Corrections

INAUGURAL ARTICLE, APPLIED PHYSICAL SCIENCES. For the article "Inaugural Article: Dynamic interfaces in an organic thin film," by Chenggang Tao, Qiang Liu, Blake S. Riddick, William G. Cullen, Janice Reutt-Robey, John D. Weeks, and Ellen D. Williams, which appeared in issue 43, October 28, 2008, of *Proc Natl Acad Sci USA* (105:16418–16425; first published September 2, 2008; 10.1073/pnas.0805811105), the authors note that the author name Blake **S.** Riddick should have appeared as Blake **C.** Riddick. The author line has been corrected online. The corrected author line and related author contributions footnote appear below.

Chenggang Tao, Qiang Liu, Blake C. Riddick, William G. Cullen, Janice Reutt-Robey, John D. Weeks, and Ellen D. Williams

Author contributions: C.T., J.D.W., and E.D.W. designed research; C.T., Q.L., and W.G.C. performed research; W.G.C. and J.R.-R. contributed new reagents/analytic tools; C.T., Q.L., B.C.R., and E.D.W. analyzed data; and C.T., W.G.C., J.R.-R., J.D.W., and E.D.W. wrote the paper.

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PSYCHOLOGY. For the article "The spontaneous expression of pride and shame: Evidence for biologically innate nonverbal displays," by Jessica L. Tracy and David Matsumoto, which appeared in issue 33, August 19, 2008, of *Proc Natl Acad Sci USA* (105:11655–11660; first published August 11, 2008; 10.1073/pnas.0802686105), the authors note that Fig. 3 is copyrighted by Bob Willingham and is reprinted with permission. The figure and its corrected legend appear below.

Fig. 3. Pride expression in response to victory shown by a sighted (*Left*) and congenitally blind (*Right*) athlete. [Reproduced with permission (copyright 2004, Bob Willingham).]

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IMMUNOLOGY. For the article "Reciprocal patterns of methylation of H3K36 and H3K27 on proximal vs. distal IgV_H genes are modulated by IL-7 and Pax5," by Cheng-Ran Xu, Lana Schaffer, Steven R. Head, and Ann J. Feeney, which appeared in issue 25, June 24, 2008, of *Proc Natl Acad Sci USA* (105:8685–8690; first published June 17, 2008; 10.1073/pnas.0711758105), the authors note that due to a printer's error, Fig. 2 appeared incorrectly and was a duplicate of Supporting Information Fig. S2. The correct figure and its legend appear below.

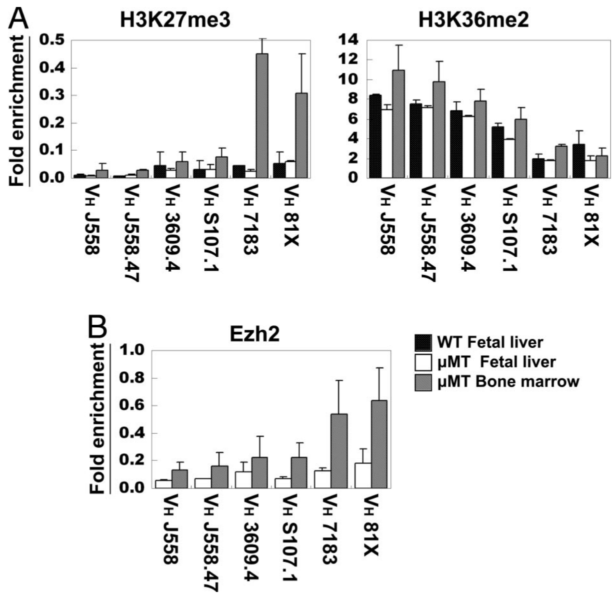

Fig. 2. The patterns of histones H3K27me3 and H3K36me2 and Ezh2 in fetal liver are different from adult bone marrow. (*A*) ChIP assays were performed by using antibodies reactive with H3K27me3 or H3K36me2 on pro-/pre-B cells ($CD19^+IgM^-$) from BALB/c fetal liver, pro-B cells ($B220^+CD19^+$) from μMT fetal liver, and pro-B cells ($B220^+CD19^+$) from 3- to 4-week-old μMT bone marrow. (*B*) ChIP assays were performed by using Ezh2 antibody on pro-B cells from μMT fetal liver and 3- to 4-week-old μMT bone marrow. Data are presented as relative to the positive control of the Neuregulin gene (Neuregulin = 1).

