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Transgressions and Expressions: Affective Facial Muscle Activity Predicts Moral Judgments

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Abstract

Recent investigations into morality suggest that affective responses may precede moral judgments. The present study investigated, first, whether individuals show specific facial affect in response to moral behaviors and, second, whether the intensity of facial affect predicts subsequent moral judgments. Muscle activity relating to disgust (levator labii), anger (corrugator supercilii), and positive affect (zygomaticus major) was recorded while participants considered third-person statements describing good and bad behaviors across five foundations of morality (purity, fairness, harm, authority, and ingroup). Facial disgust was highest in response to purity violations, followed by fairness violations. In contrast, harm violations evoked anger expressions. Importantly, the extremity of subsequent moral judgments was predicted by facial affect, such that judgments about purity and fairness correlated with facial disgust, harm correlated with facial anger, and ingroup correlated with positive facial affect. These results demonstrate that individuals spontaneously exhibit domain-specific moral affect that allows inferences about their moral judgments.

Keywords

moral judgments, facial expressions, affect, electromyography

Witnessing a moral transgression can evoke strong emotions: One might feel disgusted with someone cheating in a game of cards or angry at a person throwing a rock at a dog. Yet the exact involvement of emotion in moral judgment remains unclear (see Huebner, Dwyer, & Hauser, 2009) and indeed has been a topic of debate for centuries. Immanuel Kant (1788/1997), for instance, saw little role for emotions in judgments of morality, which he believed were instead largely the product of pure reasoning. This rationalist view of morality was later adopted by many psychologists studying moral development in children (e.g., Kohlberg, 1969; Piaget, 1932; Turiel, 1983). On the other hand, sentimentalist philosophers such as David Hume (1751) have argued that moral judgments are driven by the emotional response elicited by a moral stimulus (for a contemporary review of this approach, see Prinz, 2007). This approach has been further developed in contemporary psychological theories such as Haidt's (2001) social intuitionist model, which suggests that intuitions and emotional responses often precede and guide moral judgments.

Support for the link between emotions and morality has been provided by studies that induced specific affective states and then examined how these states influenced subsequent moral judgments. For example, when feeling physically disgusted, participants often make more severe moral judgments (Schnall, Haidt, Clore, & Jordan, 2008; Wheatley & Haidt, 2005). Similarly, individuals who are highly sensitive to disgust are more likely to endorse a guilty verdict in a mock trial (Jones & Fitness, 2009) and respond less favorably to the concept of homosexuality (Inbar, Pizarro, Knobe, & Bloom, 2009). Moreover, cleansing behaviors performed following a disgust induction reduce the severity of moral judgments (Schnall, Benton, & Harvey, 2008). However, although these studies demonstrate that inducing an affective state can influence moral judgments, they do not examine spontaneous affective responses to immoral behaviors. The present study addresses this gap in the literature.

One method of directly assessing an individual's affective state as it unfolds in response to a specific stimulus is to measure facial muscle activity using electromyography. This technique provides a direct measure of muscle activity by measuring electrical activity on the surface of the skin, which corresponds to the amount of muscle activation: Greater muscle

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activation results in higher amplitude recordings, whereas muscle relaxation results in lower amplitude recordings (see Fridlund & Cacioppo, 1986). Using this approach, Chapman, Kim, Susskind, and Anderson (2009) demonstrated that the levator labii muscle, which is responsible for raising the upper lip in disgust expressions, was more active as offers became more unfair in the Ultimatum Game. This muscle activity also correlated with participants' ratings of how disgusted—but not how angry—they felt about these offers. Fairness is clearly one important aspect, yet morality represents a broad range of concerns that go beyond fairness alone.

Five such concerns are proposed by moral foundations theory (Graham, Haidt, & Nosek, 2009; Haidt & Graham, 2007). These include the two most frequently studied moral foundations of ensuring *fairness* and preventing *harm.* Furthermore, studies that demonstrate the relationship between disgust and moral judgments suggest that individuals desire to protect the *purity* of their body and spirit by condemning actions associated with physical contamination. In addition, individuals attempt to protect the rights of their social group (*ingroup*) and maintain order within society (*authority*).

