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ACKNOWLEDGEMENTS. This study was supported by a grant (number 417101) of National Agricultural Innovation Project (NAIP) of ICAR (New Delhi), through its sub-project entitled 'Synthesis and characterization of nanocellulose and its application in biodegradable polymer composites to enhance their performance'. We also thank our colleagues Drs P. G. Patil and Sujata Saxena for their suggestions and support in carrying out this research work. The authors also thank the reviewer for suggesting improvements.

Received 21 June 2016; revised accepted 31 October 2017

doi: 10.18520/cs/v114/i04/897-901

Identification of unique characteristics of deception from facial expression

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Facial asymmetry provides important information for detecting deception. The present study aims at deciphering deception in facial expression unique to Indian culture and to detect differences between parameters of expression of 'felt' emotion and 'deceived' expression. Facial expressions are analysed based on Facial Action Coding System. Results reveal that participants deamplify happiness whereas they neutralize and mask negative emotions.

Keywords: Deception, facial asymmetry, facial expression.

MOST people rely on facial expressions to understand emotion. However, not all emotional facial expressions of the partners reflect actual emotional experience. When these expressions intend to transmit misleading information or to suppress information, it may be termed as deception. The fine line of distinction between posed and deceived emotions in facial expressions has rarely been examined. This is important as facial expressions of emotion are culturally constructed and there is a great degree of variation between cultures, especially of Western and Eastern cultures.

Several studies have been conducted on posed facial expressions using Facial Action Coding System (FACS)[1]. These studies however, did not distinguish between posed and deceived emotions. According to Ekman[2], posed emotion is defined as an expression of the facial configuration without felt emotional experience. However, in the case of deceived emotion the facial configuration provides two types of information: false but convincing emotional expression and concealed felt emotional expression. The present study aims at deciphering the structural composition of the face during felt and deceived emotions, using FACS. The study however does not aim at examining cross-cultural differences in these expressions. Therefore the study is conducted with Indian encoders of facial expressions only.

The sample consisted of normal, healthy, 20 female young adults in the age range 18 to 25 years. Their average educational age was 13 years and all of them were right-handed. Participants were chosen randomly for portraying their facial expression. Skin texture of participants was normal and without makeup. Participants were also asked to uncover their forehead to fully show their eyebrows. For photographs, participants with rough skin texture, eye glasses and anatomical facial asymmetry were not selected. Participants who were not naïve for the purpose of the experiment were not considered.

Informed written consent was obtained from each subject. The purpose of the research was explained to the participants and they were assured of confidentiality of their expressions. They were also given the right to withdraw from the study at any stage.

FACS coding manual has been used for facial action coding of the facial expressions of portrayers. FACS[3], as informed by the pioneering work of Hjortsjo[4], is a comprehensive tool[5] for coders to manually code all possible facial displays, which are decomposed into 30 action units (AUs) and 14 miscellaneous actions. The fundamental actions of individual muscles or groups of muscles

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that are characteristically observed while producing facial expressions of emotion are AUs.

Individuals were selected according to the inclusion and exclusion criteria. Written consent was obtained from the participants.

Inclusion criteria: Age range was 18–25 years (mean = 21.4, S.D. = 1.17) and average educational age was 13 years.

Exclusion criteria: (i) Those who are not naive to the experiment; (ii) those who are experts in voluntary movement of facial expressions (dancers, theater persons, mimicry performers, actors, etc.); (iii) those with rough skin texture, any mark on any part of face, facial hair (moustache, beard); (iv) those with very high degree of anatomical asymmetry; (v) those who have any physical illness or any complaints of eyesight problem and (vi) those who have any psychological illness.