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The spontaneous expression of pride and shame: Evidence for biologically innate nonverbal displays

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The present research examined whether the recognizable nonverbal expressions associated with pride and shame may be biologically innate behavioral responses to success and failure. Specifically, we tested whether sighted, blind, and congenitally blind individuals across cultures spontaneously display pride and shame behaviors in response to the same success and failure situations—victory and defeat at the Olympic or Paralympic Games. Results showed that sighted, blind, and congenitally blind individuals from >30 nations displayed the behaviors associated with the prototypical pride expression in response to success. Sighted, blind, and congenitally blind individuals from most cultures also displayed behaviors associated with shame in response to failure. However, culture moderated the shame response among sighted athletes: it was less pronounced among individuals from highly individualistic, self-expression-valuing cultures, primarily in North America and West Eurasia. Given that congenitally blind individuals across cultures showed the shame response to failure, findings overall are consistent with the suggestion that the behavioral expressions associated with both shame and pride are likely to be innate, but the shame display may be intentionally inhibited by some sighted individuals in accordance with cultural norms.

emotion | innate behavioral response | nonverbal expression | self-conscious emotion

Thanks to ABC's "Wide World of Sports," the word "victory" is, in the minds of many, inextricably associated with the emotion "thrill." Yet thrill may not be the most meaningful emotion experienced in response to success. After winning an athletic competition or succeeding at work or school, individuals do not simply appear excited or happy. Rather, as social beings focused on what such events mean for how we are perceived by others and where we stand in the social hierarchy, we also feel the emotion of pride. Similarly, the "agony" long associated with defeat may in fact represent shame, the painful emotion experienced in response to failure. Pride and shame are typically not included among the small set of emotions thought to be innate, biologically based, pan-culturally experienced, shared with other primates (possibly due to similar ancestral origins), and identifiable via discrete, universal nonverbal expressions (1). Yet, recent studies suggest that both emotions may meet several of these criteria. Specifically, both are associated with distinct, cross-culturally recognized nonverbal expressions, which resemble the dominance and submission displays shown by nonhuman primates.

The pride nonverbal expression is accurately identified by children as young as 4-years old and adults from a range of cultures including preliterate, highly isolated small-scale traditional societies, who are very unlikely to have learned the expression through contact with other contemporary cultures (2–4). The expression includes features such as expanded posture and head tilt back, behaviors similar to the "inflated display" observed in dominant chimpanzees who have defeated a rival (5), as well as the chest-beating intimidation displays seen in mountain gorillas (6) and the "strutting. . . confident air" that characterizes dominant Catarrhine monkeys (7). The shame expression is also accurately identified across cultures, including in the same isolated small-scale societies (4, 8, 9). Shame is recognized from a simple head tilt downward, but based on Darwin's theory of antithesis (10) and the importance of expanded posture in the pride expression, the full shame display may include slumped shoulders and narrowed chest—behaviors similar to the "cringing" and lowered posture associated with submission in a range of animal species including chimpanzees, macaques, baboons, rats, rabbits, crayfish, wolves, elephants, seals, and salamanders (5, 11, 12). These findings raise the possibility that pride and shame behavioral responses may be human universals, evolved to serve unique adaptive functions.

Given that pride occurs in response to success, its nonverbal expression may function to signal an individual's success to others, thereby boosting status. Emotion signals are thought to have originated as purely functional (i.e., noncommunicative) displays and over time became "ritualized" (i.e., simplified and exaggerated) to the clearly communicative versions we see now (13). Thus, the expanded posture and outstretched arms associated with pride may have originated as a way of appearing larger, allowing for the assertion of dominance and attracting attention. The veracity of a behavioral signal may be established on the basis of whether it is "handicapping"—that is, perilous to the sender (14). If individuals display signals despite inherent risks (e.g., revealing oneself to a predator in the process of alerting others to the danger), onlookers can trust the message's sincerity. Thus, the potentially risky open posture associated with pride (and nonhuman primate dominance displays) may have originated as a way of conveying the validity of the individual's belief in his/her dominance or success. Similarly, although displaying behaviors associated with shame or submission requires individuals to place themselves physically beneath adversaries and thus within their control, doing so may indicate the veracity of their submission. This display likely originated as a way of conveying acceptance of an aggressor's power, thereby removing the need for conflict and sparing resources. In humans, the ancient submission display may have been ritualized into a shame expression that also serves a secondary function: appeasing onlookers who observed the failure (12, 15). By nonverbally communicating an awareness of one's transgression, the individual can maintain his/her reputation as a trusted group member who accepts social norms (16).