The specific objectives of the present study were to investigate whether behaviors relating to the five moral foundations spontaneously evoked facial muscle activity and, furthermore, whether such activity would predict subsequent moral judgments. One possible outcome might be that transgressions of all five of these foundations would result in the same affective response. If this were the case, then we might expect to see the same disgust expression that Chapman and colleagues (2009) identified in their investigation of fairness generalizing to violations of all five foundations. Alternatively, different categories of moral transgression may evoke differential affective responses because specific moral concerns are based on specific emotional intuitions. For example, physical disgust is considered to have evolved to protect from possible contamination or illness from harmful substances such as spoiled food (Rozin, Haidt, & McCauley, 2008). Sociomoral disgust may be the result of the physical disgust response extending to social contexts such that people find situations disgusting in which moral standards are violated. Thus, disgust is a reaction to offensive objects as well as offensive actions. Chapman et al.'s finding that fairness violations relating to the sharing of resources elicited facial disgust may be the result of sociomoral disgust. This effect may or may not generalize to a wider range of fairness transgressions such as cheating, discrimination, and stealing. In contrast, moral anger or outrage often occurs simultaneously with sociomoral disgust but is a distinct emotional response that can be elicited specifically by immoral behaviors that result in harm (e.g., Gutierrez & Giner-Sorolla, 2007). Similarly, self-rated anger, but not disgust, has been shown to predict moral judgments of vignettes containing justice violations (Horberg, Oveis, Keltner, & Cohen, 2009). Thus, facial anger, but not disgust, may be elicited when thinking about behaviors that harm others. Based on these previous findings, we predicted that there would be specific associations between different emotions and different moral concerns. Because a range of affective responses were of interest, the activity of three muscles was recorded while participants were thinking about moral behaviors. These muscles related to positive affect (zygomaticus major) and two types of negative affect: disgust (levator labii) and anger (corrugator supercilii).[1] The present investigation used corrugator activity as a measure of anger because brow knitting associated with corrugator activity forms part of the universally recognized anger facial expression (Ekman, Sorenson, & Friesen, 1969) and anger-related stimuli have previously been demonstrated to elicit corrugator activity (e.g., Cannon, Hayes, & Tipper, 2009; Dimberg & Karlsson, 1998). Because the corrugator muscle can also respond to disgusting stimuli (e.g., Vrana, 1993), we use a specific pattern of facial activity to differentiate between these two emotional states. For disgust responses we anticipate greater levator activity relative to corrugator activity, whereas for anger we anticipate the reverse. Indeed, the primacy of levator activity for disgust and corrugator for anger has previously been demonstrated when reading emotional sentences (Vrana, 1993) and emotion-relevant words (Niedenthal, Winkielman, Mondillon, & Vermeulen, 2009).

Although previous studies have proposed that moral judgments are associated primarily with disgust (e.g., Chapman et al., 2009), we made specific predictions about the link between different emotions and morality. Facial disgust was expected to be elicited by violations of purity and fairness, whereas anger was expected to be elicited by behaviors that harm others. Not only was negative affective muscle activity expected to be higher in response to moral transgressions, but also a highly specific relationship between muscle activity and judgments was anticipated: Purity and fairness were expected to evoke greater disgust facial activity, and in addition this activity was expected to predict the severity of subsequent moral judgments about these behaviors. In contrast, facial anger should predict the severity of judgments about harm. We made no specific predictions about facial responses to behaviors relating to ingroup or authority.

Method

A total of 39 members of the University of Plymouth community panel (23 female) with a mean age of 27.20 years ($SD = 10.54$) volunteered and were paid £6. Participants' ethnicity was predominantly White British.

Procedure

Participants were given the cover story that the study involved measuring frontal brain activity using electrodes placed on their forehead while they listened to recorded statements about other people. The computer-based experiment was divided into two blocks separated by a short break. In the first block, participants listened to 90 statements about positive and negative moral behaviors presented in a randomized order. After each statement, a slide was presented for 4 s that instructed, "Please think about this behavior." In this first block, facial muscle activity was recorded while participants were considering these behaviors. In the second block, these statements were repeated in a different order. After hearing each statement, participants provided a moral judgment using a slide that asked, "How negative or positive was this behavior?" accompanied by a 7 point scale, labeled from –3 (*very negative*) to +3 (*very positive*). For both blocks, trials were preceded by a fixation cross for 2 s. At the end of each trial, there was a 250 ms blank screen, followed by the instruction "Please Wait" for 2 s between trials. It is important to note that during the first block, participants were not aware that they would be asked to make judgments in the second block.

