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Encoding differences in posed negative emotional expressions between prosocials and proselfs

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Abstract
The purpose of this paper was to test whether people with proself orientation would be less accurate in the encoding of negative facial expressions than people with prosocial orientation when they intentionally make facial expressions. Six universal facial expressions, which were anger, disgust, fear, happiness, sadness, and surprise, of 72 participants were photographed. Then, the accuracy of expressing action units (AUs), which are compositions of facial expressions, was measured using an automatic facial expression decoding program. Afterwards, the mean differences in the values of AUs and their combinations of each facial expression between prosocials and proselfs were examined. First, according to the correlation analysis of self-reported measures proself orientation was positively related to amoral manipulation and vulnerable type of narcissism, and negatively related to mental health and emotional competence. Second, compared to prosocials, proselfs expressed less accurately in upper lid raiser for both fear and surprise facial expressions when AUs at the baseline were not controlled. Third, the expression of inner brow raiser in fear facial expression was suppressed among proselfs when the baseline AU was controlled. However, there was no significant difference found in each combination of AUs. Partially supporting our hypothesis, these findings suggest that proselfs express negative emotions less accurately than prosocials, particularly showing suppressed AUs of fear facial expression. This result may reflect proselfs' high exploitativeness and competitiveness as well as suppressed submissiveness, which serve to present themselves as dominant. Further implications of the results of the present study were discussed.

Keywords Facial expressions · Social value orientation · Action units · Prosocial · Proself

Early economic theories considered self-interest a typical motive of human beings (Smith 1776; Miller 1999). However, later studies (McClintock 1978; Messick and Brewer 1983; Van Lange et al. 1997; Kaltwasser et al. 2017a) verified that in the process of distributing limited resources, motives could be heterogeneous. Specifically, these studies demonstrated that in situations of a social dilemma, there were variations in the behavior of distributing limited resources, depending on the individual's social value.

The differing social value could also affect the expression of emotions (Kaltwasser et al. 2017a; Matsumoto et al. 1986; Schug et al. 2010). People consciously or unconsciously communicated their motives through facial expressions as the keyway among many different nonverbal behaviors (Parkinson 2005). A smile could mean happiness in one situation, and it could be a smile to take advantage of others in another (Matsumoto et al. 1986). An individual could also express or hide a specific emotion to conceal his/her motive (Schug et al. 2010). In the present study, we tested individuals' encoding differences in posed facial expressions to show that negative emotions could be expressed distinctly due to the individual's social value. To this end, an automated facial expressions reader was applied in the analysis process.

Social Value Orientation

Social Value Orientation (SVO) is defined as "stable preferences for certain patterns of outcomes for oneself and others" (Van Lange et al. 1997, p. 733). The theory on SVO supposes two motives of human beings in a situation of a social dilemma (Van Lange et al. 1998). The first motive is personal interest, and the second is collective interest.

SVO is classifiable in many different ways. One way classified SVO into two distinctive types (Van Lange et al. 1998):

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prosocial orientation, and proself orientation. Van Lange et al. (1998, p. 799) asserted that prosocials tended to be "maximizing outcomes for self and others, and minimizing differences between these outcomes", and that proselfs were more likely to be "maximizing outcomes for self, in an absolute sense or in a relative sense."

According to De Cremer and Van Lange (2001), prosocials were more socially responsible and able to form a favorable relationship with others than proselfs. Furthermore, prosocials showed higher scores than proselfs in both self-reported empathy test and the one measuring theory of mind (Declerck and Bogaert 2008). It was also revealed that prosocial behavior was related to positive indicators in a person's life, such as happiness and high life expectancy (Aknin et al. 2013). These pieces of evidence indicate that social value orientation might be related to mental health, definable as "social", "emotional", and "psychological" well-being (Lamers et al. 2011).

Furthermore, it has been suggested that narcissistic characteristics are correlated with social value orientation. According to Sakalaki and Sotiriou (2012), narcissism measured by the Narcissistic Personality Inventory (NPI; Raskin and Hall 1979) correlated significantly with a lower prosocial tendency, but not significantly with proself tendency. Sakalaki and Sotiriou's (2012) study employed NPI, which arguably measured both healthy and unhealthy narcissism (Pincus et al. 2009). For this reason, Sakalaki and Sotiriou (2012) may not have captured the exploitative characteristics of proselfs.

Stouten et al. (2005) further suggested that prosocials and proselfs could react to different social rules. They assigned a hypothetical situation whereby participants could contribute money to the public good. In this experiment, a financial reward was given to the group that achieved the goal, and the reward was to be equally distributed among group members. After the investment was made, participants were told that one of the group members violated the equality rule, and they were not able to receive the reward. At this point, negative emotions were measured, and Stouten et al. (2005) consequently investigated whether there was a difference between when the reward was obtained, and when not. If negative emotion levels did not differ depending on the existence of a reward, it was considered that the equality rule was employed, whereas if they did differ, the efficiency rule that considered the gain and the loss in the game was applied.