However, in both cases, these functionalist arguments are premised on 2 central assumptions yet to be tested. First, are the pride and shame behavioral expressions universally displayed when individuals experience success and failure? It is possible that individuals across cultures reliably recognize these expres-

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sions not because they regularly see them, but rather because of shared stereotypes (17). Furthermore, even if there is universal agreement about behaviors that signify "pride" and "shame," cultures could differ on whether those behaviors correspond to success and failure. If pride and shame are not universally associated with success and failure, it is unlikely that they evolved to send messages relevant to these events.

The second question that needs to be addressed is whether the pride and shame nonverbal expressions are likely to be innate biological propensities rather than learned forms of social communication. Even if individuals across cultures reliably display these expressions in the predicted situations, we cannot know whether they do so because they are modeling others or because humans evolved to innately display these distinct behaviors, perhaps as fixed action patterns, in these recurring, socially important situations. To address this issue, we need to examine spontaneous displays of pride- and shame-associated behaviors in individuals who could not have learned to show them from observing others (13). Thus, in the present research, we examined behavioral responses to success and failure in congenitally blind individuals. These individuals have been unable to view others' expressions from birth or shortly thereafter and thus cannot have learned to produce expressions through modeling. If congenitally blind individuals display pride and shame expressions in the same situations as sighted individuals, it would provide compelling evidence for a biologically innate source of these expressions, because it would be highly improbable for blind individuals to have learned discrete behavioral configurations that occur as automatic emotional reactions (13). This conclusion is particularly likely if findings hold across congenitally blind individuals from different countries and cultures.

Although no previous research has tested whether the recognizable pride or shame expressions are cross-culturally displayed in response to success and failure, several studies are consistent with this possibility. Western children have been found to show several components of both expressions in response to experimentally manipulated achievements or failures (18–21) and examination success (22). However, studies have not coded behavioral responses to naturalistic successes and failures for all components of the prototypical pride and shame expressions or examined the issue cross-culturally. Furthermore, no previous study has examined pride- and shame-associated behaviors in blind individuals. Previous studies assessing spontaneous emotional responses to naturalistic events have sought only those few emotions that can be coded from the face alone (e.g., fear, anger, happiness) (23–27); pride and shame expressions require head and body movements outside the face (8, 28). Similarly, all previous studies assessing blind individuals' expressions examined only emotions shown in the face (e.g., 13, 29–31).

In the present research, we coded spontaneous behavioral responses to winning or losing a judo match in the 2004 Olympic and Paralympic Games. Sighted and blind athletes from 37 nations were scored on the cultural dimensions of collectivism vs. individualism (i.e., the extent to which emphasis is placed upon the needs of the individual vs. the group) (32), traditional vs. secular-rational values (i.e., the importance of religious and traditional values vs. secular beliefs) (33), and survival vs. self-expression values (i.e., the importance placed upon subsistence and security vs. subjective well-being and self-expression) (33). The latter 2 dimensions have been shown to account for the large majority of cross-national variance in major areas of human concern. The former dimension has been shown to predict differences in shame and pride subjective experiences, with shame more strongly emphasized in collectivistic cultures and pride more emphasized and valued in individualistic cultures (34, 35). Thus, if pride and shame responses to success and failure differ across cultures, such differences would be most likely to emerge in comparisons among cultures that vary on these 3 dimensions. Finally, we also tested whether larger geographic region (i.e., regions with shared history and geography) influenced these behavioral responses (36).

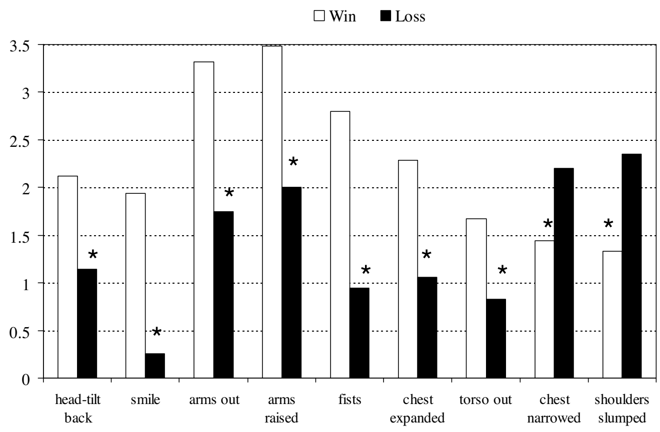

Fig. 1. Mean levels of pride and shame nonverbal behaviors spontaneously displayed in response to match wins and losses by sighted athletes, $n = 108$. *, $P < 0.05$.

