition rates = 25%, 24%, 23%, and 21% for the four expressers). Consequently, we excluded contempt from the stimulus set. Several researchers have argued that contempt does not have a distinct, recognizable expression (e.g., Izard & Haynes, 1988) and, indeed, Elfenbein and Ambady's (2002) meta-analysis showed that contempt is the least-well-recognized expression across cultures. Nonetheless, investigators who want to obtain FACS-verified photos of contempt posed by the four expressers should contact Jessica L. Tracy.

[3] This chance rate is more stringent than that typically used in the emotion literature (Hertenstein, Keltner, App, Bulleit, & Jaskolka, 2006), which would be based on the number of options presented (i.e., 9% in the present study). It is also more stringent than the rate proposed by critics of forced-choice recognition studies, who have argued that participants do not guess randomly among the options presented but rather choose from four true emotion options defined by the two orthogonal dimensions of arousal and valence (Russell, 1994), suggesting a "true" chance guessing rate of 25%.

[4] Spontaneously displayed emotion expressions are often less prototypical—that is, they include fewer of the associated features and at lower intensities (Carroll & Russell, 1997; Ekman, 2003)—than the expressions developed here, which were intended, for the purpose of controlled experimentation, to include all prototypical features at a fairly high intensity.

Table 1
Recognition Rates for the Best Recognized Exemplar of Each Emotion Provided by Each Expresser in Studies 1 and 2

Emotion expression	Recognition rate (%) Study 1	Study 2
Anger		
African female	77*	79*
African male	81*	75*
White female	71*	80*
White male	67*	62*
Disgust		
African female	72*	70*
African male	34	**80***
White female	83*	89*
White male	78*	84*
Embarrassment (with/without face touching)		
African female	—/41*	—/44*
African male	69*/41*	67*/55*
White female	70*/46*	68*/55*
White male	76*/53*	74*/64*
Fear		
African female	59*	58*
African male	33	**15**
White female	38	**70***
White male	24	**62***
Happiness		
African female	90*	91*
African male	95*	94*
White female	95*	97*
White male	97*	96*
Pride (arms akimbo/arms raised)		
African female	90*/85*	96*/82*
African male	93*/84*	95*/80*
White female	91*/81*	95*/83*
White male	94*/90*	86*/97*
Sadness		
African female	96*	95*
African male	73*	65*
White female	87*	77*
White male	56*	**83***
Shame (slumped posture/normal posture)		
African female	—/33	—/39*
African male	57*/43*	60*/65*
White female	44*/18	62*/36
White male	19/57*	29/49*
Surprise		
African female	95*	94*
African male	79*	93*
White female	89*	93*
White male	87*	86*

Note. In Study 1, $N = 175$; in Study 2, $N = 234$. Values in boldface type represent recognition rates for new expressions; that is, expressions that were posed again and photographed for Study 2 because the Study 1 version was suboptimal.
* $p < .05$.

emotion. These new expressions were included along with all versions of expressions included in Study 1 that were recognized at acceptable levels; the five suboptimal photos were omitted and replaced by several new exemplars: disgust shown by the African male, fear shown by all expressers except the African female, and sadness shown by the White male.

Participants and procedure. Two hundred thirty-four undergraduate students (79% female, 21% male) participated in exchange for course credit. The procedure was the same as in Study 1; participants viewed a total of 73 stimuli.

Results and Discussion

Again, we first examined recognition rates of emotions for which particular expressers produced several viable exemplars and included only the best recognized exemplar of each emotion for each expresser. Recognition rates varied across emotions, with means ranging from 47% (shame) to 94% (happiness). On the basis of the binomial test, all expressions except White female shame (no slumped posture) and African male fear were recognized at levels significantly greater than chance (set at 33%), all ps $< .05$. Table 1 presents recognition rates for each expresser showing each expression. Mean false alarm rates are presented in Table 2.

On the basis of these results, we retained the new versions of White male sadness, African male disgust, White female fear, and White male fear, but we retained the original version of African male fear. For embarrassment, all of the best recognized exemplars of both versions were retained, but we suggest that investigators use the face-touching version whenever possible, given its higher recognition levels. For shame, all of the best recognized exemplars of both versions were retained, but investigators should be aware that several of the versions with no slumped posture have low recognition rates.

General Discussion

The present research developed and tested the reliability of a new set of FACS-verified emotion expressions, which we refer to as the University of California, Davis, Set of Emotion Expressions (UCDSEE). The UCDSEE includes new expressions of the following emotions: anger, disgust, embarrassment, fear, happiness, pride, sadness, shame, and surprise. These expressions were posed by four indivduals, crossing gender and ethnicity (African and White), and in all cases except one (African male fear), they were recognized at levels comparable with those previously reported in the literature. These expressions are full color photos and are available in .jpeg format at www.ubc-emotionlab.ca/research/#UCdavis or by contacting Jessica L. Tracy.

