Indian Affective Picture Database

(IAPD)



Braj Bhushan

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Preface

The *Indian Affective Picture Database (IAPD)* has been developed to serve as a standardized resource for researchers, educators, and practitioners working in the fields of psychology, neuroscience, and behavioural sciences. Since 2019, IAPD has progressed into IAPD 2.0 and further diversified into IAPD Caricature (IAPD-C) and IAPD Exaggerated Caricature (IAPD-EC). Recognizing the importance of culturally relevant stimuli in affective research, the IAPD provides a carefully curated set of images, videos, and caricatures designed to evoke a wide range of emotional responses within the Indian socio-cultural context.

This manual offers guidance on the structure, methodology, and application of the database. It explains the processes of image selection, validation, and categorization across diverse affective dimensions, ensuring that users can employ the resource with confidence and consistency. By integrating rigorous scientific protocols with cultural sensitivity, the IAPD bridges a critical gap in emotion research, enabling studies that are both globally comparable and locally meaningful.

The database is intended to support a broad spectrum of research applications, from experimental psychology and cognitive neuroscience to clinical diagnostics and intervention, and human-computer interaction. It also provides opportunities for interdisciplinary exploration, allowing scholars to investigate how emotions influence cognition, behaviour, and social interaction in varied contexts.

I hope this manual will serve as a practical guide for effective use of the IAPD. The creation of this resource reflects a commitment to advancing affective science in India and contributing to the global research community.

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Introduction

Emotion science explores how humans experience, express, and regulate emotions, often using facial expressions as a key indicator. Researchers rely on facial expression databases to study emotional recognition, affective computing, and psychological responses.

Having an Indian database of facial expressions of emotions is crucial for both scientific and cultural reasons. Emotions are universal, yet their facial manifestations vary across cultures due to differences in social norms, expressive styles, and contextual interpretations. A database built from Indian faces ensures that psychological, neuroscientific, and AI research accurately reflects the emotional nuances of India's diverse population. It will help avoid biases that may arise with Western datasets. Moreover, such a resource strengthens India's contribution to global affective science, enabling culturally grounded studies in cross-cultural emotion research, affective computing, and psychological assessment.

The Indian Affective Picture Database (IAPD: Sharma & Bhushan, 2019) and IAPD-2.0 (Bhushan, 2023) are multimodal resource designed to advance emotion research. In addition, Indian Affective Picture Database- Caricature (IAPD- C) includes cartoon versions of the facial expressions, as well as Indian Affective Picture Database- Exaggerated Caricature (IAPD- EC), exaggerated cartoon expressions derived using mathematical modelling based on the hurst coefficient and fractal dimensions. A distinctive feature of IAPD-2.0 is the inclusion of 3-D printed cartoon expressions, making the stimuli available in both digital and product formats. By integrating static, dynamic, stylized, exaggerated, and tangible representations of affective stimuli, IAPD-2.0 provides a comprehensive platform for psychological, neuroscientific, and computational studies of emotion.

References

Bhushan, B. (2023). Exploring fractal dimension as a technique to study facial expressions of emotions". Unpublished project report SERB/HSS/2019488, Indian Institute of Technology Kanpur.

Pandey, R. & Bhushan, B. (2026a). Validation of the Indian Affective Picture Database 2.0. DOI: https://doi.org/10.17605/OSF.IO/X4CSD

Sharma, U. & Bhushan, B. (2019). Development and validation of Indian Affective Picture Database. *International Journal of Psychology, 54: 4*, 462-467. DOI: https://doi.org/10.1002/ijop.12471

Indian Affective Picture Database (IAPD)

The Indian Affective Picture Database (Sharma & Bhushan, 2019) comprise of 140 coloured facial expressions depicting six basic emotions— happiness, sadness, anger, fear, disgust, and surprise along with a neutral expression. The expressions were posed by four expressers, two males and two females and captured from five different angles: -90 (full left profile), -45 (half left profile), 0 (straight), +45 (half right profile), and +90 (full right profile) degrees keeping the background uniform.

Stimulus Development

Four amateur actors (two males and two females; $M = 25.25$ years, $SD = 3.77$) posed the expressions. To ensure authenticity, they were shown reference images of artists displaying relevant emotions and instructed to imagine and recreate those emotional states vividly. Each expression was captured from five angles (−90°, −45°, 0°, +45°, +90°) against a uniform background, following the procedure of Lundqvist et al. (1998). Post-processing was done in Adobe Photoshop 16, producing images sized 562 × 762 pixels.

Validation Procedure

The stimuli were validated with 350 undergraduate participants, who labelled each emotion and rated its intensity.

- **Mean biased hit rate:** 93.02 ($SD = 7.33$)
- **Mean unbiased hit rate:** 0.519 ($SD = 0.015$)
- **Mean intensity rating:** 5.94 ($SD = 0.77$)

Results Summary

Emotion	Mean Hit Rate (%)	Mean Intensity (1–9 scale)
Neutral	77.14	4.42
Happy	99.91	6.95
Sad	94.18	6.00
Anger	96.21	6.07
Fear	92.91	6.16
Disgust	95.66	6.17
Surprise	95.15	6.22

Using within-subjects ANOVA, the authors have reported significant main effect of emotion ($F(1, 6) = 7.598, p < .001$), and a t-test ($t = 23.116, p < .001$) confirming that the participants identified emotions correctly beyond chance. Gender comparisons showed no significant differences in recognition accuracy or unbiased hit rates between male and female expressers.

Conclusion

The IAPD provides a valid and reliable set of affective stimuli for emotion recognition research in Indian populations. Its inclusion of multiple viewing angles and culturally relevant expressions enhances ecological validity and supports diverse applications in psychology, neuroscience, and cross-cultural emotion studies.

Reference

Sharma, U. & Bhushan, B. (2019). Development and validation of Indian Affective Picture Database. *International Journal of Psychology, 54: 4*, 462-467. DOI: https://doi.org/10.1002/ijop.12471

Indian Affective Picture Database (IAPD)- 2.0

The Indian Affective Picture Database 2.0 (IAPD- 2.0; Bhushan, 2023), comprise of 399 grayscale and coloured images of 19 amateur actors (7 males, 12 females) that feature full-face presentations with clear details such as beards, collars, and earrings. Facial expressions in the database represent six basic emotions, happiness, sadness, fear, anger, surprise, and disgust, along with neutral expressions. Each actor's expressions have been captured from three distinct camera angles: 0° (frontal profile), -45° (half-left profile), and +45° (half-right profile).

Stimulus Development

Stimulus development involved 19 amateur actors (7 males, 12 females) with a mean age of 21.1 years (SD = 2.58). Male expressers had a mean age of 22.14 years (SD = 2.41), while female expressers averaged 20.5 years (SD = 2.58). In order to ensure methodological rigor and cultural validity, participants were presented with reference images of professional artists enacting specific emotions. They were then instructed to vividly imagine and internalize those affective states before reproducing them in their own expressions. This approach enhances the authenticity of the dataset by grounding each portrayal in both visual exemplars and experiential engagement, thereby minimizing superficial mimicry and promoting genuine emotional representation. The database captures facial expressions corresponding to six basic emotions— happy, sad, fear, anger, surprise, and disgust along with neutral expressions. Each expression was recorded from three camera angles— frontal (0°), half-left (-45°), and half-right (+45°). The collection includes candid, achromatic, and chromatic photographs and videos, presenting full-face views with detailed features such as facial hair, collars, and earrings. Of the seven male actors, five had facial hair and two were clean-shaven.

IAPD- 2.0 is a multimodal emotion database developed in India that includes photographs and videos (Bhushan, 2023) as well as cartoons and exaggerated cartoons (Pandey & Bhushan, 2026b). It is also available in 3-D printed models. Figure 1 illustrates sample chromatic and achromatic facial expression (static) from IAPD- 2.0.



Happy (-45 degree) **Happy (0 degree)** **Happy (+45 degree)**

Figure 1. Sample chromatic and achromatic facial expression (static) from IAPD- 2.0.

Validation

Pandey and Bhushan (2026a) validated IAPD- 2.0 with 369 participants (155 females and 214 males), who labelled each emotion and rated its intensity.

Results Summary for IAPD 2.0

Emotion	Mean Hit Rate (%)	Mean Intensity (1–5 scale)
Neutral	68.20%	3.15
Happy	94.46%	3.23
Sad	48.83%	3.06
Anger	50.75%	3.11
Fear	25.84%	3.05
Disgust	52.77%	3.23
Surprise	55.88%	3.32



Figure 2. Confusion matrix of emotion recognition accuracy.

Note: Values represent the percentage of responses. The diagonal elements represent the percentage of correct identifications (hit rates) for each target emotion. Off-diagonal elements represent the percentage of trials where a target emotion was systematically misclassified as another emotion.