In the first phase, 20 young adults were selected. Each subject was seated 4 ft away from a Nikon D3200 camera and was asked to face it frontally during emotion recollection. Video clips were shot in a diffuse light condition. There are various methods for eliciting emotions, for example: using of films, emotional stories, voluntary facial movements, imagery technique. In this experiment imagery technique was used to elicit emotion. The primary benefit of imagery technique is that one can draw on intense personally relevant situations. Participants were given instructions to imagine oneself in an emotional situation or to recall any personally significant emotional life event and portray their facial expression in their own way. After the video recording started, the experimenter left the room, so that the subject felt free to portray his/her felt emotion. After few minutes of recording, when the experimenter entered the room, the subject started to deceive her emotions deliberately. This strategy was used to capture the deceived expression. Later, the participants were debriefed. Social display rules are consciously used to conceal felt emotions for effective communication. This can be termed as deception. The expression which misleads a person by deliberate squelched expression, neutralizing or masking their true felt emotion can be defined as deceived expression. In this experiment participants were compelled to deceive their felt emotion by sudden presence of experimenter while recalling an emotional situation.

In case of neutral expressions, the subject was asked to give a static photograph without posing or feeling any emotion as far as possible.

Brightness and contrast of the pictures were held constant. Size of the stimulus was held constant at 6/6 inch. Inter session interval, lighting and head position were held constant during the video shoot. Noise was minimized as far as possible. The background of photos was kept white. In a two-day session (one day session: one emotion) emotional expressions were captured. The expressions were video taped. All videos were converted into 1000 frames of static images. The static image at the moment of intensified felt emotion and that of the very moment of deceived expression were taken for analysis. In the second phase, coding was done on the basis of FACS to decipher the parameters of felt emotion and deceived emotion.

The following analysis of AUs were adopted from FACS coding manual[3]. Table 1 shows the consistent AUs present in 75% of the participants in each of the emotion categories. Distinctive inter-subject variabilities are given in brackets. These AUs were observed in some, but not in all individuals. The percentages within the bracket represent the proportion of participants that use this AU while expressing these emotions during recollection of emotion and while deceiving emotion.

The study (Table 1) reveals that reliable AUs for felt smile are lip corner pullers, cheek raise, lips apart, deepened naso labial furrow. The smiling action itself intensified the zygomaticus major muscles (lip corner puller) which in turn raises the cheeks, gathers the skin below the eyes and produces crow's feet wrinkles[6]. This bagged skin below the eyes, is actually the activation of orbicularis oculi muscle.

In the case of expressing happiness, participants deceived by using deliberate squelched expression of lower face (lips pressure). The false smile did not accompany the involvement of the muscles around the eyes. Even other reliable measures of felt emotion become less intensified during deception.

In the case of negative emotion, the reliable AUs for felt sadness are brow lowering, lip corner down, wrinkles in chin boss and lips pressure. Another clue for felt emotion is reflection of the eyes due to tears. Though reflection of eye is not included in the FACS coding system, the eyes are thought to be the windows of the soul to reveal the inner most feelings. When compared to felt smile, felt sadness has many subtle AUs like infra orbital, cheek raise, deepened naso labial furrow.

Sadness is a negative sedimentary feeling; participants deceived by using masking (lip corner puller, lips stretcher) and de-intensification of reliable AUs.

Another important clue to detect deception is facial asymmetry or lateralization of deliberate actions. Earlier theories predicted the right hemispheric specialization for negative emotion and positive or approach emotions. From the composite photos (Figures 1 *a* and *b* and 2 *a* and *b*) it is observed that left hemi-facial composite shows more intensified emotion than the right counterpart, especially in the lower face, regardless of positive and negative emotion.