Following the computer task, participants were debriefed using a funneling procedure to ascertain whether they had guessed the nature of the experiment. Only one participant guessed the purpose of the recording equipment, and her data were excluded from analysis.

Stimuli

Covering a broad range of both positive and negative behaviors, 90 statements about other peoples' behavior were presented to the participant.[2] These were based on a set developed to specifically investigate the moral foundations (Ranganath & Graham, 2010), and some items were slightly modified from American English to conform to British English. Statements covered the five moral foundations: purity (e.g., "Someone meditates to keep her mind free of impure thoughts"; "Someone eats in the same place she goes to the bathroom"), fairness (e.g., "Someone demonstrated in a civil rights rally"; "Someone cheated in a game of cards"), harm (e.g., "Someone showed compassion to those in need"; "Someone pinched a baby's nose until it cried"), authority (e.g., "Someone gave his seat on the bus to an elderly person"; "Someone was disobedient to all authority figures"), and ingroup (e.g., "Someone skipped lunch to work on a team project"; "Someone gossiped about a friend at work").[3]

Electromyographic Analyses

Electromyographic data were collected using a Contact Precision Instruments amplifier sampling at 4 KHz. Data were rectified, downsampled to 100 Hz, filtered using a high pass filter at 30 Hz, a low pass filter at 1 KHz, and a notch filter at 50 Hz, $\log_{10}$ corrected, and then standardized across participants and muscle sites. Mean muscle activity for the 500 ms period prior to each trial was subtracted from the activity level during the 4 s period following stimulus offset, resulting in a change score that controlled for tonic muscle activity. Activity was recorded using 4 mm unshielded Ag/AgCl electrodes filled with electrolyte gel. Preparation was consistent with Fridlund and Cacioppo's (1986) guidelines. The four recording sites were the inside brow (corrugator supercilii: knits brow when frowning), cheek (zygomaticus major: pulls up corner of mouth when smiling), nose (levator labii: raises top lip during facial disgust expression), and forehead (medial frontalis: not reported because of a hardware fault on this channel). Using blind-coded videos of the participants' faces recorded during the experiment, 9.5% of trials were excluded before analysis because of face or body movement during the baseline period.

Results

Moral Judgments About Good and Bad Behaviors

Moral judgment data from Block 2 were entered into a 5 (foundations: purity, harm, fairness, authority, ingroup) × 2 (valence: good, bad) repeated-measures analysis of variance.[4] This revealed significant main effects of foundation, $F(4, 144) = 29.54$, $p < .001$, $\eta^2 = .02$, valence, $F(1, 36) = 863.74$, $p < .001$, $\eta^2 = .83$, and a significant interaction between foundation and valence, $F(4, 144) = 55.30$, $p < .001$, $\eta^2 = .06$. Planned repeated contrasts were conducted comparing the difference between foundations for each valence. For bad behaviors, judgments about each foundation were ordered from most negative to least negative. In order of severity of moral judgments, harm violations (M = –2.39) were rated as the most negative, followed by fairness (*Mdiff* = –0.36, $p < .001$), purity (*Mdiff* = –0.39, $p = .007$), authority (*Mdiff* = –0.41, $p = .002$), and then ingroup (*Mdiff* = –0.23 $p = .04$). Good behaviors were ordered from most positive to least positive. Positive harm foundation behaviors ($M = 2.37$) were rated more positive than fairness (*Mdiff* = 0.52, $p < .001$), which was judged to be more positive than authority (*Mdiff* = 0.35, $p = .01$), which was judged to be equal to ingroup (*Mdiff* = 0.03, $p = .75$), although ingroup was more positive than purity (*Mdiff* = 0.59, $p < .001$).