Pandey and Bhushan (2026a) further determined the percentage accuracy for each image expressing emotions. Figures 3 and 4 illustrates image-wise recognition accuracy and mean intensity ratings across the IAPD- 2.0 database.

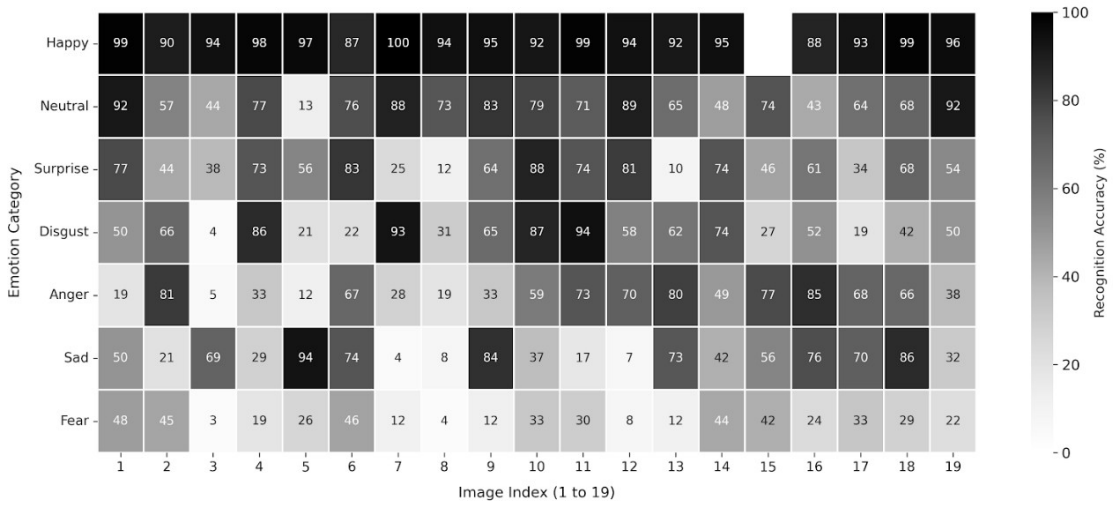


Figure 3. Image-wise recognition accuracy across the IAPD-2.0 database.

Note. Values represent the percentage of correct identifications for each specific image stimulus (Columns 1–19) across the seven emotion categories.

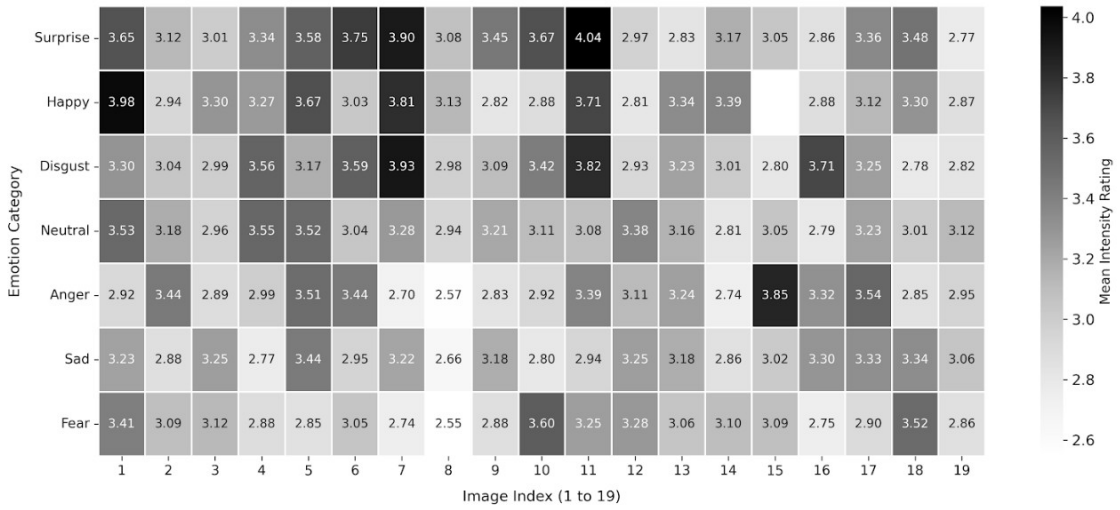


Figure 4. Image-wise mean intensity ratings across the IAPD- 2.0 database.

Note: Values represent the mean perceived intensity of the emotional expression for each individual image stimulus (Columns 1–19) across the seven emotion categories. Darker shading indicates a higher perceived emotional intensity.

Conclusion

The novelty of IAPD- 2.0 is combination of static and dynamic facial expressions, stylized versions of facial expressions (cartoon expressions), mathematically enhanced exaggerated cartoons using hurst coefficient and fractal dimensions and 3-D printed models of cartoon expressions. It matters because it bridges digital and physical formats and enables cross-disciplinary research in psychology, neuroscience, AI, and design by providing novel exaggerated stimuli for studying perception and recognition of emotions.

Details of IAPD- 2.0 static-dynamic and chromatic-achromatic facial expression are as follows—

Total number of images: 1596

Emotions: Anger, Disgust, Fear, Happy, Neutral, Sad, Surprise

Expressors: 19 (7 Male & 12 Female)

Table 1. Summary of format wise viewing angle specific facial expressions of emotions in chromatic/achromatic types.

Format	Type	Angle	Facial Expressions of Emotions						
			Anger	Disgust	Fear	Happy	Neutral	Sad	Surprise
Static	Chromatic	0 degree	19	19	19	19	19	19	19
		+ 45	19	19	19	19	19	19	19
		- 45	19	19	19	19	19	19	19
	Achromatic	0 degree	19	19	19	19	19	19	19
		+ 45	19	19	19	19	19	19	19
		- 45	19	19	19	19	19	19	19
Total number of expressions			114	114	114	114	114	114	114
Dynamic	Chromatic	0 degree	19	19	19	19	19	19	19
		+ 45	19	19	19	19	19	19	19
		- 45	19	19	19	19	19	19	19
	Achromatic	0 degree	19	19	19	19	19	19	19
		+ 45	19	19	19	19	19	19	19
		- 45	19	19	19	19	19	19	19
Total number of expressions			114	114	114	114	114	114	114
Grand total number of expressions			228	228	228	228	228	228	228

Figure 5 illustrates the front view (0 degree) of chromatic and achromatic static happy expressions.

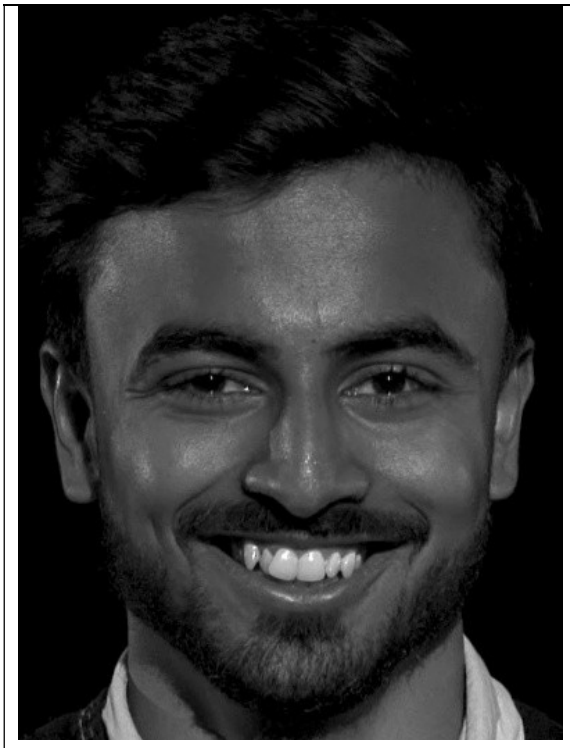
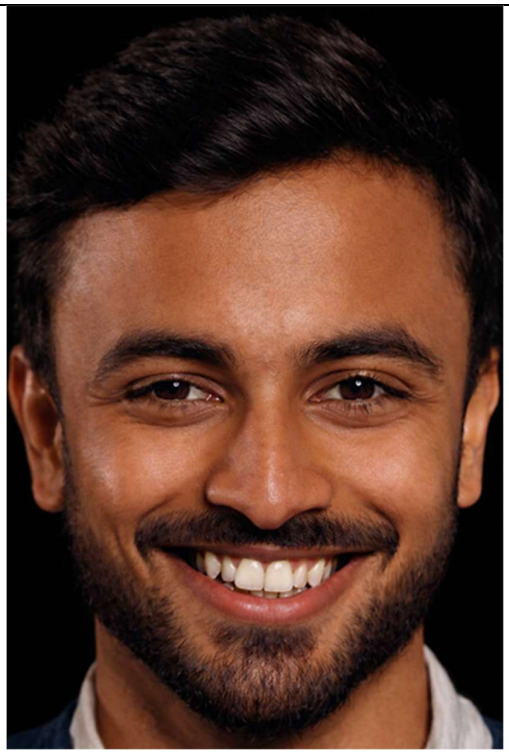
	
Happy (chromatic)	**Happy (achromatic)**

Figure 5. Front view (0 degree) of chromatic and achromatic static happy expressions.