From Table 2 it can be interpreted that felt emotional expressions were defined by the presence of AUs which receive intensity rating of 'b' using Friesen and Ekman's[7] updated 5-point 'a' to 'e' intensity scale. Deceived emotional expressions were defined by the absence of certain reliable features (AUs) or neutralization and

Table 1. Consistency of action units among portrayers

Category	Felt Prototypical (and variant AUs)	Deception Prototypical (and variant AUs)
Happy	6B, 12B, 25B, 11B (2 (40%))	24B, 12A, 11A (12A 20%)
Sad	4B, 15B, 17A, 24B (11A (30%), 9A (20%))	6A, 17A, 24A (2A (10%), 20A (20%), 12A (10%))

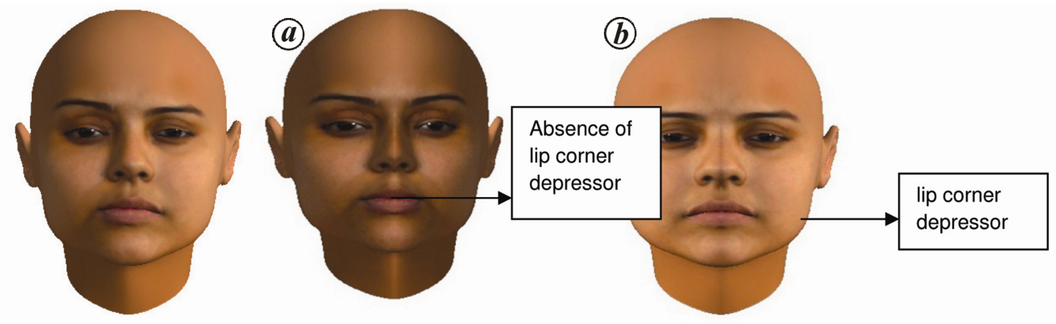

Figure 1. Facial asymmetry: deceived expression. ***a***, Right–right (sad); ***b***, Left–left (sad).

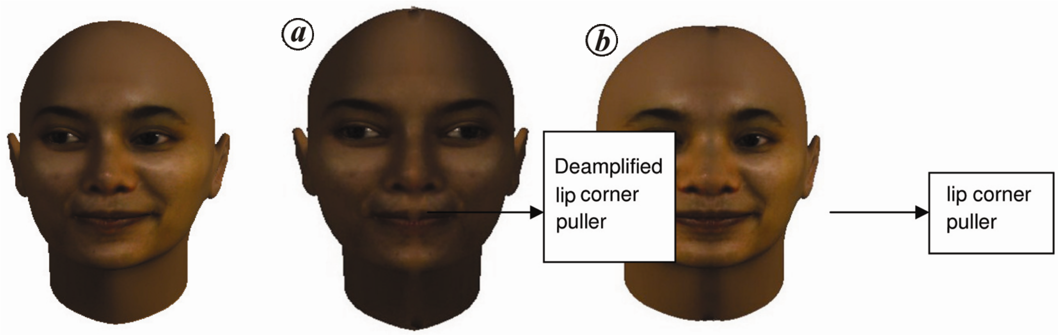

Figure 2. Facial asymmetry: deceived expression. ***a***, Right–right (happy); ***b***, Left–left (happy).

de-amplification of AUs. This was evident by an intensity rating of 'a' using Friesen and Ekman's updated 5-point 'a' to 'e' intensity scale.

In previous studies, reliability of FACS AUs was computed as the percentage of agreement between coders (i.e. (agree/(agree + disagree))[7]. Since this statistic only accounts for agreements due to chance[8,9], coefficient alpha is the preferred statistic. Statistical analysis of data was done to meet the objectives of the study.

Judgement was done by two coders on a 5 point rating scale: (i) AUs relevant for each specific emotion ('1' for minimum and '5' for maximum relevance); (ii) AUs intensity ('1' for weak intensity and '5' for strong intensity). Coefficient alpha was calculated for analysis of inter observer reliability.

Table 3 reveals that facial action coding done using FACS had decent inter-observer reliability for coded features. The same however does not hold true for AU intensity. In the case of felt happiness, inter-observer reliability for action unit intensity is less than the deceived one. In the case of felt sadness inter-observer reliability for AU intensity is greater than the deceived one.