It was found that prosocials expressed negative emotions regardless of the reward, while proselfs showed significantly stronger negative emotions when they did not receive the reward. This result revealed that prosocials expressed negative emotions when the equality rule was impeded, while proselfs did not. This highlighted the difference in characteristics between prosocials and proselfs, which could be revealed through emotional reactions.

Social Value Orientation and Facial Expressions

Among nonverbal expressions, facial expression plays an important role in communicating emotions (DePaulo 1992). Both producing and understanding facial expressions could be linked to an adaptive function necessary for communicating emotional information (Horstmann 2003).

Several studies have linked prosociality to the capacity to communicate through facial expression. For example, prosocials were better at recognizing fear facial expression compared to other types of facial expressions, and the accuracy in the recognition of fear facial expression significantly correlated with individual differences in prosocial tendency (Kaltwasser et al. 2017a).

In addition, prosocials tended to show an approach motive in terms of fear facial expression, because fear could facilitate concern for others only in prosocials (Kaltwasser et al. 2017b). These studies are inconsistent with the earlier conception of fear that activates avoidance motive, suggesting that an emotional reaction to fear could be moderated by social value orientation.

Prosocials appear to be more reactive to others' facial expressions, which could then make them more likely to bond with others during social interaction (Stel et al. 2011). For example, likeability of an interactive partner increased when the partner mimicked the facial expression of prosocials, but not in proselfs.

Although these studies jointly suggest that prosocials were more sensitive to other's emotional expression compared to proselfs, there is also evidence that proselfs might be reactive to other's disappointment. For example, in a negotiation situation, when their partners showed disappointment, proselfs made less severe demand, and no such pattern was observed in prosocials (Van Kleef and Van Lange 2008).

Prosocials are more likely to be emotionally expressive than are proselfs. For example, prosocially oriented people expressed positive emotions more often (Brown et al. 2003; Mehu et al. 2007). However, expressivity of positive emotions can be situation-dependent, rather than being unique to prosocials. Consistent with this idea, it has been shown that participants' positive emotions increased when they behaved in an uncooperative or proself manner in studies where preschool children interacted with peers in the Prisoner's Dilemma game (Matsumoto et al. 1986).

Other studies have shown that prosocials more frequently expressed not only positive, but also negative emotions, compared to proselfs (Schug et al. 2010). In this study, participants' facial expressions were videotaped during the ultimatum game, and the examination of their expressivity of facial expressions revealed that prosocials were more emotionally expressive than proselfs. This finding was further confirmed by a more recent study using the Prisoner's Dilemma game

(Kaltwasser et al. 2017a), which showed that in the cooperation condition, prosocial tendency was associated with more smile, whereas in the defection condition, there was more expression of anger, less surprise and less neutral expression.

While these previous studies (Kaltwasser et al. 2017a; Schug et al. 2010) had provided important evidence that prosociality can be linked to increase in emotional expressivity, this conclusion is based only on spontaneous, rather than posed facial expressions. Although both posed and spontaneous facial expressions were frequently used to test the function of nonverbal behavior in expressing emotions and communicating intentions (Bonanno and Keltner 2004; Horstmann 2003), posed facial expressions could reflect different qualities of emotional expressions from spontaneous ones, in that the former and the latter are more likely to reflect socially/culturally learnt emotional knowledge and natural emotional experience, respectively (Hunt 1941).

Furthermore, the encoding ability of posed facial expressions would require different skills from spontaneous facial expressions. More specifically, although the degrees of both posed and spontaneous facial expressions were positively correlated with emotional expressivity, the former was positively correlated with social and emotional control, whereas the latter was negatively correlated with emotional control, but not with social control (Tucker and Riggio 1988). In summary, these studies are in line with the idea that spontaneous facial expressions reflect natural emotional reactivity in social contexts, whereas posed facial expressions reflect emotional communication competence in social interactions, a set of skills necessary for understanding and regulating emotions (Camras et al. 1988; Friedman et al. 2003).

In the present study, we focused on measuring socially acquired emotional competence as measured by deliberately posed facial expressions, and specifically tested any difference in posed facial expressions between prosocials and proselfs. Given the previous report that a significant difference between prosocials and proselfs was found only in negative emotional expressivity (Schug et al. 2010), we focused specifically on the difference in the accuracy of encoding negative facial expressions between prosocials and proselfs.

We anticipated that proselfs' production of negative emotional expressions would be less efficient, because they would exert more self-presentational efforts than their prosocial counterparts. To illuminate this, we compared the tendency of amoral manipulation, the tendency to intentionally manipulate others while engaging in self-monitoring and impression management tactics, between prosocials and proselfs (Dahling et al. 2009).