Results and Discussion

Among sighted athletes, all components of the prototypical pride expression and several components of the shame expression were spontaneously displayed in response to success and failure, respectively. Specifically, pride-relevant behaviors of head-tilt back, t (109) = 4.13, d = 0.84; smile, t (109) = 6.85, d = 1.45; arms out from the body, t (107) = 5.82, d = 1.12; arms raised, t (108) = 5.37, d = 1.03; hands in fists, t (106) = 5.32, d = 1.07; chest expanded, t (102) = 5.30, d = 1.09; and torso pushed out, t (107) = 3.34, d = 0.65; all $ps < 0.05$; were greater in response to winning than losing. In contrast, shame-relevant behaviors of shoulders slumped forward, t (100) = 4.10, d = 0.82, and chest narrowed, t (100) = 3.12, d = 0.62, both $ps < 0.05$, were greater in response to losing than winning (see Fig. 1). Losing did not predict head-tilt down or face hiding, behavioral signatures of the recognizable shame expression. In addition, winners were far more likely than losers to show all pride components together (i.e., the full pride expression), χ^2 (1) = 24.75, $P < 0.05$. Losers were no more likely than winners to show the full shame expression (head tilt down, face covered, and shoulders slumped or chest narrowed), χ^2 (1) = 0.52, *ns*, most likely because head tilt down and face covering were not associated with failure. These analyses are considerably more stringent than those examining each component separately because spontaneously displayed expressions are typically not shown in full form and can be recognized from certain components alone (28, 37).

Neither gender nor any of the 3 cultural dimensions nor world region moderated the effects of winning on pride behaviors. Furthermore, in almost all cases pride-relevant behaviors were shown to a greater extent in response to winning than losing *within* each culture group [see supporting information (SI)]. The full pride expression was also a more frequent response to success than failure within each culture group, χ^2 (1) = 7.45 (collectivistic), 9.71 (individualistic), 13.33 (traditional), 12.54 (secular), 13.18 (survival), and 9.89 (self-expression), all $ps < 0.05$.[§] However, individualism/collectivism moderated the effect of losing on the shame-relevant behavior of shoulders slumped, $B = 0.30$, $P < 0.05$; the same interaction emerged with world

[§]These within-group analyses were not possible for world regions because in most cases sample sizes were too small.

region $F(3, 83) = 3.74$, $P < 0.05$.[¶] These interactions indicate a weaker shame behavioral response among more individualistic, West Eurasian and North American regions (see SI). We also ran these analyses at the country level (i.e., correlating mean behavioral responses to success and failure across all individuals within a given country with country-level cultural dimension scores). Based on these country-level analyses, none of the 3 dimensions were significantly correlated with any behavioral responses except shoulders slumped and chest narrowed in response to loss: these 2 behavioral responses to failure were negatively correlated with individualism and self-expression values, *r*s (19) = −0.53, −0.53 (individualism) and *r*s (25) = −0.56, −0.51 (self-expression), all *p*s < 0.05; indicating that the more individualistic and self-expression-valuing a given country is, the less likely its athletes are to show the shame behavioral response to failure.

One caveat to all these results is that behaviors may be due not to the situation of winning vs. losing, but to personality. Thus, we analyzed behaviors shown by 15 athletes (7 women) who both won and lost in different matches. In this within-subjects analysis, winning again led to greater pride-relevant behaviors [i.e., smiling, *t* (14) = 2.36 (*M*s = 1.51 vs. 0.35, *d* = 0.93), arms extended out, *t* (13) = 4.98 (*M*s = 3.45 vs. 1.33, *d* = 1.63), arms raised, *t* (14) = 2.52 (*M*s = 3.53 vs. 2.03, *d* = 0.90), hands in fists, *t* (13) = 2.12 (*M*s = 2.50 vs. 0.79, *d* = 0.94), and chest expanded, *t* (12) = 2.59 (*M*s = 2.28 vs. 1.31, *d* = 0.77); all *p*s < 0.05], suggesting that the pride behavioral response to success can be attributed to the situation of winning and not to the personality of individuals who win. No differences emerged for shame-relevant behaviors.

We next tested whether pride- and shame-relevant behaviors would remain significant predictors of win/loss outcomes when controlling for other emotion-associated facial muscle movements or "action units" (AUs) (38). In fact, AU 12 (lip corners pulled up) and the pride behavior of arms extended out remained significant when controlling for all other pride- and happiness-relevant behaviors (*B*(exp)s = 6.01, 3.67, respectively, both *p*s < 0.05). Both of these behaviors are part of the pride expression; AU 12 is also part of happiness. When shared variance between shame and sadness behaviors, shame and anger behaviors, and shame and disgust behaviors was removed, only shoulders slumped—a shame behavior—remained significant in each equation, *B*(exp)s = 0.30, 0.32, and 0.30, respectively, all *p*s < 0.05 (one-tailed). When shared variance between shame and fear behaviors was removed, both shoulders slumped and AU 1 (inner brow raiser—part of the fear expression) remained significant, *B*(exp)s = 0.23, 0.41, both *p*s < 0.05. Thus, unique components of both pride and shame expressions (arms extended out and shoulders slumped) predicted win vs. loss outcomes above and beyond what can be predicted from previously established emotion expressions, suggesting that shame and pride expressions may be unique signals of success and failure.