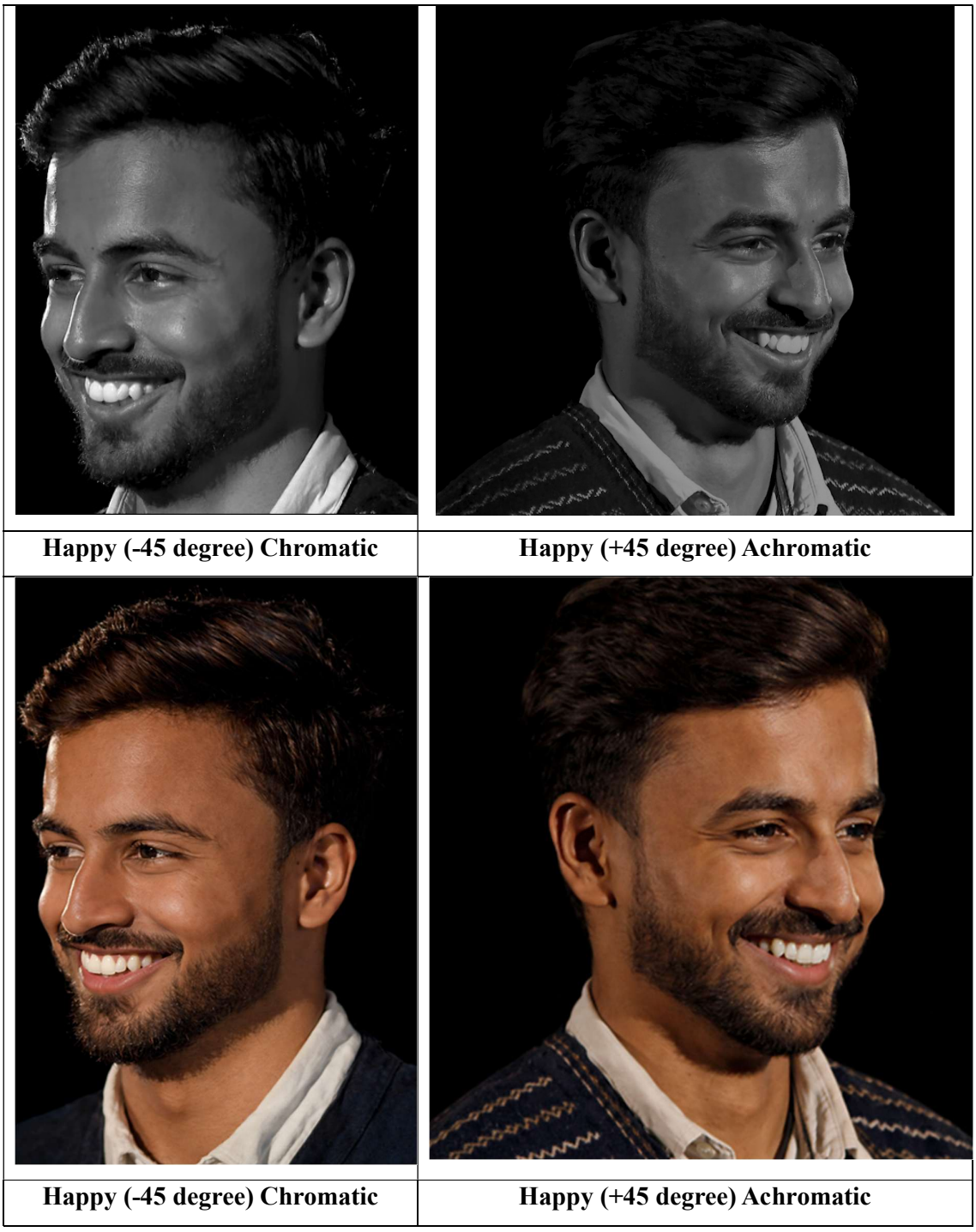


Figure 6. ± 45 degrees of chromatic and achromatic static happy expressions.

Reference

Bhushan, B. (2023). Exploring fractal dimension as a technique to study facial expressions of emotions". Unpublished project report SERB/HSS/2019488, Indian Institute of Technology Kanpur.

Pandey, R. & Bhushan, B. (2026a). Validation of the Indian Affective Picture Database 2.0. DOI: https://doi.org/10.17605/OSF.IO/X4CSD

IAPD- 2.0 (CARICATURE)

Details of IAPD 2.0 caricatures are given below—

Emotions: Anger, Disgust, Fear, Happy, Neutral, Sad, Surprise

Expressors: 19 (7 Males & 12 Females)

Total Caricatures = 132

Total Exaggerated Caricatures = 132

Grand total= 264

Figure 7 illustrates both the caricature and the exaggerated caricature representation of a happy facial expression.

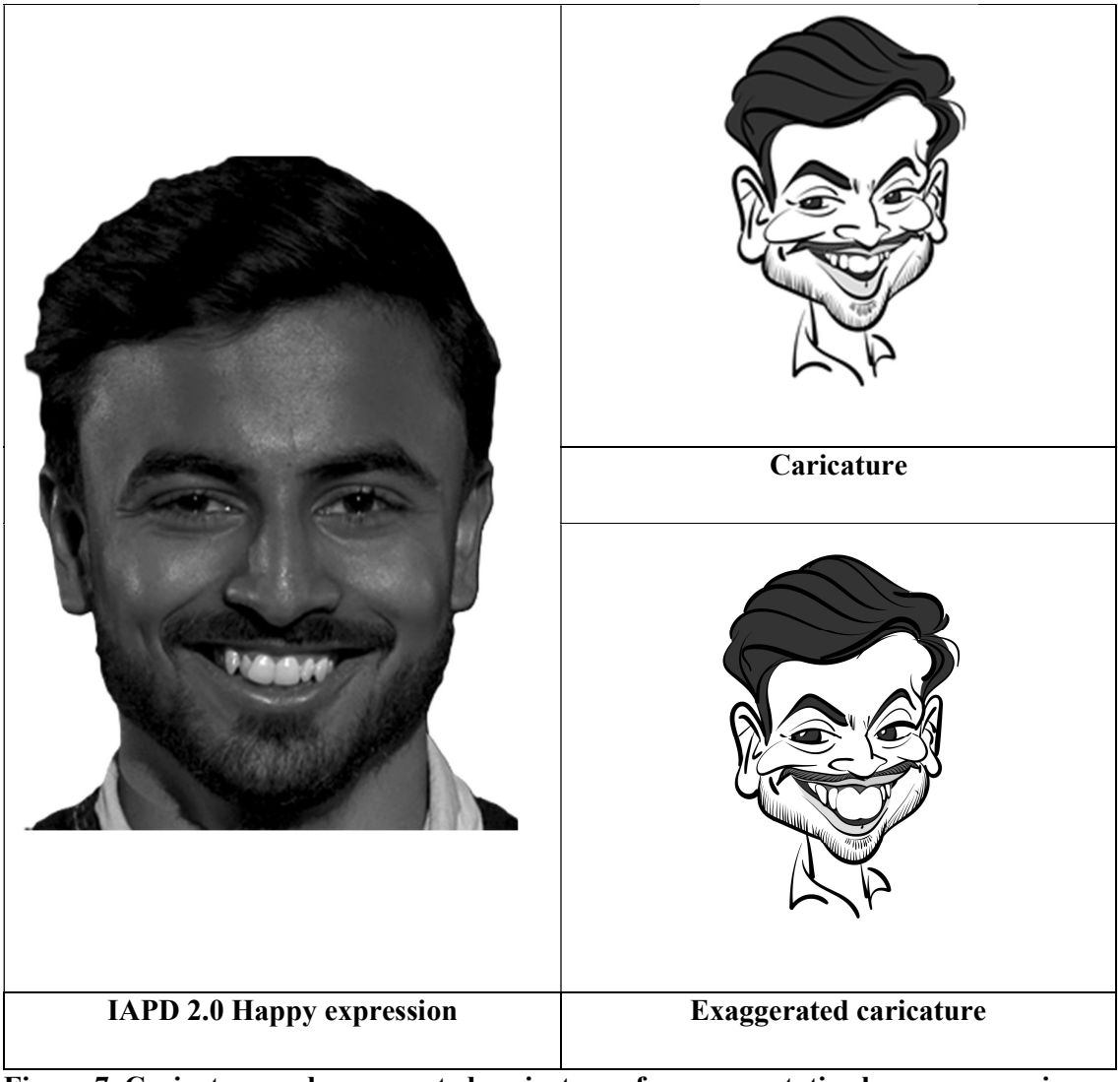


Figure 7. Caricature and exaggerated caricature of a representative happy expression.