It was suggested that people with highly manipulative intentions had difficulty in expressing negative emotions, even when feelings of an intense emotional experience were presented because the true expression of emotions could be a disadvantage (Szijjarto and Bereczkei 2015). Consistent with our hypothesis, it was claimed that proselfs had highly opportunistic intentions in terms of their partner (Sakalaki and Sotiriou 2012), implying a higher amoral manipulation tendency than prosocials. If this were the case, proselfs would express negative, but not positive, emotions less accurately than prosocials. Thus, our a priori hypothesis was as follows.

Hypothesis: proselfs would express negative emotions less accurately than prosocials when they intentionally make facial expressions.

Method

Participants

We recruited an initial sample of seventy-eight participants. Once participants had been classified into prosocial and proself conditions using Van Lange et al. (1998), a total of seventy-two participants were employed, while six of the original participants remained unclassified. Accordingly, our final analysis included seventy-two adults (40 female, 32 male; $M_{age} = 30.69$, $SD_{age} = 9.42$). Informed consent was obtained before participation. As recompense for the participation in this research, 50,000 won, approximately 44.15 U.S. dollars, was provided.

Selection of Facial Expressions

The current study examined the facial expression of six universal emotions, which consist of anger, disgust, fear, happiness, sadness, and surprise, as proposed by Ekman and Friesen (1986). Although contempt was also suggested for its universality (Matsumoto 1992), Ekman's (2016) survey from scientists who studied emotion showed that the six emotions, excluding contempt, were most preferably investigated and agreed to among researchers. Based on this result, only six facial expressions were included in the present study.

Emotional expressions could be distinguished into positive and negative based on their level of pleasantness (Watson and Tellegen 1985). Reflecting this characteristic, happiness was classified as a positive facial expression; with surprise classified as neutral; and anger, disgust, fear, and sadness classified as negative facial expressions.

Each facial muscle configuration was selected with reference to Matsumoto et al. (2008). The selected AUs were as follows: Happiness (AU 6, 12); Anger (AU 4, 5, 7, 24); Disgust (AU 9, 10); Fear (AU 1, 2, 4, 5, 20); Sadness (AU 1, 15); Surprise (AU 1, 2, 5, 26).

Procedure

After receiving a brief orientation, participants completed a packet of self-reported measures. Participants were divided into two groups: prosocials and proselfs based on their scores from the Social Value Orientation Scale (Van Lange et al. 1997).

Then, each participant's upper body was photographed, after participants were directed to pose the six different facial expressions and a baseline facial expression. Before being photographed, participants were informed that their facial expressions would be rated. Furthermore, they were asked to make as usual but accurate facial expressions as possible, without being given artificial situations or anecdote.

In order to control stimuli other than facial expressions, the background was standardized as white, and participants were asked to wear a blue gown. Moreover, instructions about facial expressions were also standardized as follows: "Please make the face you make when you are happy"; "Please make the face you make when you are sad"; "Please make the face you make when you feel anger"; "Please make the face you make when you feel fear"; "Please make the face you make when you are surprised"; "Please make the face you make when you feel disgusted." Photographs were taken for approximately ten minutes. The study was reviewed and approved by local institutional review boards (IRB).

Data Analysis

All statistical data analyses were conducted using SPSS software version 23.0. We employed descriptive statistics for sample characteristics and correlation analysis, in order to verify the relationship between prosocial/proself orientation and self-reported variables. Furthermore, a *t*-test was used for the purpose of finding out whether there were differences in facial expressions and AUs between prosocials and proselfs.

Statistical analyses repeatedly found that the *t*-test was robust in terms of violation of the normality assumption when the sample size was large enough at more than twenty-five to thirty based on the Central Limit Theorem (Boneau 1960), and an even more generous standard applied for *t*-test with independent variables at the .05 alpha level (Edgell and Noon 1984). Some researchers (Sawilowsky and Blair 1992) suggested nonparametric analysis for consideration as an alternative when extreme cases were presented. In reference to Kline (2011), the acceptable level could be variables presented with the absolute value of Skewness no greater than 3, and Kurtosis no greater than 10.

Taking this advice, we applied the Mann-Whitney *U*-test for the variables skewed greater than 3 with kurtosis greater than 10 in the condition of prosocial. The Mann-Whitney *U*-test was nonparametric analysis commonly used for testing the difference between two independent variables (Nachar 2008).

Measures

Amoral Manipulation This trait was measured to test whether proselfs had any tendency to conceal their motive to take advantage of others compared to prosocials. To measure amoral manipulation, the current study employed four items from the Machiavellianism Personality Scale (MPS) developed by Dahling et al. (2009), which was adapted and validated by Kim et al. (2011). The four items were as follows: "I am willing to be unethical if I believe it will help me succeed", "I am willing to sabotage the efforts of other people if they threaten my own goals", "I would cheat if there was a low chance of getting caught", "I believe that lying is necessary to maintain a competitive advantage over others". The Cronbach's α in the current study was .79.