Turning to the blind athletes, all prototypical pride behaviors were again shown to a greater extent in response to winning than losing: head-tilt back, *t* (58) = 1.86, *d* = 1.11; smile, *t* (50) = 3.13, *d* = 1.31; arms out, *t* (58) = 3.66, *d* = 1.05; arms raised, *t* (58) = 4.48, *d* = 1.26; hands in fists, *t* (57) = 2.57, *d* = 0.78; chest expanded, *t* (58) = 5.20, *d* = 1.52; and torso pushed out, *t* (58) = 4.62, *d* = 1.46; all *p*s < 0.05 (one-tailed for head tilt back). In addition, the 2 shame-relevant behaviors shown by sighted athletes, chest narrowed and shoulders slumped, were shown by

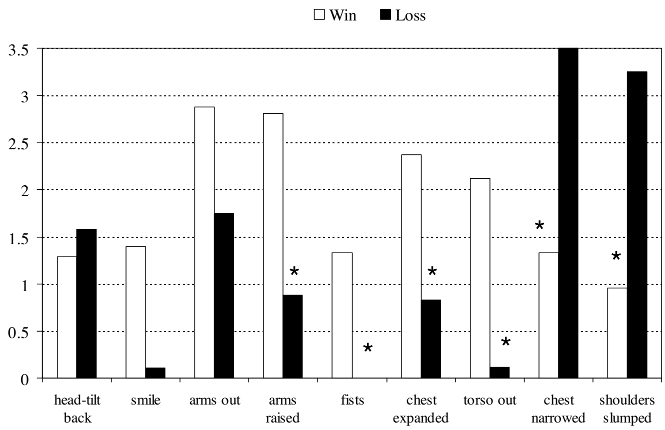

Fig. 2. Mean levels of pride and shame nonverbal behaviors spontaneously displayed in response to match wins and losses by congenitally blind athletes, *n* = 12, *, $P < 0.05$.

blind athletes in response to failure, *t* (58) = 2.14, *d* = 0.57, *P* < 0.05, and *t* (58) = 1.89, *d* = 0.50, *P* < 0.05 one-tailed. None of these effects were moderated by any of the 3 cultural dimensions, world region, or gender. Winners were again far more likely than losers to show the full pride expression, χ^2 (1) = 5.28, *P* < 0.05; losers were again no more likely than winners to show full the shame expression, χ^2 (1) = 3.64, *ns*.

The effects of winning on pride-relevant behaviors were not moderated by blind status (i.e., congenital blindness vs. later onset). However, blind status did moderate the effect of losing on both shame-relevant behaviors, *F*s (1, 31) = 8.82, 6.42 for shoulders slumped and chest narrowed, respectively, both *p*s < 0.05, such that a *larger* behavioral response emerged in the congenitally blind athletes; across the 2 behaviors, *M*s = 3.33 (failure) vs. 0.63 (success) for congenitally blind individuals, and 1.92 (failure) vs. 1.63 (success) for later-onset blind individuals. Thus, the shame behavioral response to failure held within the congenitally blind sample, *t* (10) = 2.59, *d* = 1.97, for shoulders slumped; and *t* (10) = 2.58, *d* = 1.95, for narrowed chest, both *p*s < 0.05. In addition, the pride behavioral response to success largely held within the congenitally blind sample: winners showed greater arms raised, *t* (10) = 2.01, *d* = 0.68, hands in fists, *t* (7) = 2.06, *d* = 1.46, chest expanded, *t* (9) = 3.15, *d* = 1.88, and torso pushed out; *t* (8) = 3.25, *d* = 2.04, all *p*s < 0.05 (one-tailed for arms raised and hands in fists; see Fig. 2). Effects for arms extended and smiling were in the expected direction but did not reach significance. However, we computed a scale based on the mean of all pride-relevant behaviors ($\alpha = 0.76$) and found higher scale scores for winners compared to losers within the congenitally blind sample, *t* (10) = 2.05, *d* = 1.74, *P* < 0.05, one-tailed. Thus, it appears that individuals who have never seen others show pride and shame expressions in response to success and failure spontaneously show precisely these expressions in these situations. The large effect sizes that emerged within this sample make it unlikely that the inclusion of additional participants—even those who did not show the predicted behaviors—would reduce effects to nonsignificance (39).