As a manipulation check, planned t tests were conducted that assessed whether means for good and bad behaviors for each foundation were significantly different from the midpoint on the scale. These revealed that bad behaviors for all five foundations were rated significantly more negative than the midpoint of the rating scale (all *p*s < .001, all *d*s > 3.4) and that all good behaviors were rated significantly more positive than the midpoint of the scale (all *ps* < .001, all *ds* > 2.2). These moral judgments are shown in Figure 1.

Muscle Activity

Electromyographic data were analyzed using 5 (foundations: purity, harm, fairness, authority, ingroup) × 2 (valence: good, bad) repeated-measures analyses of variance.[5] Different predictions were made about the levator, corrugator, and zygomaticus muscles, so data for each were analyzed separately. The purpose of these analyses was to determine whether moral and immoral behaviors relating to the five moral foundations would elicit differential facial muscle activity.

For the levator muscle there was a significant interaction between foundation and valence, $F(4, 148) = 5.41$, $p < .001$, $\eta^2 = .05$. Entering the foundation factor into a separate analysis of variance for each valence revealed that there was a significant difference within the five foundations for bad behaviors, $F(4, 148) = 6.57$, $p < .001$, $\eta^2 = .15$, but not for good behaviors, $F(4, 148) = 0.80$, $p = .53$, $\eta^2 = .02$.[6] This predicted effect was analyzed further using planned two-tailed one-sample t tests to