Table 2. Summary of caricatures and exaggerated caricatures of facial expressions of emotions (static format) for 0 degree (frontal view).

Format	Type	Angle	Facial Expressions of Emotions						
			Anger	Disgust	Fear	Happy	Neutral	Sad	Surprise
Caricature	Achromatic	0 degree	19	19	19	18	19	19	19
Exaggerated Caricature		0 degree	19	19	19	18	19	19	19
Total number of expressions			38	38	38	36	38	38	38

Validation

Pandey and Bhushan (2026b) validated IAPD- 2.0 caricature and exaggerated caricature databases with 312 participants (134 females and 178 males), who labelled each emotion and rated its intensity.

Results Summary for Caricatures

Emotion	Mean Hit Rate (%)	Mean Intensity (1–5 scale)
Neutral	67%	3.12
Happy	91%	3.32
Sad	72%	3.12
Anger	70%	3.23
Fear	37%	3.18
Disgust	41%	3.11
Surprise	60%	3.47

Figure 8 shows the confusion matrix of the mean accuracy for different emotions on caricatures.

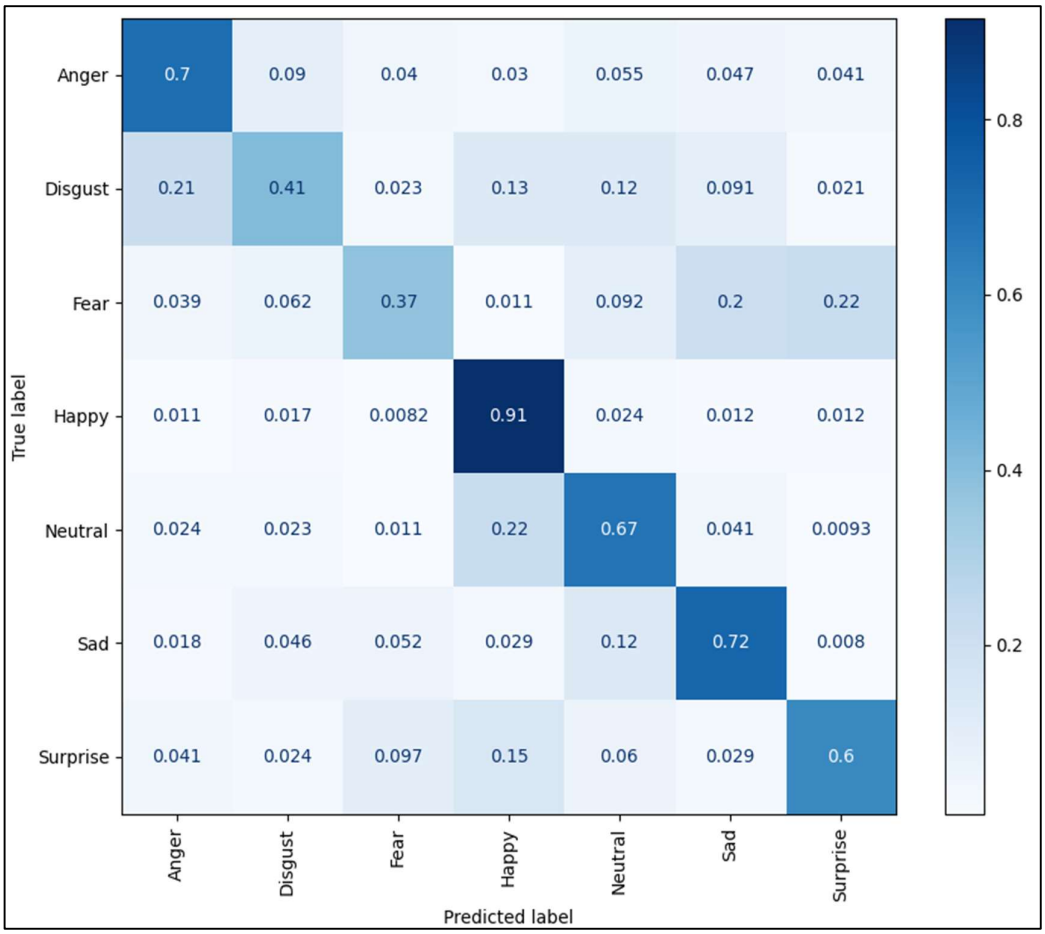


Figure 8. The confusion matrix of the mean accuracy for different emotions on caricatures.

Pandey and Bhushan (2026b) have also validated the exaggerated caricature database on 268 participants (114 females, 154 males) who labelled each emotion and rated its intensity.

Results Summary for Exaggerated Caricature

Emotion	Mean Hit Rate (%)	Mean Intensity (1–5 scale)
Happy	94%	3.49
Sad	82%	3.24
Anger	66%	3.12
Fear	45%	3.29
Disgust	44%	3.005
Surprise	61%	3.63

Figure 9 shows the confusion matrix of the mean accuracy for different emotions on exaggerated caricatures.

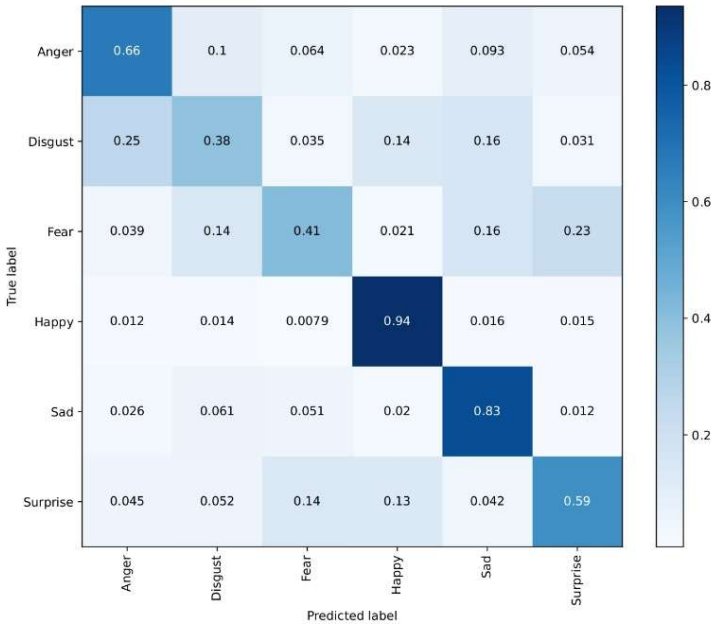


Figure 9. The confusion matrix of the mean accuracy for different emotions on exaggerated caricatures.

IAPD- 2.0 (3D-Cards)

It consists of a collection of 70 three-dimensional cards featuring IAPD-2.0 caricatures of facial expressions, designed in two distinct styles— 35 exaggerated and 35 non-exaggerated. Each card is produced on a square plate measuring 140 × 140 mm with a uniform thickness of 4 mm, ensuring consistency and durability across the set. The exaggerated versions emphasize stylized, overdrawn features for expressive impact, while the non-exaggerated versions maintain natural proportions for a more realistic representation. Together, the collection provides a balanced study set of caricatured facial expressions in both exaggerated and non-exaggerated forms.

Figure 10 illustrates 3-D card showing non-exaggerated expression of happiness.



Figure 10. 3-D card showing non-exaggerated expression of happiness.

Table 3a. Summary of IAPD- 2.0 caricatures and exaggerated caricatures of facial expressions of emotions (static format) for 0 degree (frontal view).

Type	Anger		Disgust		Fear		Happy		Neutral		Sad		Surprise		Total Number
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
Caricature	2	3	1	4	2	3	3	2	2	3	1	4	2	3	
Total	5		5		5		5		5		5		5		35
Exaggerated caricature	2	3	1	4	2	3	3	2	2	3	1	4	2	3	
Total	5		5		5		5		5		5		5		35
														Grand Total	70

Table 3b. Summary of items (Images/Videos/Caricatures/Exaggerated Caricatures)—

IAPD- 2.0 Facial Expressions	No. of Images/Videos	Sum
Static Images Front View (Chromatic)	133	399
Static Images -45 degree View (Chromatic)	133	
Static Images +45 degree View (Chromatic)	133	
Static Images Front View (Achromatic)	133	399
Static Images -45 degree View (Achromatic)	133	
Static Images +45 degree View (Achromatic)	133	

Dynamic Images Front View (Chromatic)	133	399
Dynamic Images -45 degree View (Chromatic)	133	
Dynamic Images +45 degree View (Chromatic)	133	
Dynamic Images Front View (Achromatic)	133	399
Dynamic Images -45 degree View (Achromatic)	133	
Dynamic Images +45 degree View (Achromatic)	133	
Images (Caricature)	132	132
Images (Exaggerated Caricature)	132	132
3-D cards of caricatures	35	35
3-D cards of caricatures with exaggeration	35	35

IAPD- 2.0 is typically aimed at users who need to recognize, interpret, and respond to facial expressions and emotional cues with high accuracy. It can be used to train users from law enforcement agencies, psychological operations teams, psychologists, special educators, cognitive scientists, emotion researchers, and others. It also has relevance to AI/ML teams training computer-vision models.