General Discussion. The present research assesses pride and shame expressions on the basis of spontaneous, nonverbal behaviors shown by sighted and blind individuals across cultures, in response to the same naturalistic situation. The findings demonstrate, first, that the prototypical components of the recognizable pride expression are displayed in response to success by individuals from collectivistic; individualistic; tradition-, secular-, survival-, and self-expression-valuing cultures and by sighted,

¶World region also moderated the effect of losing on chest narrowed, $F(3, 83) = 3.51$, $P < 0.05$, but this effect did not hold in the smaller sample with independent data only. Self-expression values also moderated the effect of losing on shoulders slumped, $B = 0.31$, $P < 0.05$, but this effect also did not hold in the smaller sample.

Fig. 3. Pride expression in response to victory shown by a sighted (*left*) and congenitally blind (*right*) athlete.

blind, and congenitally blind individuals across cultures. In all of these analyses, success had a large effect on the display of pride-relevant behaviors (39), which could not be attributed to a third-factor personality variable or to shared variance with facial expressions of happiness.

Second, several components of the shame expression (slumped shoulders and narrowed chest) are displayed in response to failure by sighted, blind, and congenitally blind individuals. These findings could not be attributed to shared variance with any other negative emotion expression; in fact, shame-relevant behaviors were a better predictor of whether an individual lost than were behaviors associated with any other negative emotion except fear. However, the shame behavioral response was weaker in sighted athletes from individualistic, self-expression-valuing cultures within West Eurasian and North American regions. In addition, the 2 behaviors previously associated with the recognizable shame expression (head-tilt down, averting/hiding the face) were not part of the spontaneous behavioral response to failure. Findings from the congenitally blind sample help clarify these ambiguities, as discussed below.

Implications. These findings imply, first, that the cross-culturally recognized pride expression is not simply a widely held stereotype, but rather is a discrete behavioral configuration actually produced in ecologically valid situations and may be an evolved and innate behavioral response to success. The pride behaviors identified here were almost identical to those recognized as pride across cultures; the only exception was the absence of hands on hips—a component of the recognizable pride expression that was not reliably displayed during a success experience. The finding that congenitally blind individuals who could not have learned to show the pride expression from watching others nonetheless displayed these same behaviors in the same situation (see Fig. 3) suggests that this behavioral response to success is unlikely to be learned. Although parents may teach young children to engage in some of these behaviors through direct physical contact (e.g., moving a child's arms above his/her head), it is unlikely that parents would or could teach the full configuration of behaviors (e.g., expanded chest, hands in fists) in this manner[‖]. Thus, the most parsimonious interpretation of these findings is that congenitally blind individuals engage in these behaviors in response to success because humans have an innate biological propensity to do so (13).

Overall then, the pride expression appears to meet one of the central criteria for a functional universal (i.e., a psychological entity that evolved to serve a particular adaptive function): it is recognized and displayed across cultures in the same contexts and situations (40, 41). These findings are thus consistent with theoretical accounts of pride as an evolutionary adaptation for securing status. By responding to success with behaviors that expand the body and are reliably identified as pride, individuals advertise their accomplishment, and thereby may ensure their continued status and acceptance within their social group.

Similarly, the shame-relevant behaviors of shoulders slumped and chest narrowed are not simply stereotypes associated with shame but rather are behavioral responses actually produced in ecologically valid shame-eliciting situations and thus may represent an evolved and innate behavioral response to failure. Somewhat surprisingly, the expression previously found to be recognized as shame (head tilt down, face covered) was not shown in response to failure. However, this may be due to the methodology used; the single photographer, who often had to shoot from behind athletes, may not have captured all facial/head movements. Regardless, it seems clear that the bodily components of shame are spontaneously displayed in response to failure.

However, among individuals from individualistic, self-expression-valuing, West Eurasian and North American cultures, even these behaviors were not reliably associated with failure. One explanation for this cultural difference is that these athletes felt shame but suppressed its expression, in accordance with cultural norms that stigmatize the display of shame and emphasize asserting oneself and maintaining a high quality of life (34, 42). In contrast, athletes from more collectivistic nations, where shame is an appropriate response to social trespass and a socially valued emotion, would not have needed to suppress their shame in response to public failure (34, 43). The finding that congenitally blind individuals from a range of cultures displayed shame behaviors in response to failure, and did so to a greater extent than individuals who acquired blindness later in life, supports this interpretation.[**] Individuals who have never seen others show or suppress emotion expressions are likely less aware of culture-specific norms of how emotions should be regulated, and may be generally less sensitive to distinctions between appropriate and inappropriate behavioral displays. Thus, the fact that these individuals showed the greatest evidence of a shame behavioral response suggests that these behaviors are the evolved, innate response, and the absence of a clear shame expression among sighted athletes from certain cultures represents culture-specific emotion regulation. Although it is also possible that these sighted athletes simply felt less shame after losing, their lack of a shame response is unlikely to indicate that the expression does not generalize to these cultures, given previous evidence of shame recognition in American cultures and behavioral displays of shame in response to failure among American children and adolescents (8, 9, 18, 20).