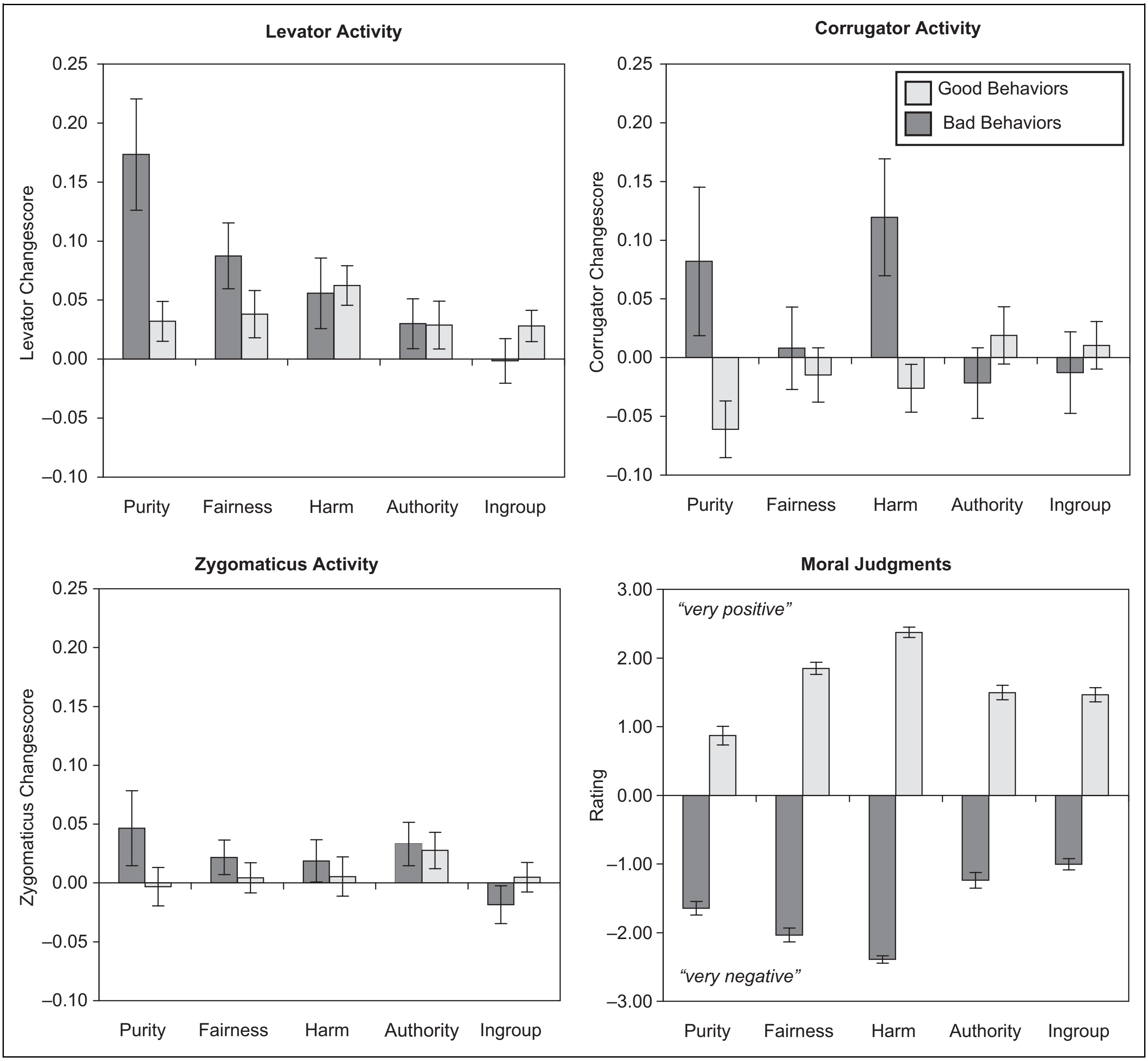

Figure 1. Average muscle activity and moral judgments for behaviors covering the five moral foundations
Note: Muscle activity was recorded during the 4 s following exposure to stimuli in Block 1 while participants were instructed "Please think about this behavior." For each statement, a change score was calculated by subtracting the average muscle activity from the 500 ms period immediately before listening to the behavior from the muscle activity while thinking about the same behavior. Moral judgments were collected in Block 2 following a second exposure to each behavior. Error bars represent standard errors.

compare whether muscle activity during the thinking period was significantly higher than the baseline level of muscle activity immediately before listening to these behaviors. As predicted, purity violations resulted in the greatest increase in levator activity, $t(37) = 3.68$, $p = .001$, $d = 1.2$, followed by fairness violations, $t(37) = 3.13$, $p = .003$, $d = 1.0$. There was also a marginal increase in activity to harm violations, $t(37) = 1.87$, $p = .07$, $d = 0.61$, but no significant increase in activity in response to ingroup or authority violations (both $p > .16$).

The corrugator muscle also showed a significant interaction between foundation and valence, $F(4, 148) = 4.75$, $p < .001$, $\eta^2 = .05$. Analyzing each valence separately revealed that there was a significant effect of foundation for both bad behaviors, $F(4, 148) = 3.32$, $p = .01$, $\eta^2 = .08$, and good behaviors, $F(4, 148) = 2.90$, $p = .02$, $\eta^2 = .07$. Because corrugator activity was predicted to be evoked by violations of the harm foundation, this effect was assessed using a one-sample *t* test versus the baseline level of activity. Indeed, when thinking about bad behaviors in the harm foundation, there was a significant increase in corrugator muscle activity, $t(37) = 2.40$, $p = .02$, $d = 0.79$. There was no significant increase in corrugator activity to violations of the purity, fairness, ingroup, or authority

Table 1. The Relationship Between Muscle Activity Evoked While Thinking About Behaviors From the Five Moral Foundations in Block 1 and the Moral Judgments of These Same Behaviors in Block 2

	Moral foundation				
	Purity	Fairness	Harm	Authority	Ingroup
Levator	–.72***	–.45*	.02	.25	.21
Corrugator	–.56**	–.05	–.59**	.07	.01
Zygomaticus	–.45*	–.31	–.22	.12	.42*
n	18	17	18	18	17

Note: A negative correlation reflects higher muscle activity for more negative judgments.
* $p < .05$, one tailed. ** $p < .01$, one tailed. *** $p < .001$, one tailed.

foundations (all *ps* > .20). Because there also was a significant difference in activity across the five foundations while thinking about good behaviors, this unpredicted effect was investigated using *t* tests. Thinking about good behaviors involving purity significantly reduced the level of corrugator muscle activation, $t(37) = -2.52$, $p = .02$, $d = 0.83$; no other differences were significant (all *ps* > .21).

Finally, the zygomaticus muscle did not show a significant interaction between foundation and valence, $F(4, 148) = 1.73$, $p = .15$, $\eta^2 = .02$. Unlike the corrugator and levator muscles, neither purity ($p = .15$, $d = 0.48$), nor harm ($p = .30$, $d = 0.34$), nor fairness ($p = .15$, $d = 0.49$) violations evoked increased zygomaticus response.