Mental Health This variable was measured through the short version of the Mental Health Continuum (MHC-SF) developed by Keyes et al. (2008), and adapted and validated by Lim et al. (2012). This measure is composed of three subscales: emotional well-being, psychological well-being, and social well-being. Each item was measured with a 6-point Likert-type scale (from 0 "*Not at all*", to 5 "*Every day*"). The score range was (0 to 70), and a higher score was interpreted as a higher level of mental health. The Cronbach's α for the present study was .85.

Pathological Narcissism This factor was measured through the Pathological Narcissism Inventory (PNI) developed by Pincus et al. (2009), and translated by Yang and Kwon (2016). The inventory was composed of two subscales: grandiosity and vulnerability. Items were placed on a 6-point scale ranging from 0 (*Not at all like me*), to 5 (*Very much like me*). The Cronbach's α for the present study was .94.

Perceived Emotional Competence This factor was measured by the Trait Meta-Mood Scale (TMMS) developed by Salovey et al. (1995), and further adapted and validated by Lee and Lee (1997). This scale was composed of three subscales: clarity, attention, and repair, with each item measured on a 5-point Likert-type scale. The Cronbach's α for the present study was .88.

Social Value Orientation This factor was measured by a nine-item scale developed by Van Lange et al. (1997). This scale presented a list of choices between particular combinations of payoffs to the self and the other. The following is an example. Option A: I take 480 and give 80 to the other. Option B: I take 540 and give 280 to the other. Option C: Both equally take 480. Option A represented a competitive choice, because there was a substantial difference between the share for myself and for the other. Option B represented an individualistic choice, because the share that I took was absolutely bigger than the other choices. Option C represented a pro-social choice, because the total share was bigger than other choices, and the difference between the share for the other and for the self was the smallest.

SVO could be classified if at least six out of nine items were consistent with one of the sub-categories. As per Van

Lange et al. (1998), the participants were classified into two subtypes: pro-social and pro-self which included both individualist and competitive types. To be specific, participants who chose at least six items of prosocial choices were classified as prosocials, and those who chose at least six items of either individualistic or competitive choices were categorized as proselfs. Following these criteria, we identified twenty-seven prosocial participants, and forty-five proself participants.

The Accuracy of Facial Expressions This factor was measured by using an open source, AFF-DEX software development kit (McDuff et al. 2016). This program automatically detected and classified AUs of seven emotion expressions that were anger, disgust, fear, happiness, sadness, surprise, and contempt, based on Ekman and Friesen's (1978) Facial Action Coding System (FACS). It also provided scores on the accurate expression of each emotion and AU, ranging from 0 (*absent*) to 100 (*present*). The software provided the information about facial valence with a scoring system that ranged (−100 to 100). The negative emotional valence to neutral was presented with (−100 to 0) and neutral to positive emotional valence with (0 to 100). When in McDuff et al. (2017), trained computer classifiers of this program were assigned to code AUs in facial expressions in the video of different image sets, they showed inter-coder reliability, free marginal kappa, as high as .78 to .95.

As was the case with McDuff et al. (2016), the automated software in the present study detected faces and facial landmarks based on the Viola-Jones face detection algorithm (Viola and Jones 2001), which uses integral image as an image representation along with a small set of critical features as a classifier contributing to cascade structure, in order to discard background, and focus on object-specific regions. A total of 34 facial landmarks were confirmed by employing facial bounding box. After these were confirmed, Histogram of Orientation Gradient (HOG) features was extracted, and classified into facial actions.

Automated software programs generally compute a face image by comparing it to images taken from an established dataset (Olderbak et al. 2014). Likewise, the AFF-DEX SDK was trained on a database that includes both posed and spontaneous facial expressions. The software, AFF-DEX SDK, was trained on an independent set of 10,000 facial images, which were manually coded, and included diverse ethnicities: Caucasian, Asian and Hispanic. The universal emotion expressions were modeled based on the emotional facial action coding system (EMFACS; Friesen and Ekman 1983).

The software (Sénéchal et al. 2013) proposed a coding system to detect asymmetries in which a right hemi-face trained classifier separately analyzed a facial image and its flip, and then computed the difference between the two values. The test result on 200 posed facial expressions showed 98.5% accuracy in the detection rate of asymmetric lip expressions that were presented at AU 12, AU 14, and AU 20.

However, even with such a coding system, there might still be individual differences in facial expressions that need to be controlled (Olderbak et al. 2014). In the present study, baseline facial expression and their AUs were measured, in order to control such individual differences. For this purpose, following a suggestion from Olderbak et al. (2014), each AU and facial expression's value of baseline facial expression was subtracted from each corresponding value of targeted facial expression. For example, the inner brow raiser's (AU 1) value of baseline facial expression was subtracted from that of the fear facial expression.