It is a collection of static-dynamic images of facial expressions of emotions. The user is free to use static, dynamic, caricature, exaggerated caricature, or dynamic expressions of emotions according to their need. Users are recommended to visit Facial Affect Classification and Evaluation Training (FaceTrain), a module developed using IAPD- 2.0.

Facial Action Unit Analysis of the Indian Affective Picture Database- 2.0 (IAPD- 2.0)

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Emotion research is both exhilarating and intricate, particularly when decoding and quantifying the intensity of facial expressions. While facial cues offer a visible window into emotional states, the overall emotion research involves multimodal complexity. Integrating these diverse modalities into a coherent system is a challenge. Subjectivity and cultural variability further add to this challenge. Ambiguity in emotional states is yet another dimension as emotions rarely occurs in isolation. Mixed emotions or transitions between states of emotions are hard to label and detect accurately.

Behavioural studies have mapped strength of an emotion by measuring arousal either through subjective rating or using physiological signals such as skin conductance or heart rate variability. While subjective ratings allow researchers to capture nuanced differences across participants, Action Units (AUs) provide a muscle-level description of facial expressions, bypassing subjective interpretation. For instance, AU12 (smile), AU6 (cheek raiser) indicate positive valence while AU4 (brow lowerer), AU15 (lip corner depressor) indicate negative valence. Similarly, AU5 (upper lid raiser), AU20 (lip stretcher) indicate high arousal, while minimal AU activation indicates low arousal. It is amply clear that certain AU combinations correlate with emotional dimensions. While the two-dimensional model (valence and arousal) has its own merit, it oversimplifies complex emotional experiences. Some emotions, such as awe, don't fit neatly into this grid.

Action Units (AUs) are a powerful tool in tackling the challenges of emotion recognition and intensity mapping. The Facial Action Coding System (FACS: Ekman & Wallace, 1978) analyzes facial expressions by breaking them down into Action Units (AUs) wherein each AU corresponds to a specific facial muscle or group of muscles. They can occur individually or in combination to express specific emotions. Each AU represents a specific facial muscle movement and combinations of AUs form recognizable emotional expressions like happiness, sadness, or anger. Researchers have argued that AUs are culture-independent. Besides helping distinguish one emotion from the other, it helps distinguish between mild and strong emotions. AU Intensity is typically rated on a 5-point scale (A–E or 1–5), from trace to

maximum intensity and reflects how strongly a muscle is activated. For example, a subtle smile might show AU12 at level 2 whereas a broad grin could show AU12 at level 5.

Studies examining cross-cultural differences in AUs have used a variety of rigorous methodologies to ensure valid and meaningful comparisons across cultures. Working on Facial Action Coding System (FACS) manual coding, Matsumoto et al. (2008) and Jack et al. (2012) made trained coders manually annotate facial expressions using the FACS system. While high accuracy and interpretability were the strengths of this method, it was time-consuming and subject to coder bias. OpenFace, FaceReader, and iMotions are the prominent automated AU detection tools used recently (Cao et al., 2022; Lewinski et al., 2014; Song et al., 2024; Zadeh et al., 2018). Although it is scalable and fast and thus useful for large datasets, it may show bias across ethnicities due to training data skew.

Jack et al. (2012) and Russell (1994) compared AU frequency, intensity, and co-occurrence across cultural groups. Such studies use matched samples from different cultures and thus ensuring equivalence in stimuli and interpretation becomes challenging. Cao et al. (2022) trained models to generalize across identities and cultures by learning shared representations in order to reduce identity-based bias in AU detection. Matsumoto and van de Vijver (2021) analyzed individual-level AU data nested within cultural groups, thus accountings for both Expresser and cultural variance.

The universality hypothesis of emotional facial expressions has been challenged by cultural constructionist theories, which argue that expressions are shaped by social norms and display rules learned within cultures (Ekman & Friesen, 1975; Matsumoto & Hwang, 2013). Research shows an in-group advantage in emotion recognition, with people better identifying expressions from their own cultural group (Elfenbein & Ambady, 2002). Cultural “non-verbal accents” also influence how emotions like happiness are expressed—such as preferences for open- or closed-mouth smiles (Elfenbein et al., 2002; Bjornsdottir & Rule, 2021). Studies by Mandal et al. (2001) reveal culture-specific patterns in hemifacial asymmetry and emotion valence, with Japanese, Indian, and North American participants showing distinct biases. Further findings suggest that ethnic facial features may influence emotion distinctiveness more than culture alone, especially for negative emotions, highlighting the complex interplay between observer, expresser, and emotional valence (Mandal et al., 2005)

Driven by growing interest in affective science, India has seen a notable surge in the development of facial expression databases. The Indian Affective Picture Database (IAPD:

Sharma & Bhushan, 2019) is a culturally tailored resource developed create a validated set of facial emotion stimuli suitable for Indian populations, addressing cultural differences in emotion recognition. It comprises of 140 colour photographs depicting six basic emotions (happiness, sadness, anger, fear, surprise, disgust) and a neutral expression of 4 expressers (2 male, 2 female) with an average age of ~25 years. These expressions have been captured from five different angles with a uniform background. Validated by 350 undergraduate participants, who labelled emotions and rated intensity, it has hit rate of 93.02%, unbiased hit rate of 0.519 and mean intensity rating of 5.94 on a 7-point scale. In recent years, this database has attracted several researchers (Nara et al., 2024; Pordoy et al., 2024; Verma et al., 2023; Fabricio et al., 2022). Using IAPD, some researchers have studied the temporal dynamics involved in processing happy and sad emotions vis-à-vis visual angle using MEG (Nara et al., 2024).

Moving a step towards granular facial analysis, Bhushan and Munshi (2021) explored the geometric properties of facial expressions in relation to expression intensity and viewing angle marking a significant first in the Indian research landscape. Their methodology involved analyzing three distinct facial regions, computing pixel-level differences, and calculating fractal dimensions across all basic emotions. This approach not only quantified the spatial complexity of expressions but also highlighted how viewing angle modulates perceived emotional intensity. Subsequently, the Indian Affective Picture Database– 2.0 (IAPD- 2.0: Bhushan, 2023) has been introduced. It comprises of 399 grayscale and coloured photographs as well as dynamic videos portraying a range of facial expressions, captured from 19 amateur actors (7 male, 12 female), offering a culturally contextualized stimulus set for emotion research. Fractal dimension and Hurst coefficient-based analysis of IAPD- 2.0 has also been reported (Bhushan & Munshi, 2025). These findings contribute to a growing body of work that seeks to move beyond Western-centric datasets and models, offering insights into the nuanced ways facial geometry encodes emotion in diverse populations. However, none of the studies have performed AU analysis of IAPD.

The granular facial analysis of IAPD- 2.0 by breaking down expressions into muscle-level components (AUs) is likely to yield precise identification of subtle emotional cues, especially useful in distinguishing similar emotions like surprise vs. fear. While emotional interpretation varies culturally, the underlying muscle movements (AUs) are more universal making AUs a robust foundation for emotion recognition across diverse populations. Thus, this will add to the cross-cultural consistency of IAPD- 2.0.

The primary objective of this study was to analyze AUs from the IAPD- 2.0, exploring individual differences in baseline arousal, and classifying primary, secondary, and tertiary AUs for basic emotions. While certain AUs are reliably associated with specific emotions, secondary and tertiary AUs may reveal culturally nuanced or intensity-modulated variations. Further, posers with higher baseline arousal may exhibit more pronounced or complex AU patterns, reflecting heightened emotional reactivity or expressiveness. Primary AUs are typically the most salient markers of emotion, but secondary and tertiary AUs may encode cultural expressivity, inter-expresser nuance, or regulation strategies. Accordingly, it was hypothesized that—

(i) Primary, secondary, and tertiary AUs will show distinct and consistent patterns across basic emotions as captured in the IAPD-2.0.

(ii) Individual differences in baseline arousal levels will significantly modulate the intensity and configuration of AU activation across emotional expressions.

(iii) Primary AUs will contribute most strongly to perceived emotional intensity, while secondary and tertiary AUs will modulate subtle variations and contextual cues.