Relationship Between Moral Judgments and Muscle Activity

The previous set of analyses revealed specific patterns of muscle activity in response to positive and negative behaviors within the five moral foundations. To test whether facial affect in response to moral and immoral behaviors predicts subsequent moral condemnation, facial muscle activity recorded in Block 1 was correlated with the moral judgment for that same behavior in Block 2.[7] These analyses were conducted at an item level to determine whether muscle activity for different moral behaviors predicted the extremity of subsequent moral judgments. Item-level data are preferable to participant-level data in these analyses because they can describe whether behaviors that are judged to be more severe moral violations also evoke greater muscle activity. The relationship between muscle activity and moral judgments for the five foundations is shown in Table 1.

Overall, muscle activity was negatively correlated with moral judgments such that more negative items tended to elicit higher muscle activity. This pattern was significant for both the levator, $r(88) = -.23$, $p = .04$, and the corrugator, $r(88) = -.30$, $p = .005$, but not the zygomaticus, $r(88) = -.12$, $p = .26$.

Owing to the foundation-specific hypotheses about this relationship, separate correlations were calculated for each of the five foundations. Table 1 shows that, as expected, levator muscle activity predicted the extremity of moral judgments for purity and fairness, but this was not the case for harm, ingroup, or authority. In this relationship, increased levator activity predicted more severe moral judgments and decreased levator activity predicted more positive moral judgments. Similarly, corrugator muscle activity predicted the extremity of moral judgments for harm foundation items. There were also several unpredicted effects. Corrugator activity was correlated with extremity of moral judgments for purity. Because of the severity of the disgust response to purity violations, it is likely that the corrugator muscle was also recruited in response to these behaviors, forming a full face disgust expression. Supporting this possibility, controlling for levator activity using a partial correlation resulted in a nonsignificant relationship between corrugator muscle activity and moral judgments, $rp(15) = -.21$, $p = .41$. In contrast, controlling for levator activity did not change the relationship between corrugator activity and moral judgments for harm behaviors, $rp(15) = -.60$, $p = .01$.

Although there were no foundation-specific predictions for the zygomaticus muscle, analyses revealed that for the purity foundation, increased activity was related to more negative judgments. This effect can be explained by addressing the relationship between the levator and zygomaticus muscles. Collapsing across foundation and valence and analyzing the relationship between these two muscles throughout the entire experiment revealed that there was high covariance between these muscles, $r(89) = .59$, $p < .001$. To account for this covariance, the relationship between zygomaticus activity and purity moral judgments was reanalyzed while controlling for levator activity; doing so eliminated the correlation between zygomaticus activity and ratings for purity, $rp(15) = .03$, $p = .90$. It is likely that the original zero-order correlation was influenced by cross talk between these two muscle sites as a result of the close proximity between these recording sites, as previously documented by Hoefling et al. (2009).

One final unanticipated finding was that increased zygomaticus activity was positively correlated with judgments of ingroup behaviors. Because of the involvement of the zygomaticus in smiling, this finding suggests that participants experienced increased positive affect while thinking about situations involving loyal compared to disloyal behavior.

Discussion

When considering another person behaving in a way that violates accepted moral standards, individuals spontaneously express different facial expressions depending on the type of violation that is committed. As predicted, transgressions that involved the risk of contamination of the body or spirit resulted in a strong facial expression of disgust involving the levator muscle. Disgust was also exhibited during fairness violations, such as cheating, stealing, and discriminating against others. The presence of a disgust response to purity and fairness transgressions is predicted by models of sociomoral disgust (e.g., Rozin et al., 2008), suggesting that these two moral categories are closely related. In contrast, when participants considered transgressions that involved harming others they formed a frown that we interpret to be part of an anger expression, without the involvement of moral disgust. No disgust or anger responses occurred to transgressions committed against one's social group or against authority.