Results

Manipulation Check

Positive and Negative Facial Expressions To test whether the six facial expressions were classifiable into positive, negative, and neutral facial expressions, we checked the valence score of each facial expression. The facial expressions with a valence score above and below zero indicated positive and negative emotional expressions, respectively. Table 1 presents the mean, minimum, and maximum levels of valence in six facial expressions.

In addition, we conducted an ANOVA test among mean levels of six valence scores to test whether the negative emotional expressions could be distinguished from the positive emotional expression. The result revealed that the mean levels of six valence scores were significantly different $F(5, 355) = 62.97$, $p < .001$, $\eta_p^2 = .47$. A follow-up Bonferroni analysis showed that the mean valence of the negative emotional expressions (i.e., sadness, anger, fear, and disgust) were negative, and significantly different from that of positive emotional expression (i.e., happiness). Moreover, the mean valence level of the surprise facial expression was negative.

Amoral Manipulation To check the constructive validity of prosocial/proself orientation, we conducted a correlation analysis between the scores of SVO and amoral manipulation. The result showed that proself orientation was positively correlated with amoral manipulation, $r(70) = .43$, $p < .01$, indicating that higher proself tendency is associated with greater exploitative intention.

Descriptive Statistics and Correlations

Participants included 40 (55.6%) females and 32 males (55.6%), and all were Asian. They included 34 (47.2%) employed, 19 (26.4%) unemployed, and 19 (26.4%)

Table 1 Valence in six facial expressions

	Valence			
	M	*SD*	*MIN*	*MAX*
Happiness	40.09	47.27	−61.01	99.86
Sadness	−9.11	12.14	−58.59	1.32
Anger	−12.45	15.65	−69.70	3.66
Surprise	−14.71	24.71	−92.72	59.48
Fear	−16.46	19.21	−83.36	3.47
Disgust	−18.53	25.39	−80.05	68.41

$N = 72$. The range of the valence was from −100 to 100 (*negative* to *positive*)

MIN Minimum; *MAX* Maximum

undergraduate students. They also included 58 (80.6%) married, 2 (2.8%) divorced, and 12 (16.7%) unmarried.

There was no significant gender difference, $t(70) = .60$, $p = .55$, in the choice to be prosocial between male ($M = 3.63$, $SD = 4.37$) and female ($M = 3.03$, $SD = 4.06$). Likewise, male subjects ($M = 5.34$, $SD = 4.34$) were not significantly different from female subjects ($M = 5.98$, $SD = 4.06$) in the choice to be proself, $t(70) = -.64$, $p = .53$.

Table 2 shows the result of correlation analysis. Since prosocial and proself were dichotomously classified, only the correlation analysis between proself orientation and self-reported measures was included. Proself orientation exhibited negative correlations with mental health scale, $r(70) = -.29$, $p < .05$, social well-being, $r(70) = -.26$, $p < .05$, and psychological well-being, $r(70) = -.31$, $p < .01$. Proself orientation and emotional well-being were not significantly correlated. One of the subscales of pathological narcissism, vulnerability, was positively correlated with proself orientation, $r(70) = .23$, $p < .05$. On the other hand, the total score of pathological narcissism and grandiosity was not significantly correlated with proself orientation. Proself orientation showed negative correlations with emotional competence, $r(70) = -.26$, $p < .05$, and repair, $r(70) = -.28$, $p < .05$. However, the correlations with clarity and attention were not significant.

In sum, proself orientation was positively correlated with the indices related to psychological vulnerability. These findings suggest that a lower proself (or higher prosocial) tendency could be associated with more psychologically and socially adaptive variables.

Differences in Posed Facial Expressions

First, we examined individual differences in facial expression without normalization, that is, controlling for individual-specific baseline facial expressivity.

Table 3 shows the results of the *t*-test for mean-differences in posed facial expressions between prosocials and proselfs.

Table 2 Means, standard deviations, and correlations of self-reported scales with SVO

	M	*SD*	Proself
Mental health	48.31	14.21	−.29*
Emotional well-being	11.08	3.27	−.15
Social well-being	14.83	5.26	−.26*
Psychological well-being	22.39	7.25	−.31**
Pathological narcissism	77.77	27.88	.15
Grandiosity	35.85	13.15	−.00
Vulnerability	41.93	18.66	.23*
Perceived emotional competence	74.68	10.29	−.26*
Clarity	40.52	7.22	−.23
Attention	19.51	3.60	−.09
Repair	16.25	4.09	−.28*

SVO = social value orientation. Mental health = MHC-SF; Pathological narcissism = PNI; Perceived emotional competence = TMMS. Indented variables are sub-categories of the above variable. Because we measured proself and prosocial dichotomously, only the proself is presented in the table. Prosocial tendency showed the same correlation coefficient as proself, differing only in direction

* $p < .05$. ** $p < .01$

As we found that the data from prosocials were skewed (Kurtosis >10) (Kline 2011) in sad and fear facial expressions, we ran a Mann-Whitney *U*-test for these variables. These analyses revealed that there were no significant differences between the two groups in six facial expressions.