(iv) Differences in expressivity will manifest through culturally specific emotional blends and gender-based variations.

Method

Indian Affective Picture Database- 2.0 (IAPD- 2.0)

The Indian Affective Picture Database – 2.0 (IAPD- 2.0; Bhushan, 2023) consists of 399 grayscale and coloured images depicting facial expressions from 19 amateur actors (7 males, 12 females), with a mean age of 21.1 years (SD = 2.58). Male expressers had an average age of 22.14 years (SD = 2.41), while female expressers averaged 20.5 years (SD = 2.58). The database includes portrayals of six basic emotions— happiness, sadness, fear, anger, surprise, and disgust, alongside neutral expressions. Each actor was photographed from three distinct angles: 0° (frontal view), -45° (half-left profile), and +45° (half-right profile). The images are candid, achromatic, and feature full-face presentations with visible details such as facial hair, clothing elements (e.g., collars), and accessories (e.g., earrings). Among the seven male

expressers, five had facial hair and two were clean-shaven. It is available in static (photographs) as well as dynamic (video) versions.

Action Unit (AU) extraction

Facial expressions unfold in four temporal phases– neutral, onset, apex, and offset. No visible muscle movement is evident in the neutral phase. In the onset phase, muscles begin to contract and AU intensity rises. This is followed by apex phase characterized by peak intensity and thereby expression is most visible. Finally, muscles relax and AU intensity decreases in the offset phase. Facial Action Units (AUs) of the dynamic version of IAPD-R were extracted using OpenFace 2.0, an open-source toolkit. It provided AU presence and intensity (continuous scale from 0–5). The AUs were categorized into Primary AUs (core indicators of specific emotions), Secondary AUs (modulators of intensity or valence), and Tertiary AUs (subtle expressions).

Results

The primary, secondary, and tertiary action units (AU) associated with the facial expressions were temporally segmented into four groups— neutral (baseline reflecting no emotion), onset (AU starts activating), apex (strongest AU activation), and offset (AU deactivate and return to neutral). While primary AUs are most diagnostic of a given emotion, secondary AUs play a supportive role and tertiary AUs are less frequent and are contextually activated. Table 4 summarizes the emotion specific primary, secondary, and tertiary AUs as suggested by Ekman (1975).

Table 4. Summary of primary, secondary, and tertiary Action Units (AUs) for primary emotions.

Emotions	Primary AUs		Secondary AUs		Tertiary AUs	
	AU	Expression role	AU	Expression role	AU	Expression role
Happy	AU6	cheek raiser	AU25	lips part	AU7	lid tightener
	AU12	lip corner puller	AU26	jaw drop		

Sad	AU1	inner brow raiser	AU17	chin raiser	AU2	outer brow raiser
	AU4	brow lowerer	AU23	lip tightener		
	AU15	lip corner depressor				
Fear	AU1+2	brow raisers	AU25	lips part	AU7	lid tightener
	AU4	brow lowerer	AU26	jaw drop	AU27	mouth stretch
	AU5	upper lid raiser				
	AU20	lip stretcher				
Anger	AU4	brow lowerer	AU24	lip pressor	AU10	upper lip raiser
	AU5	upper lid raiser	AU17	chin raiser		
	AU7	lid tightener				
	AU23	lip tightener				
Surprise	AU1+2	brow raisers	AU27	mouth stretch	AU25	lips part
	AU5	upper lid raiser				
	AU26	jaw drop				
Disgust	AU9	nose wrinkler	AU17	chin raiser	AU4	brow lowerer
	AU10	upper lip raiser	AU15	lip corner depressor		

The AU dynamics of the respective basic emotions were analyzed to understand their phase-specific trajectories, co-activation patterns, and general trend across expressers. Figure 11 illustrates activation of primary, secondary, and tertiary AUs for happy expression, respectively.

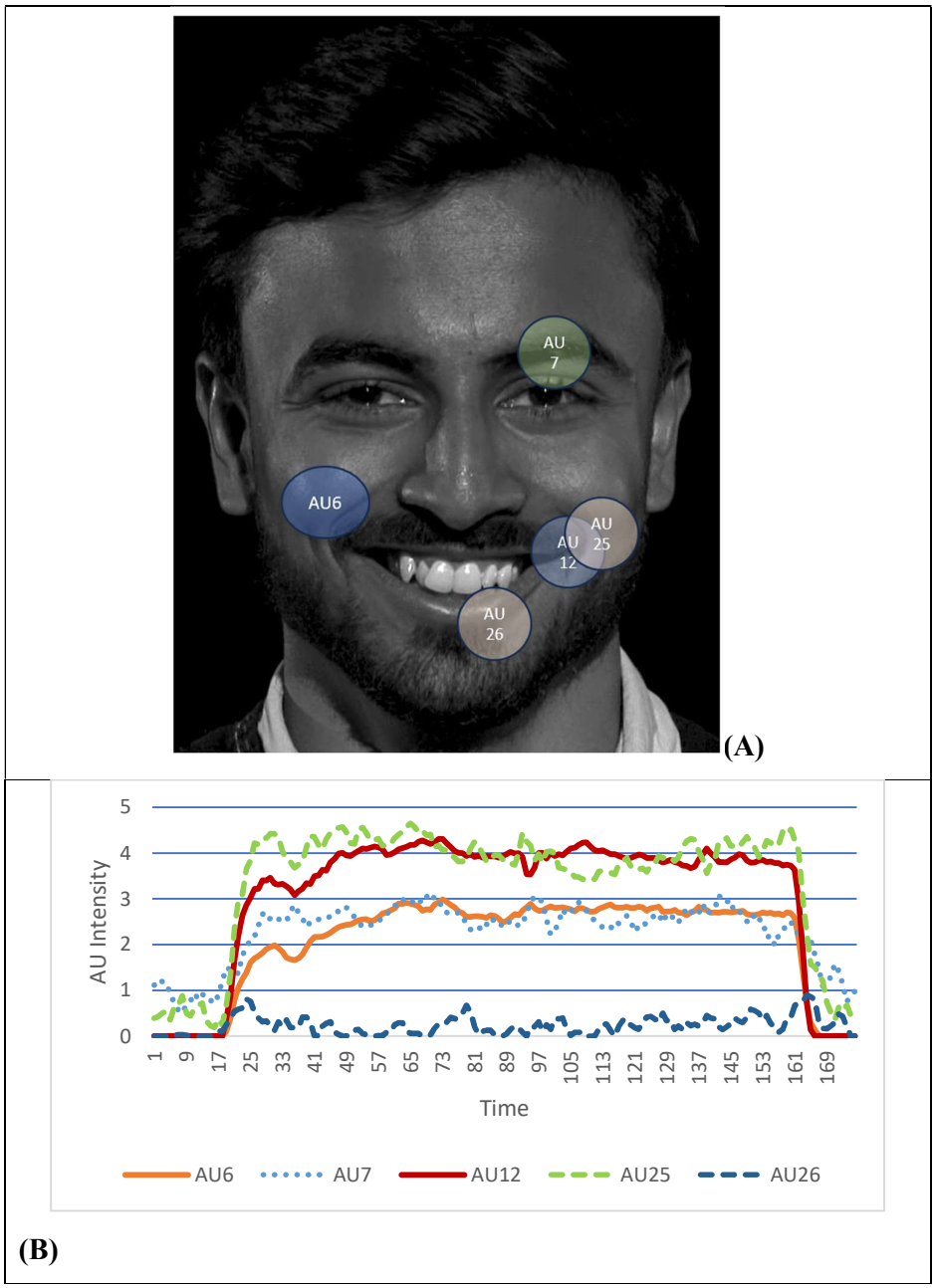


Figure 11. (A) Illustration of primary AU activation in happy expression, (B) Activation pattern of primary AUs (AU6, AU12), secondary AUs (AU25, AU26), and tertiary AU (AU7) for an expressor.

General trends across participants

Happy

The co-activation of primary Action Units AU6 (Cheek Raiser) and AU12 (Lip Corner Puller) consistently signals genuine happiness, with AU12 showing the strongest and most reliable rise, clearly marking the presence of a smile. In many cases, AU7 (Lid Tightener) joins AU6, producing the squinting effect characteristic of Duchenne smiles, which are considered authentic emotional expressions. Secondary AUs, AU25 (Lips Part) and AU26 (Jaw Drop), frequently peak alongside AU12, suggesting open-mouth configurations typical of laughter. Across participants, the apex phase generally occurs between 0.8 and 1.2 seconds, followed by a decline in intensity during the offset phase. While AU6 and AU12 often share similar onset and apex timing, subtle differences in their trajectories can be meaningful, especially when assessing emotional authenticity. AU12 consistently peaks higher than AU6, reinforcing its role as the dominant driver of smile expressivity. However, AU6 shows greater variability across individuals—some participants (e.g., 1, 5, 7) exhibit strong cheek raising, while others display modest or delayed AU6 activation. This variability suggests that participants with strong AU6 and AU12 co-activation are likely expressing genuine (Duchenne) smiles, whereas those with high AU12 but weak AU6 may be displaying social or posed smiles. The synchrony between AU6 and AU12 in both onset and apex phases serves as a valuable marker for distinguishing authentic emotional expressions from socially driven ones.