At a broader level, these findings suggest that the expressions associated with shame and pride can be assessed from spontaneous nonverbal behaviors. This finding highlights the importance of the body in emotion expression. Recent research has demonstrated that bodies and faces are perceived through similar cognitive and neural processes (44, 45); thus, it might be fruitful to devote greater research attention to the role of the body in emotion expression. Ethologically oriented researchers

‖It also is unlikely that these behaviors were verbally or physically taught by judo coaches or others involved in the sport; athletes are never instructed on specific nonverbal behaviors to show after success or failure, nor are their limbs or body moved in any particular manner in these situations.

**Within the congenitally blind sample, individualism/collectivism scores ranged from 20–89, $M = 54$; 45% of these individuals were from survival-valuing nations, and 55% from self-expression-valuing nations.

Table 1. Nonverbal behaviors coded, with interrater reliability alphas, emotion predictions, and outcomes actually associated with each behavior

Behavior	Interrater alphas	Predicted emotion	Actual outcome	References for prediction
Head				
Tilted back/up	0.78 (0.87)	Pride	Success	2–4, 10, 18, 20, 21, 28, 47–50
Tilted forward/down	0.84 (0.89)	Shame	Neither	4, 8, 9, 18, 47, 50–52
Smile	0.85 (0.98)	Pride	Success	2–4, 18, 20, 28, 47, 53
Moving hands to cover face	0.85 (0.98)	Shame	Neither	18, 47
Hiding face by moving face/head	0.75 (0.88)	Shame	Neither	8–10, 47, 51, 52
Arms				
One/both arms out from body	0.84 (0.87)	Pride	Success	2–4, 19, 28, 47, 49, 54
One/both arms raised	0.91 (0.97)	Pride	Success	2, 3, 28, 19, 47, 49, 54
One/both hands in fists	0.94 (0.95)	Pride	Success	2, 3
Hands on hips	0.96 (0.93)	Pride	Neither	2–4;28
Body				
Chest expanded	0.67 (0.88)	Pride	Success	2–4, 10, 18, 22, 28, 47, 53
Torso pushed out/leaning back	0.75 (0.89)	Pride	Success	2–4, 28, 18, 47, 20, 49
Chest narrowed inward	0.77 (0.87)	Shame	Failure	18, 20, 47, 48
Shoulders slumped	0.80 (0.90)	Shame	Failure	10, 18, 20, 47, 48

Alpha reliabilities are first reported for the sighted sample, then, in parentheses, for the blind sample. References indicate previous studies that demonstrated an association between the behavior and either knowledge of the relevant emotion or success/failure outcomes.

interested in nonverbal emotion communication have long emphasized the role of posture (10, 13, 46), but the facial musculature has since received the lion's share of research emphasis. The development of a system for measuring basic emotions from observable facial behaviors largely revolutionized the field of emotion research (38), and the present findings, particularly the pride and shame behavioral coding system that was used and validated, provide a tool that may have similarly wide and varied applications.

Limitations. Although it is likely that athletes felt pride and shame in response to some of the most important successes and failures of their lives, future studies should verify that these expressions are associated with subjective feelings of pride and shame by measuring nonverbal behaviors along with self-reports. Nonetheless, regardless of these individuals' subjective experiences, the fact that they responded to success by showing behaviors previously associated with pride and to failure with behaviors previously associated with shame is informative about the evolved signaling function of these behaviors and associated emotions. A second limitation is that, because athletes performed in front of an audience, we cannot rule out the possibility that their expressions were intentional social communications. However, it is highly unlikely that congenitally blind individuals thought about the appearance of their expressive behaviors enough to intentionally invoke (or inhibit) them.