Differences in the AUs of Posed Facial Expressions

Next, we examined Table 4, which shows the mean-differences in the AUs of posed facial expression between prosocial and proself. Proselfs showed a significantly weaker expression than prosocials in upper lid raiser (AU 5), both in fear facial expression, $t(70) = -2.31$, $p < .05$, Cohen's $d = .53$, and surprise facial expression, $t(70) = -2.52$, $p < .05$, Cohen's $d = .60$. No significant group differences were found in any other AUs in these facial expressions, as well as other facial expressions.

Further, the Mann-Whitney *U*-tests for the variables with skewed distribution (i.e., AU 6 of happiness, AU 5, 7, 24 of anger, AU 9 of disgust, AU 20 of fear, and AU 1, 15 of sadness) showed no significant differences.

Changes in Posed Facial Expressions

In the next analysis, we normalized the values of facial expression by converting them into change scores from subject-specific baseline facial expression. Table 5 presents the results of the *t*-test for contrasting the changes in facial expressions from the baseline between prosocials and proselfs. Mann-Whitney *U*-tests were performed for sadness, anger, and fear

Table 3 Group differences of accuracy in six facial emotions between prosocials and proselfs

	Prosocial ($n = 27$)		Proself ($n = 45$)		t-test
	M	*SD*	*M*	*SD*	
Happiness	46.57	48.47	44.10	46.92	−.21
Sadness	3.29	12.90	3.70	15.47	.12
Anger	4.38	11.63	4.84	11.29	.17
Surprise	22.95	34.08	10.71	23.37	−1.81
Fear	6.18	17.76	2.02	8.87	−1.33
Disgust	4.19	7.80	4.34	12.22	.06

The dependent variable was the accuracy of facial expression ranging from 0 to 100. No results were significant

facial expressions. None of these analyses revealed significant differences between the two groups in six facial expressions.

Changes in the AUs of Posed Facial Expressions

Again, we conducted t-tests to examine the group differences in changes in AUs between prosocials and proselfs, and Table 6 shows the results. The only significant group difference was found in fear facial expression. Specifically, proselfs showed a significantly weaker expression than prosocials in inner brow raiser (AU 1), $t(70) = -2.03$, $p < .05$. Cohen's $d = .49$, in fear facial expression. No significant group differences were found in any other AUs in the fear facial expression, as well as in the other facial expressions.

The Mann-Whitney U-tests were performed for the variables with skewed distribution (i.e., AU 6 of happiness, AU 7,

Table 4 Group differences of accuracy in the AUs of six emotions between prosocials and proselfs

	Accuracy				
	Prosocial ($n = 27$)		Proself ($n = 45$)		t – test
	M	*SD*	*M*	*SD*	
Happiness					
Cheek raiser (AU 6)	5.59	19.54	9.83	26.69	.72
Lip corner puller (AU 12)	51.16	48.40	49.53	46.39	−.14
Anger					
Brow lowerer (AU 4)	19.51	33.28	24.25	36.93	.55
Upper lid raiser (AU 5)	3.14	9.25	2.95	15.09	−.06
Lid tightener (AU 7)	.81	2.24	1.43	3.45	.84
Lip presser (AU 24)	1.93	8.21	.79	2.99	−.84
Disgust					
Nose wrinkler (AU 9)	.39	1.12	.08	.20	−1.81
Upper lip raiser (AU10)	19.26	34.99	12.71	29.80	.40
Fear					
Inner brow raiser (AU 1)	14.95	30.01	8.83	20.22	−1.03
Outer brow raiser (AU 2)	10.31	27.69	5.35	18.79	−.91
Brow lowerer (AU 4)	15.58	29.57	13.27	28.71	−.33
Upper lid raiser (AU 5)	26.81	40.56	9.09	24.75	−2.31*
Lip stretcher (AU 20)	0.00	.00	.00	.00	−1.81
Sadness					
Inner brow raiser (AU 1)	9.08	20.29	7.56	20.18	−.31
Lip corner depressor (AU 15)	.06	.25	.47	2.86	.75
Surprise					
Inner brow raiser (AU 1)	6.79	14.78	6.76	16.17	−.01
Outer brow raiser (AU 2)	30.47	43.75	14.03	31.09	−1.86
Upper lid raiser (AU 5)	50.23	46.43	24.47	39.01	−2.52*
Jaw drop (AU 26)	49.50	46.95	48.15	46.02	−.12

The dependent variable was the accuracy of expressing facial component for emotion ranging from 0 to 100.