Sad

AU17 (Chin Raiser) emerges as the most expressive and consistent Action Unit across participants, peaking strongly around 1.0–1.2 seconds and reaching intensity levels between 1.6 and 2.3. This AU signals chin tension and is a reliable marker of emotional engagement in sadness expressions. AU1 (Inner Brow Raiser) and AU4 (Brow Lowerer) frequently co-activate, forming the classic brow movement associated with sadness, while AU15 (Lip Corner Depressor) appears in several participants with modest peaks, reinforcing the emotional tone. AU23 (Lip Tightener) and AU2 (Outer Brow Raiser) remain subtle but contribute nuanced detail—AU23 peaks at low intensity (0.0–0.2), suggesting restrained emotion, while AU2 varies more widely (0.0–0.7), often peaking slightly earlier than AU17, indicating brief

alertness or emotional preparation. The apex phase for most AUs clusters around 1.0 seconds, with offset typically occurring between 1.5 and 2.0 seconds, showing clear temporal structure. Participants displaying AU1 + AU4 brow movement alongside AU15 and AU17 activation likely expressed genuine sadness, with AU17 serving as the dominant and synchronously timed component. This co-activation pattern provides a compelling marker for authentic emotional expression in sadness episodes.

Fear

Participants displaying strong co-activation of AU1+2 (Brow Raisers), AU5 (Upper Lid Raiser), and AU26/27 (Jaw Drop/Mouth Stretch) likely expressed fear, with AU5 consistently showing the highest peaks at the apex phase (~1.0–1.2s), marking heightened alertness. AU27 and AU26 also peaked noticeably, reinforcing the dynamics of shock and fear. AU1+2 rose moderately, often aligning with AU5 to signal concern, while AU4 (Brow Lowerer) and AU7 (Lid Tightener) added subtle intensity, suggesting emotional strain. AU20 (Lip Stretcher) and AU25 (Lips Part) remained lower overall but contributed to fear expressions, sometimes overlapping with laughter-like movements. The neutral-to-offset phases were consistent across participants, with apex clustering around 1.0s and offset around 1.5–2.0s. Overall, participants with dominant AU5 + AU27 + AU26 activation exhibited strong fear or shock responses, while those with AU4 + AU7 activation conveyed strain. AU20 and AU25 pointed to fear dynamics, and AU1+2 added nuance to concern, especially when paired with AU5. Together, AU1+2 and AU5 produced the hallmark eyebrow and eyelid raising typical of fear or surprise, AU4 introduced elements of anger, and AU20 amplified fear through lip stretching. This layered co-activation pattern underscores the complexity of fear expressions, blending alertness, strain, and subtle emotional nuances across participants.

Anger

Participants with dominant AU5 (Upper Lid Raiser) alongside AU4 (Brow Lowerer) and AU7 (Lid Tightener) often exhibited strong anger–surprise blends, where eyelid raising marked alertness or shock while brow and lid tension signalled frustration or emotional strain. AU17 (Chin Raiser) consistently showed moderate peaks, reflecting sadness or tension, and when paired with AU10 (Upper Lip Raiser) conveyed elements of disgust or contempt. Subtler

activations of AU23 (Lip Tightener) and AU24 (Lip Pressor) added nuance, often marking restraint, suppression, or controlled emotion. AU5 consistently peaked most strongly across participants, clustering around 1.0–1.2 seconds at apex, while AU4 and AU7 co-activation reinforced anger and effort. AU17 remained a reliable marker of emotional strain, and AU24, though subtle, was meaningful in signalling suppression. AU10 appeared selectively, often co-activating with AU4 or AU7 to intensify disgust or contempt. Overall, strong co-activation of AU4, AU5, AU7, and AU23 was linked to anger, with AU4 and AU7 inducing brow and lid tension, AU5 marking surprise or alertness, and AU23 reinforcing restraint or determination. These participants likely expressed focused, intense emotional states, blending anger, surprise, and controlled suppression into complex emotional displays.

Surprise

Participants with dominant AU5 (Upper Lid Raiser) combined with AU26 (Jaw Drop) and AU27 (Mouth Stretch) consistently displayed strong surprise expressions, with AU5 marking heightened alertness and AU26/27 amplifying shock or vocal dynamics. AU25 (Lips Part) appeared in several participants, often linked to speech or laughter during surprise onset, while AU1+2 (Inner and Outer Brow Raisers) added nuance of concern or sadness when paired with AU5. AU27 frequently showed the strongest peaks, clustering around the apex phase (~1.0s), and often peaking slightly later than AU25, which marked mouth opening in milder surprise. Timing across participants was tightly aligned, with apex clustering around 1.0–1.2 seconds and offset occurring between 1.5–2.0 seconds. Overall, AU1+2 + AU5 formed the hallmark eyebrow and eyelid raising typical of surprise, AU26 amplified the expression through jaw drop, and AU27 reinforced high emotional arousal. AU25 contributed subtler mouth opening, often preceding or following AU26, while AU1+2 added layers of concern or sadness depending on context. Together, these co-activations highlight the complexity of surprise expressions, ranging from mild alertness to intense shock, and occasionally overlapping with laughter-like dynamics.

Disgust

Participants with dominant AU9 (Nose Wrinkler) and AU10 (Upper Lip Raiser) consistently displayed strong disgust expressions, with AU10 showing the most pronounced

peaks across participants. The co-activation of AU9 and AU10 reinforced the classic disgust signature, often accompanied by AU4 (Brow Lowerer), which added determination or anger-like intensity. AU17 (Chin Raiser) appeared moderately, contributing tension and sometimes blending with sadness, while AU15 (Lip Corner Depressor) surfaced more subtly, marking disappointment or resignation. AU23 (Lip Tightener) occasionally added restraint, suggesting controlled negative affect. The apex phases clustered around 1.0–1.2 seconds, with offset phases extending to 1.5–2.0 seconds, showing consistent timing across participants. Overall, AU9 + AU10 dominance provided clear markers of disgust and contempt, while co-activation with AU4, AU17, and AU15 suggested complex blends of negative affect, including anger, disgust, and sadness. This layered activation pattern highlights how disgust expressions in participants often extend beyond a single emotion, instead reflecting nuanced and multifaceted states of aversion and strain.

The findings suggest that, across expressers, primary, secondary, and tertiary AUs exhibited distinct and consistent patterns corresponding to basic emotions, as documented in the IAPD-R. Further, variability in AU intensity and configuration across individuals indicates that baseline arousal levels modulate how strongly and in what pattern AUs are expressed. This confirms the hypothesis that individual differences shape emotional expression intensity. Primary AUs consistently showed distinct and robust patterns across basic emotions, while secondary and tertiary AUs added nuance, subtlety, and contextual variation. This confirms their differential contribution to perceived emotional intensity.

Expressivity Differences

Comparative insight suggest that participants vary significantly in both expressivity and timing. Thus, they can be profiled on the basis of their expressivity differences into following five categories—

(i) Anger-dominant profiles: Participants 6, 13, 16, and 18 show strong AU4 activation, indicating intense brow tension and lip compression

(ii) Surprise and fear expressivity: Participants 17 and 19 display high AU5 and AU26 activation, suggesting reactive expressions to startling stimuli.

(iii) Disgust expressivity: Participants 11 and 14 show strong AU9 and AU10, often paired with anger, producing contempt-like blends.

(iv) Sadness-dominant profiles: Participants 8, 10, and 15 show moderate AU15 and AU17 activation, indicating emotional withdrawal.

(v) Low expressivity overall: Some participants (e.g., 1, 7, 12) show weak activation across most emotions, suggesting restrained or neutral affect.

Participants also differ in how quickly and how long they express emotions. This timing difference classifies them into three categories—

(i) Fast-onset, short-duration: Some participants (e.g., 3, 9, 17) show rapid AU activation and quick decay, indicating reactive but fleeting expressions.

(ii) Slow-onset, sustained expressions: Others (e.g., 6, 13, 18) maintain AU activation into the offset phase, especially for anger and sadness.

(iii) Blended timing: A few participants (e.g., 2, 5, 11) show overlapping AU patterns, where emotions like disgust and anger co-occur with staggered timing.