The resultant set of expressions has several benefits compared with extant sets. First, it includes expressers of both genders and two ethnic groups. Second, all expressers posed all expressions, allowing researchers to conduct comparisons across emotions without differences being confounded by expresser effects.[5] Third, photos are in full color and portray individuals in modern hairstyles and clothing. Fourth, and most notably, the UCDSEE is the only extant set to include all three recognizable self-conscious emotion expressions: embarrassment, pride, and shame. Furthermore, two versions of each of these expressions are provided. In the case of shame, the present research is the first to demonstrate that shame can be recognized when shown with a slumped posture in addition to a head tilt and eye gaze downward. In addition, given that these are the first

[5] At the same time, the inclusion of only one expresser of each ethnicity–gender combination may be a limitation of the set for researchers focusing on ethnicity or gender effects.

Table 2
Mean False Alarm Rates (Averaged Across Expressers) for Each Top Expression Exemplar in Studies 1 and 2

Targeted expression and emotion label	Mean rate	
	Study 1	Study 2
Anger		
Anger	**74**	**74**
Contempt	9	12
Disgust	3	3
Embarrassment	1	0
Fear	2	1
Pride	3	2
Sadness	2	2
Shame	1	0
No emotion	2	2
None of these	2	1
Other	2	3
Disgust		
Disgust	**67**	**81**
Anger	20	10
Contempt	7	4
Excitement	0	1
Pride	1	0
Shame	1	0
Surprise	1	1
None of these	1	2
Other	2	1
Embarrassment (across both versions)		
Embarrassment	**57**	**61**
Contempt	4	2
Happiness	7	6
Pride	1	0
Sadness	2	2
Shame	13	18
Surprise	1	0
No emotion	1	1
None of these	5	2
Other	9	7
Fear		
Fear	**39**	**51**
Anger	1	0
Disgust	16	8
Embarrassment	1	2
Excitement	1	2
Sadness	3	1
Surprise	32	30
None of these	2	1
Other	4	2
Happiness		
Happiness	**94**	**94**
Contempt	1	1
Excitement	2	2
Pride	1	1
None of these	1	0
Pride (across both versions)		
Pride	**89**	**89**
Contempt	2	1
Excitement	3	4
Happiness	2	3
Surprise	1	0
None of these	1	1
Other	1	2
Sadness		
Sadness	**78**	**80**
Anger	1	2
Contempt	1	2
Disgust	2	2
Embarrassment	1	0
Fear	2	2
Shame	4	5
No emotion	2	2
None of these	2	0
Other	6	3
Shame (across both versions)		
Shame	**50**	**47**
Contempt	1	1
Disgust	1	0
Embarrassment	6	4
Sadness	37	41
No emotion	4	2
None of these	1	1
Other	2	2
Surprise		
Surprise	**88**	**92**
Excitement	5	2
Fear	2	3
Shame	1	0
Other	2	2

Note. In Study 1, $N = 175$; in Study 2, $N = 234$. Rates are presented only for response options that were chosen by greater than 0.5% of participants on average. Values in boldface type represent hit (i.e., accuracy) rates, rather than false alarm rates.

studies to examine recognition rates of these three self-conscious emotions, they provide informative new data about these expressions. For example, on the basis of false alarm rates, embarrassment was most frequently misidentified as shame, and shame was most frequently misidentified as sadness. These confusions may point to shared evolutionary origins of these three emotions and thus indicate an important direction for future research.

Despite these advantages, the major limitation of the UCDSEE is that, in several cases, recognition rates were lower than we would have hoped, despite repeated photo sessions with each expresser. In particular, the African male fear expression was not recognized at rates as high as have been found previously. Our African male expresser had difficulty posing AU 20 or the overall upper face configuration as prescribed by Ekman and Friesen (1978) for fear. This problem illustrates the difficulty of finding individuals who are capable of displaying (on cue in the lab) the entire set of emotion expressions, and helps explain why most previous stimulus sets have relied on numerous expressers to obtain recognizable expressions of all emotions. It is noteworthy that this discrepancy from the large body of previous research showing high recognition rates for fear and the other basic emotions is likely due to difficulty encountered by this particular expresser; however, this is an important issue for future research to address, and our hope is that the development of this set will spur such research. In general, we believe that the added benefit of having the same expressers pose all emotions, along with the

availability of self-conscious emotion expressions, more than offsets the disadvantage of lower recognition rates for some expressions in the UCDSEE. In summary, we hope that the stimulus set developed here will be of use to future researchers.

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