AUs Action units

* $p < .05$

Table 5 Group differences of accuracy in six facial emotions between prosocials and proselfs with the baseline controlled

	Prosocial ($n = 27$)		Proself ($n = 45$)		t-test
	M	*SD*	*M*	*SD*	
Happiness	46.56	48.47	44.10	46.92	−.21
Sadness	2.42	8.92	1.29	4.79	−.70
Anger	3.46	10.65	4.52	10.82	.41
Surprise	20.74	33.04	9.21	22.58	−1.76
Fear	6.08	17.58	1.93	8.55	−1.34
Disgust	3.74	7.81	3.88	12.18	.05

The dependent variable was the changes in facial expressions from the baseline. The values of the baseline facial expressions were subtracted from those of targeted facial expression, which yielded the change scores. No results were significant

24 of anger, AU 9 of disgust, AU 2, 20 of fear, AU 1, 15 of sadness, and AU 1 of surprise), and none of these showed significant differences.

Discussion

The present study aimed to test whether proselfs would be less accurate than prosocials in encoding deliberately posed negative facial expressions. Partially supporting our hypothesis, proselfs displayed weaker expressions of upper lid raiser (AU 5) of fear as well as surprise facial expressions, without subject-specific baseline facial expressivity controlled. When subject-specific baseline facial expressivity was controlled, the expression of inner brow raiser (AU 1) of fear facial expression was less accurate in proselfs than in prosocials. In summary, these results are in line with our hypothesis that proselfs are more likely to show diminished posed facial expressivity of negative emotion, and such a diminished emotional expressivity is particularly dominant for fear.

The fact that the group difference was observed only in an individual AU rather than an individual emotional category seems to be consistent with the previous report that a subtle change in facial expression cannot be readily categorized into the major universal categories of facial expression (Hamm et al. 2011). For example, depressive individuals compared to healthy controls showed more controlled smiling, as defined by subtle changes in individual facial muscles, such as dimpler (AU14) and lip corner depressors (AU 15), while watching a comedy clip (Reed et al. 2007).

The implications for the present study are as follows. First, proselfs appear to be less efficient in producing subtle fear emotion than prosocials, possibly because proselfs were less emotionally competent than prosocials. Supporting this account, the present study also showed that proself tendency was negatively related to emotional competence and repair measured by TMMS, and proselfs are often less empathetic and poor at the theory of mind (Declerck and Bogaert 2008). An alternative account might be that prosocials are better at posing fearful facial expression because they are more sensitive to fear-related emotion. Supporting this account, prosocials can be characterized by greater volume and activity of the amygdala, a well-known neural structure linked to fear-related emotional processing (Marsh et al. 2014).

Second, the finding that proselfs showed diminished expression of upper lid raiser (AU 5) in unnormalized fear facial expression, and also a lower expression of inner brow raiser (AU 1) in normalized fear facial expression, may reflect their competitive tendency of resisting submission. Supporting this argument, fear appears to signal the detection of threatening stimuli (Adolphs et al. 1999), and often leads to flight behavior as a response (James 1894). Furthermore, fear and sadness, relative to anger, facial expression may reveal the individual's low dominance level in situations of social interaction (Carney et al. 2005; Knutson 1996).

More importantly, the expressions of eyebrows may reflect the individual's dominance level (Camras 1977; Carney et al. 2005; Keating et al. 1981). More specifically, a lowered inner brow, often signifying angry expression, might reflect high dominance level, whereas higher inner brow, often signifying fear expression, may reflect low dominance level (Camras 1977; Carney et al. 2005; Keating et al. 1981; Marsh et al. 2005). Consistent with this idea, raised inner brows were related to a nonaggressive manner in a conflict situation (Camras 1977), potentially indicating receptiveness (Keating et al. 1981), which could be a form of cooperativeness (Kochanska et al. 2005). Combining these findings together, we can speculate that lowered inner brows in prosocials' fear facial expression may serve to deliver cooperative messages to others by making them look less aggressive.

Alternatively, it was suggested that the accuracy of fear facial expression could relate to a low exploitative tendency (Welpe et al. 2012). In fact, the present study demonstrated the positive correlation between the proself tendency and exploitative tendency measured by amoral manipulation, a subtype of MPS (Dahling et al. 2009). Therefore, the less accurate expression of fear among proselfs, as opposed to prosocials, may indicate their high exploitative intention.

Third, although revealing strong negative emotions in public may sometimes indicate malfunctioning (Diener et al. 2010), stronger expression of fear facial expression in prosocials might not do so, because our correlation analysis revealed that prosocials could be more psycho-socially well-functioning than proselfs. In fact, proself orientation correlated negatively with social well-being, psychological well-being, and repair, and positively with narcissistic vulnerability.

Fourth, the present study demonstrated that even laypersons can pose subtle emotional expression without specific directions, and even without feeling targeted emotions. This

is somewhat in conflict with a previous suggestion that negative facial expression could be expressed more intensively by professional actors than non-actors and also in a more realistic situation (Gosselin et al. 1995). Although Schug et al. (2010) employed untrained laypersons to measure non-verbal emotional expressivity in interactive situations, Kaltwasser et al. (2017a) hired professional actors for their study.