Conclusion

The present findings add to our understanding of emotion expression in several ways. By providing evidence that the behaviors cross-culturally recognized as nonverbal expressions of pride and shame are displayed in response to success and failure by sighted and blind individuals across cultures, these findings demonstrate that: (a) these expressions are not simply stereotypes intuitively associated with pride and shame but rather may be biologically innate behavioral responses to success and failure; (b) the emotions of pride and shame may have evolved, innate nonverbal expressions, challenging a longstanding assumption in the emotion literature that only a small set of emotions fit within the Darwinian framework; and (c) these emotions may be assessed without reliance on self-report. In sum, these findings support evolutionary accounts of pride and shame as affective mechanisms of promoting and inhibiting social status.

Methods

Data Collection. An official International Judo Federation photographer (blind to the research goals) photographed athletes during and immediately after each match, repeatedly for approximately 15 s, using a Nikon D2H professional digital camera (4.1 megapixels effective, 8 frames/s, 37 ms shutter-time lag), set to autofocus and manual exposure using available light and shooting in JPEG formats. The ISO range was between 400 and 800, producing shutter speeds of approximately 1/500th s, allowing for a series of moment-by-moment images of each behavioral response. Although some photos showed only the athlete's back or profile, all were included to obtain the maximum amount of information; photos that could be coded only for body, arm, or head movements were coded only on those dimensions.

Athletes. The sighted-athlete sample included 87 competitors (42 winners, 45 losers; 46% female) from 36 nations. Twenty-two of these individuals were photographed in more than 1 match (e.g., semifinals and finals), producing a total of 111 match winners and losers (58 winners, 53 losers; 43% female). The blind sample included 53 competitors (30 winners, 23 losers; 23% female) from 20 nations. Seven of these individuals were photographed in more than 1 match, producing a total of 60 match winners and losers (36 winners, 24 losers; 20% female). For both samples, results are presented for the full set of winners and losers, but only those that held in the smaller set (based on the last match each athlete fought) are included to avoid issues associated with nonindependent data.[††] Blind status was available for 68% of the full blind sample; of these, 29% ($n = 12$) were congenitally blind.

Participants were scored, based on their nationality, on each of the 3 major cultural dimensions: individualism/collectivism, secular-rational/traditional values, and survival/self-expression values (32, 33). Individualism/collectivism scores, based on Hofstede's country-level findings, ranged from 17 (Taiwan) to 91 (United States); scores were unavailable for 11 nations (Algeria, Azerbaijan, Belarus, Cuba, Georgia, Moldova, Mongolia, N. Korea, Slovenia, Tunisia, Ukraine, *ns* = 26 sighted athletes, 10 blind athletes). Secular-rational/traditional values scores ranged from −1.65 to 1.84; survival/self-expression values scores ranged from −1.86 to 2.05. For both dimensions scores were based on Inglehart's country-level findings of 2 dimensions of cross-cultural variation (33), and were unavailable for 4 nations (Cuba, Mongolia, North Korea, Tunisia, *ns* = 9 sighted athletes, 2 blind athletes). Finally, each partic-

[††]Results for the smaller set are available from the first author.

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ipant was scored as belonging to 1 of Murdock's 6 world regions, a division of the world's nations based on shared history and geography (36; see SI).

Pride and Shame Behavioral Coding. All photos taken after match completion (omitting those portraying physical interactions with opponents) were coded for pride- and shame-relevant behaviors, based on previous research (see Table 1). Three coders (upper level undergraduate research assistants, blind to study goals) rated the intensity of each movement on a scale from 0 (''not at all present'') to 1 (''visible but very mild intensity'') to 5 (''extreme intensity''). Interrater alphas are shown in Table 1. Most single movements (e.g., head tilt) were represented by several photos, so the first coder to rate a match determined where each movement began and ended, then coded behaviors *across* those photos. All photos were subsequently rated by 1 or 2 (nonblind sample) or 3 (blind sample) other coders, who followed this delineation. If an athlete was photographed making several movements, each was coded separately. Total scores for an athlete's behavioral responses to a match were computed by taking the mean rating for each item (across coders) for each movement, and then taking the highest mean rating across all movements. We used highest mean ratings instead of overall means to ensure that athletes were scored for their largest movement that was captured, without giving greater weight to athletes who were photographed making more movements. Behavioral responses were thus operationalized as the intensity with which a single (most intensely recorded) movement was displayed and not the frequency with which a movement was displayed.

Facial Action Coding. For 69% of the sighted athletes (*n*s = 62 for the full sample, 60 for the smaller sample), at least 1 photo was coded using the Facial Action Coding System (38). These expressions were coded by 2 certified FACS coders; interrater reliability, calculated by doubling the number of codes on which coders agreed and dividing by the total number of codes used, was 0.79. AUs were coded on a 5-point intensity scale ranging from 0 (''not present'') to 5 (''extreme intensity'').

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