In this study, participants were instructed in three ways. In the first situation, they were instructed for neutral expression ('a static photograph without posing or feeling any emotion'). In the second situation, they were instructed to recall by imagining previously experienced significant emotional events (e.g. 'think about the happiest day of your life'). During recollection of the emotion, no one was present in the experimental situation. In the third situation, deception could not be introduced with explicit instruction. So, deception was introduced by sudden presence of the experimenter during the recalling of an emotional situation. It was assumed to be a deliberate extraction of deceived expression.

Table 1 revealed differences among the facial muscle movements during the second and third situations, i.e. the emotionally aroused situation and the deceived situation. These findings could be due to the fact that the portrayers were alone in an emotionally aroused situation reproduced by imagery technique. As the portrayer could elicit private emotions more effectively, this may be considered to be closer to genuine emotion.

Felt spontaneous emotion is also an expression of display rules when it is internalized and becomes part of one's spontaneous emotional repertoire. In contrast to felt emotion, when social display rules are not automatized (habitual), withholding felt emotional expressions using these rules are deceived emotions. Squelching spontaneous expression and masking is not a habitual response. It requires more conscious effort to mislead someone. This fact has been substantiated by the result of the present study.

In deceiving positive emotion, the indices of deintensified lip corner pullers, naso labial furrow deepener, and absence of cheek raise, lips apart (Tables 1 and 2) revealed that participants used deamplification (Figure 3 *b*). This result indicates that in deception the activity levels of the muscles which are involved in felt smile, zygomaticus major and orbicularis occuli[10] are reduced consciously. However, the observation of lip pressure in the deception of positive emotion indicates the conscious effort to withhold felt emotion. The resulting output in deception in lower face may occur because neurobiological disposition of the lower face is more voluntarily controlled than the upper face[11]. As opposed to false smiles, felt smile involves contraction of a muscle near the eyes. Since zygomatic branch innervate the orbicularis oculi muscle[12] and zygomaticus major muscle, during deception conscious suppression of the activated zygomaticus major muscle may have some inhibitory effect on orbicularis oculi muscle.

In the case of negative emotion, the indices of lips pressure and absence of wrinkles in chin boss, brow lowering, lip corner depressor, naso labial furrow deepener (Tables 1 and 2) revealed that participants (70%) used deamplification (Figure 4 *a*). This result implies reduced activation of the muscles which are involved in felt sadness during deception. The observation of lip pressure in deception of negative emotion, like positive emotion, also shows the conscious effort to conceal felt emotion. According to Crosby and Dejonge[13] and Nelson[14], lower facial muscles are more controlled, because their motor neurons normally depend on significant cortical innervations.

Table 2. Agreed responses on AUs intensity

	Felt expression	Deceived expression
AUs (happy)		
Cheek raise AU6	B	–
Outer brow raise AU2	A	–
Naso labial furrow deepener AU11	B	A
Lip corner puller AU12	B	A
Lips apart AU25	B	–
Lips pressure AU24	–	B
AUs (sad)		
Outer brow raise AU2	–	A
Brow lowerer AU4	B	–
Infra orbital AU9	A	–
Naso labial furrow deepener AU11	A	–
Lip corner down AU15	B	–
Wrinkles in chin boss AU17	B	A
Lip stretcher AU20	–	A
Lips corner puller AU12	–	A
Lips pressure AU24	B	A

While deceiving negative emotion, 30% of the participants used masking (Figure 4 *b*) which was indexed by deintensified lip corner puller and lips stretcher to deceive felt sadness. This result implies conscious activation of the muscles, which are involved in deceived smile, i.e. less activation of zygomaticus major muscle[10] in deception. Ekman[2] claimed that from early childhood, everyone learns to control negative emotions by falsifying felt emotion. Participants attempted to falsify their sedimentary feeling by using masking, with a deamplified smile.

The reason to mask sadness with a deceived smile, may be to cover up sadness with a positive communicable response, which has social acceptance, and to many it is the most frequent emotional expression while encountering another person. People are accustomed to overlooking lies in the context of polite greetings[15].