A second set of analyses examined the relationship between muscle activity while thinking about these behaviors the first time that they were encountered and the later subjective moral judgments about these behaviors. Overall, there was a relationship between both levator and corrugator muscle activity and moral judgments, with increased muscle activity while thinking about bad behaviors and relaxation of these muscles when thinking about good behaviors. However, this relationship again depended on the type of behavior under consideration, with facial disgust correlating with moral judgments about purity and fairness, frowning correlating with moral judgments about harm, and positive facial affect correlating with ingroup behaviors. Critically, these effects occurred without participants being aware that their facial muscle activity was being recorded or that they would subsequently be asked to make moral judgments about these behaviors. The additional finding that zygomaticus activity also predicted purity violations was likely the result of cross-talk activity with the levator muscle in extreme disgust facial expressions (e.g., Hoefling et al., 2009; Vrana, 1993); however, an alternative possibility that warrants further investigation is that participants may have found some of the more extreme purity behaviors amusing as well as disgusting (see McGraw & Warren, 2010).

Although our study replicates the finding that disgust expressions are evoked by fairness violations (Chapman et al., 2009), we find that this is not a universal response to all moral violations. Previous studies have demonstrated that perceiving an intention to cause harm can evoke increased anger judgments (Gutierrez & Giner-Sorolla, 2007; Rozin, Lowery, Imada, & Haidt, 1999). Our data build on these previous findings by demonstrating that facial anger can be spontaneously evoked while merely thinking about behaviors that cause harm. In these situations the magnitude of the anger response was greater than the disgust response, supporting our claim that emotions beyond disgust contribute to moral decisions.

One finding worthy of discussion is that authority and ingroup transgressions did not evoke strong negative affective responses. This finding might be explained by dual process models of morality that propose that both conscious reasoning and affective responses guide moral judgments (e.g., Greene & Haidt, 2002). The present data suggest that although spontaneous facial affect generally predicted the extremity of moral judgments, in some domains the precise relationship depended on a complex interplay of different facial muscles and moral concerns. Thus, some moral transgressions might be more likely than others to evoke affective responses, and for those that do not, namely concerns related to ingroup and authority, additional cognitive, controlled processes might be recruited to arrive at a moral judgment.

In conclusion, the present study provides the first evidence of affective facial muscle activity in response to a broad range of moral concerns. In general, our findings support feeling-based approaches to moral judgment, such as the social intuitionist model (Haidt, 2001), by demonstrating that when people consider moral situations, facial affect and moral judgment go hand in hand. Not only do individuals form disgust and anger facial expressions in response to certain immoral behaviors, but also the amount of facial muscle activity elicited predicts how severe they perceive these violations to be. Thus, specific facial affect could serve as an implicit indicator of the moral concerns on which individuals base their objections to real-world moral dilemmas. This may in turn guide policy decisions with regard to the handling of sensitive ethical issues, such as stem-cell research, assisted reproduction, and cognition-enhancing drugs.

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Notes

1. An advantage of using electromyography is that it can measure nonvisible activity from the muscles that form facial expressions. For this reason, when we refer to facial expressions (such as smiling and frowning) we are actually referring to specific muscle activity that forms part of these expressions.
2. Data for two statements were treated as outliers: One statement from the fairness category was excluded from analysis because of a mispronunciation in the recording of this statement; indeed, data for that statement differed substantially from data of all other fairness items. One item from the ingroup category was excluded because it evoked unusual facial muscle activity that was inconsistent with all other items within this category.
3. See online supplementary material at http://spp.sagepub.com/supplemental.
4. Judgment data were unavailable for one participant because of a data recording malfunction.
5. Participant sex did not interact with the foundation and valence factors (all muscles, $p > .12$) and was not included in subsequent analyses.
6. For completeness, these *t* tests were also computed for good behaviors. The only significant increase in levator activity was for harm foundation behaviors, $t(37) = 3.75$, $p = .001$, although this activity was not significantly different from the levator response for bad harm foundation behaviors ($p = .84$).
7. These analyses represent Pearson product–moment correlation coefficients calculated using the mean values of muscle activity and moral judgments. The identical pattern of results (including both relative magnitude of the correlation coefficients and pattern of statistically significant effects) was replicated using Spearman's rank order correlation coefficients; these were calculated using the rank position of muscle activity and moral judgment, as used by Chapman, Kim, Susskind, and Anderson (2009).

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