Fifth, this study showed a greater emotional expression of surprise facial expression among prosocials than proselfs. Although surprise could usually be classified as a neutral emotional expression, the surprise facial expression in our study was rated more negatively in valence. Consistent with this finding, it was previously shown that posed surprise facial expression was more likely to be interpreted negatively by perceivers (Neta and Whalen 2010). Therefore, it is likely that when participants deliberately pose surprise facial expression, they tend to encode it more negatively.

The limitations of and suggestions for the present study are as follows. First, our stimuli included six facial expressions, but only one of them was a positive facial expression. Such an imbalance between positive and negative facial expression limits our conclusion on the null finding in positive facial expression.

Second, surprise facial expression could be classified into positive surprise and negative surprise (see Russell 1980); and therefore, the observed significant group difference in surprise facial expression may be due to participants' confusion of the expression with fear facial expression, which may be considered a negative surprise facial expression. Further investigation is necessary that contrasts positive and negative surprise facial expression more carefully,

Table 6 Group differences of accuracy in AUs of six emotions between prosocials and proselfs with the baseline controlled

	Accuracy				
	Prosocial ($n = 27$)		Proself ($n = 45$)		t – test
	M	*SD*	*M*	*SD*	
Happiness					
Cheek raiser (AU 6)	5.59	19.54	9.83	26.68	.72
Lip corner puller (AU 12)	51.16	48.40	49.53	46.39	−.14
Anger					
Brow lowerer (AU 4)	14.88	27.03	18.68	33.80	.50
Upper lid raiser (AU 5)	−6.88	25.19	.10	20.79	1.27
Lid tightener (AU 7)	.71	2.05	1.36	3.39	.89
Lip presser (AU 24)	1.92	8.21	.78	2.98	−.85
Disgust					
Nose wrinkler (AU 9)	.39	1.12	.07	.13	−1.92
Upper lip raiser (AU10)	18.62	35.33	11.69	28.21	−.92
Fear					
Inner brow raiser (AU 1)	10.01	25.43	−0.86	19.77	−2.03*
Outer brow raiser (AU 2)	2.97	13.82	2.35	16.38	−.17
Brow lowerer (AU 4)	10.95	22.35	7.70	20.42	−.63
Upper lid raiser (AU 5)	16.78	32.31	6.24	28.60	−1.44
Lip stretcher (AU 20)	−0.00	.00	.00	.00	.80
Sadness					
Inner brow raiser (AU 1)	4.14	21.88	−2.12	14.37	−1.47
Lip corner depressor (AU 15)	−.69	2.92	.40	2.70	1.60
Surprise					
Inner brow raiser (AU 1)	1.86	12.44	−2.93	13.43	−1.50
Outer brow raiser (AU 2)	23.12	39.02	11.02	28.25	−1.52
Upper lid raiser (AU 5)	40.20	43.33	21.62	42.08	−1.79
Jaw drop (AU 26)	46.08	46.66	46.13	44.44	.01

The AUs of the baseline facial expressions were subtracted from those of targeted facial expression, which yielded the change scores

AUs Action units

* $p < .05$

to examine any difference between them in reflecting individual differences in prosociality.

Third, the present study did not take into account individual difference in baseline mood as a control variable, although subject-specific baseline facial expressivity was controlled for. Given that depressive mood could affect posed facial expression (Reed et al. 2007), and that the depressive patient showed a decrease in facial reaction to positive stimuli (Davies et al. 2016), it may be necessary to measure and control subject-specific baseline mood level in future follow-up studies.

Fourth, it is still inconclusive whether the observed group difference is due to proselfs being better at suppressing fear facial expression, or prosocials being better at expressing the facial emotion of fear. Perhaps other physiological measures, such as skin conductance responses and brain responses, collected simultaneously while posing facial expressions, could provide additional evidence to resolve this issue.

Fifth, it is not clear to what extent participants' posed facial expressions were driven by their self-presentational motive. Although we assumed that people would engage in self-presentation motive when making posed facial expressions, a former study has suggested that the self-presentational motive is revealed primarily in situations of interacting with a real or imagined partner (Leary and Allen 2011). Due to the lack of social interaction, our task may have failed to make participants fully engage in the self-presentational motive. Future studies will be needed to verify whether or not the present findings would be replicated in a situation of interacting with a real partner.

Sixth, we found group differences in individual, rather than combinations of, AUs. It is likely that untrained lay participants may have had difficulty in engaging more than one AU simultaneously to pose a targeted facial expression. In fact, even for trained actors, eliciting targeted emotion with a scenario significantly improves simultaneous activation of different AUs in posing happiness, anger, and sadness facial expressions (Gosselin et al. 1995). It would be important to see if more than a single AU would be engaged simultaneously when a targeted emotion was elicited either by scenario, or by using a real social interaction.

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Compliance with Ethical Standards

Ethical Approval All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research committee and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Conflict of Interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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