In masking, one needs to suppress the felt emotion as well as reproduce a new emotion to cover it, which requires more conscious control over facial nerves. This conscious effort, another cue of deception, has been observed in facial asymmetry.

Darwin[16] suggested that true feelings may be revealed despite efforts to conceal emotions, which is termed by Ekman as 'leakage phenomenon'. This 'leakage phenomenon' has been substantiated by the present analysis of lateralization of facial expression. In the present study, the hemi-facial observation in some cases (3 out of 20 participants) implies that facial asymmetry could be an indicator of deception. Early studies also revealed that in contrast to the symmetrical expression in genuinely felt emotion, asymmetries are more likely to occur in the presence of an observer or when the subject knows that he or she is being evaluated[17,18].

From the composite photos (Figures 1 *a* and *b*; 2 *a* and *b*), it is observed that left hemi-facial composites show more intensified emotion than the right counterpart, especially in the lower face, regardless of positive and negative emotions. From Figure 1 *a*, it is seen that the lower right hemi face showed absence of lip corner depressor. In contrast, Figure 1 *b* reveals lower left hemi face showing lip corner depressor – a reliable indicator of felt sadness. In Figure 2 *a*, it is seen that the lower portion of the right hemi face showed deamplified lip corner puller. But, Figure 2 *b* reveals that the left hemi face showed lip corner puller which is a reliable indicator of felt smile. These results provide support for the right hemisphere

Table 3. Inter-observer reliability for emotion-specified expressions and for action unit intensity

Coded features	Inter-observer reliability (coefficient alpha) Felt	Deception	Action unit intensity	Inter-observer reliability Felt	Deception
Happy	0.85	0.80	Happy	0.65	0.75
Sad	0.87	0.90	Sad	0.71	0.67

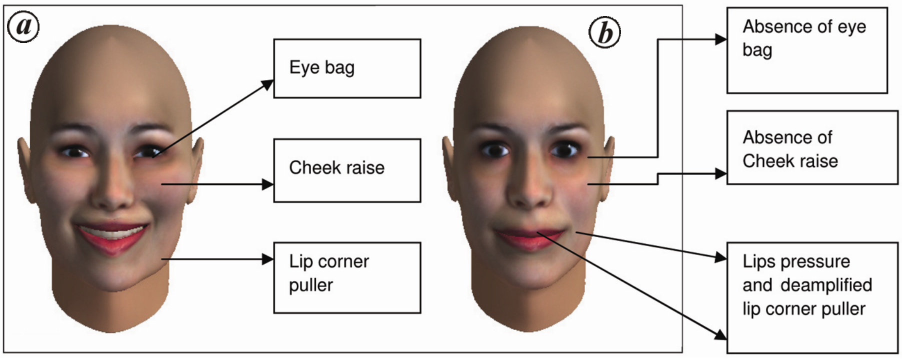

Figure 3. ***a***, Felt expression (happy). ***b***, Deceived expression (happy).

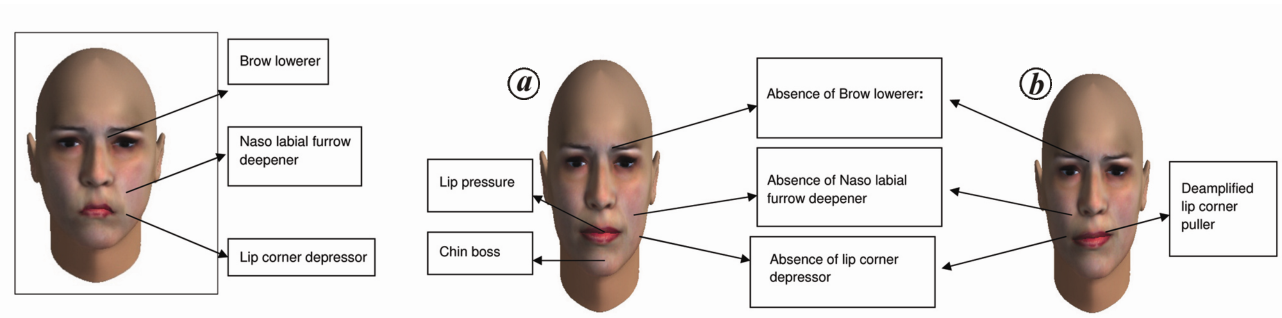

Figure 4. Felt expression (sad). Deceived expression (sad): ***a***, De-amplification; ***b***, masking.

specialization hypothesis in terms of leakage phenomenon of felt emotion at the lower left hemi face and also support left hemispheric inhibitory control mechanism over lower right hemi face.

Results from previous studies with composite photos more consistently support the right hemispheric specialization hypothesis, that is, right hemisphere is specialized for the production and perception of positive as well as negative emotions. In a review by Borod *et al.*[19], six of the seven studies found that the left hemi face shows greater emotional expressivity than the right hemi face[20,21].

In the case of felt emotion (Table 2), FACS coding revealed that the expression of happiness is much louder than sadness. It is because a smile serves multiple functions and is the simplest emotional expression in terms of signal characteristics. The felt sadness being expressed through more subtle features may be because people follow social display rules with minimal conscious effort as it becomes their deeply ingrained habit[2].

The present study was conducted on a small scale to study the cues to spontaneous deception during a socially inhibited context. This empirical finding is in line with the 'inhibition hypothesis', proposed by Paul Ekman based on Darwin[16]. The study thus substantiated the theoretical position, advocated by Ekman and other subsequent studies on facial expression. However, the uniqueness of the current study was utilizing this theoretical position on social deception. Though further research is required, this knowledge can be applied in future studies that are based on personnel selection in different professions. This study can assist counselors and professionals involved in individuals' learning or training experiences.

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Received 26 April 2016; revised accepted 13 October 2017

doi: 10.18520/cs/v114/i04/901-906

Soybean MAGIC population: a novel resource for genetics and plant breeding

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The acronym MAGIC that stands for 'multiparent advanced generation intercross' is a powerful next generation mapping population to precisely map the agronomically important quantitative trait loci. An eight parent based soybean MAGIC population was developed by employing 2-way, 4-way and 8-way intercross hybridization. The aim was to obtain MAGIC-derived breeding lines with higher yield, broader genetic base, increased diversity and variability. The 8-way and 4-way intercross hybrids so developed in the present study will be evaluated for their yield potential in the subsequent generation under changing climatic conditions (F_2–F_8 generation).

Keywords: High-throughput genotyping, quantitative trait, multiparent, 8-way hybrids.

THE demand placed currently on food production globally requires greater advances in genetic improvement in cereals and pulse crops. A crucial step towards enhancing the productivity of food crops entails rapid identification of gene(s) and their utilization in plant breeding to provide better control and delivery of agronomic traits. Traditional approach for identification of such genetic elements based on biparental mapping populations is found to have some drawbacks[1–3]. The major problems associated with biparental mapping populations are lower allelic diversity; inappropriate for fine mapping (of quantitative trait loci (QTLs)) due to low level recombination events; creation of narrow genetic base in the derived breeding lines which leads to susceptibility to biotic and abiotic stresses. Further, identifying genes that have smaller effects on quantitative traits is more difficult. Many QTL mapping studies have been conducted in different crops but few have pinpointed causal genes[3]. In order to address these problems, multiparent-based mapping populations have been created and extensively studied for various quantitative traits in *Arabidopsis thaliana*[4], wheat[5,6], rice[7] and are underway in a variety of other crops[8].

Worldwide, a number of studies are presently in progress to exploit the multiparent advanced generation intercross (MAGIC)-derived breeding lines. The evaluation of multi-genotype based varieties for yield and associated traits under multi-location test indicated superior performance of MAGIC-derived lines over biparental derived lines in rice[1]. In wheat, eight parent MAGIC

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