Sex difference

IAPD- 2.0 has 7 male and 12 female expressers, respectively. AU analysis suggest that male and female expressers do show differences in emotional expressivity and timing, consistent with both cultural norms and broader gender-related findings in emotion research. Male expressers tend to show stronger and more sustained AU4 and AU9/10 (anger and disgust). Anger is often sustained longer, reflecting cultural acceptance of men displaying dominance-related emotions. On the other hand, they have generally weaker and restrained AU15, AU17, AU5, AU26. Thus, sadness and fear may be suppressed due to cultural expectations of male stoicism. In terms of timing, they show more sustained expressions of anger/disgust and are less reactive in surprise/fear compared to females. Their timings show longer duration of expression with slower offset. Figure 12 illustrates weak, moderate, and strong AU activations using radar chart.



Figure 12. Radar chart comparing emotional responses of participants across six emotions— Happy, Sad, Fear, Anger, Surprise, and Disgust. Each participant is represented by a coloured line, and the concentric rings show increasing intensity from the centre. The innermost ring represents Weak, middle ring Medium, and outermost ring High intensities, respectively.

Female expressers show stronger AU6/12 for smiles and AU15/17 for sadness suggesting that happiness is often expressed more openly, while sadness is more facially visible. They are more reactive (AU5/26 activation), leading to quicker, sharper expressions of fear and surprise. They express anger but often shorter in duration and disgust tends to be subtler. In terms of timing, they are more reactive, and show short-lived expressions, especially for high-arousal emotions (surprise, fear). They have faster onset and quicker offset compared to males.

This evidence also supports the hypothesis as the results highlight culturally specific blends and gender-linked variations in expressivity. These findings demonstrate that expressivity is not uniform but shaped by cultural learning and sex differences.

Discussion

Ekman identified six basic emotions as universally expressed through facial muscle movements (AUs). The AU analysis of IAPD-2.0 used the same AU categories and confirms that the AU activation align with Ekman's Facial Action Coding System (FACS) with all participants showing activation of these AUs to varying degrees.

Ekman's "Emotional Episode Timeline" describes how emotions unfold over time from trigger to peak to offset. The findings of this study show that some participants have fast-onset, short-duration responses (e.g., reactive surprise/fear) while some others show slow-onset, sustained expressions (e.g., prolonged anger or sadness). This mirrors Ekman's timeline model. While endorsing Ekman's proposition, IAPD-2.0 database encompasses individual variability in expressivity and timing that Ekman's model treats as secondary. Ekman emphasized universality whereas IAPD-2.0 AU analysis highlights inter-expresser differences. It cluster participants by expressive style, revealing emotional archetypes (e.g., anger-dominant vs. sadness-dominant), which is extension beyond Ekman.

While Paul Ekman's theory emphasizes universality in facial expressions of emotion, cross-cultural research has highlighted certain cultural nuances. As IAPD-2.0 involved Indian expressers, the meaningful distinctions revealing important variations in intensity and timing were further analyzed vis-à-vis the social display rules. Indian culture tends to emphasize emotional restraint in public, especially for negative emotions like anger or sadness. Thus 'display rules' may lead to suppression of overt expressions in formal or group settings. Studies (Gallant et al., 2026) show that while Indians can recognize universal emotions, their production of facial expressions may differ in intensity and timing. For example, fear and surprise may be expressed more subtly, and sadness may be internalized rather than facially displayed. AU analysis of IAPD-2.0 unequivocally suggest that Indian expressers often show blended emotions, such as anger mixed with disgust or sadness with resignation. Further, cultural norms around emotional blending and contextual appropriateness influence AU activation patterns.

The findings of sex difference suggest that men are dominant in anger/disgust but restrained in sadness/fear expressions. Women are dominant in happiness/sadness but reactive in fear/surprise expressions. This is consistent with the cultural overlay— men permitted more overt dominance emotions, women more affiliative emotions.

The study significantly contributes through rich expressive diversity of IAPD- 2.0. Besides extending support to Ekman's universal baseline it endorses cultural shaping of expressivity through social norms, emotional blending, and timing. The same AUs are significant, but intensity and timing are modulated by cultural norms. Consistent with Ekman's later work acknowledging cultural modulation, this work endorses individual variability and expressive diversity, especially in anger, surprise, and disgust, emotions often tied to social context in Indian culture.

In summary, IAPD- 2.0 supports Ekman's universality claim (the same emotions and AUs appear), but also highlights cultural nuances. Indian participants show restrained expressivity, especially for sadness and fear. Anger and disgust are expressed, but often in blended or controlled forms. Surprise is reactive but short-lived, consistent with collectivist display rules.

This study distinguishes between emotion via AU activation patterns, mood and expressivity through baseline arousal differences, and expressivity via cultural and gender-linked variations. This can be helpful in operationalizing these constructs for computational use. The findings pertaining to culture specific emotion blends can be of immense help for research focused on global emotion expression and inclusive AI design.

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Developmental Variations in Facial Emotion Recognition Across Age Groups

Rishabh Pandey & Braj Bhushan

Pandey and Bhushan (2026a) explored how emotion recognition, intensity rating, and reaction times vary across age groups using a subset of 132 front profile images of IAPD- 2.0 as stimuli on a sample of 369 participants (155 females, 214 males) from three distinct age groups—children (6-11 years), adolescents (12-17 years), and adults (18-24 years). The findings are summarized below.

Findings

Table 5. Age-wise recognition accuracy for IAPD 2.0 database.

Emotions	Children (6-11 years)	Adolescents (12-17 years)	Adults (18-24 years)
Happy	90%	92%	95%
Sad	44%	44%	53%
Fear	19%	25%	27%
Anger	41%	48%	53%
Surprise	42%	54%	57%
Disgust	46%	49%	53%
Neutral	59%	67%	66%

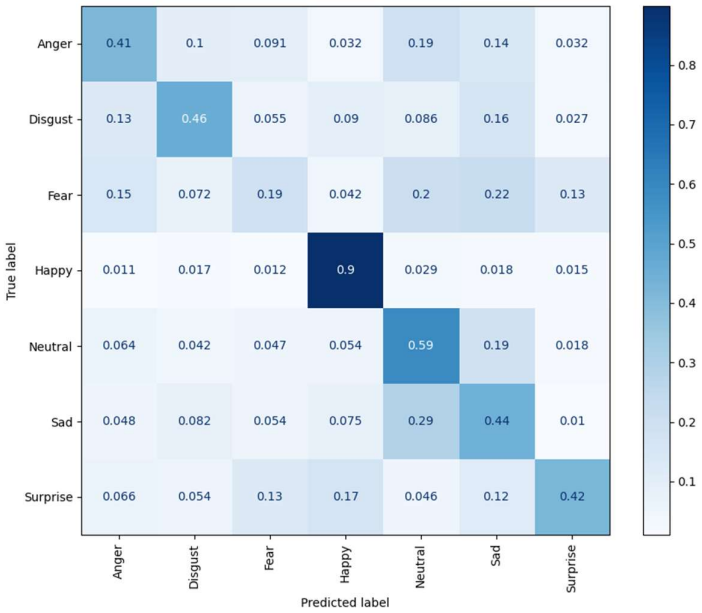


Figure 13. Confusion matrix of children's emotion recognition accuracy for IAPD 2.0 database.

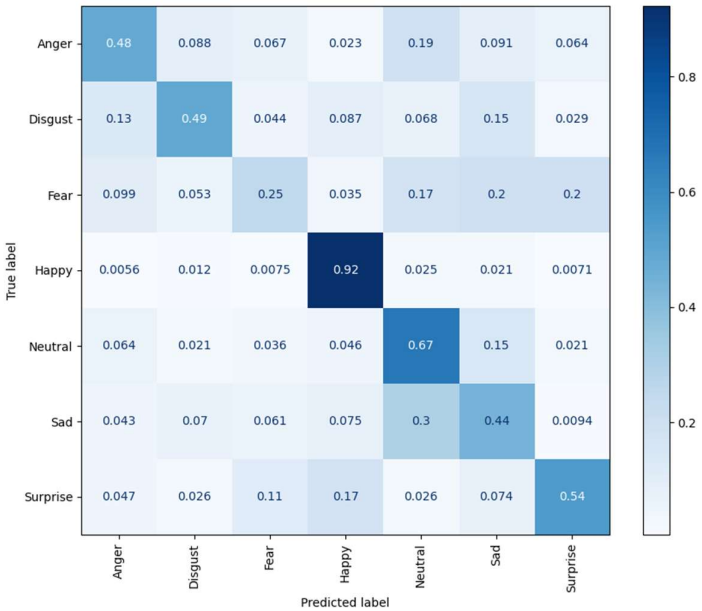


Figure 14. Confusion matrix of adolescents' emotion recognition accuracy for IAPD 2.0 database.

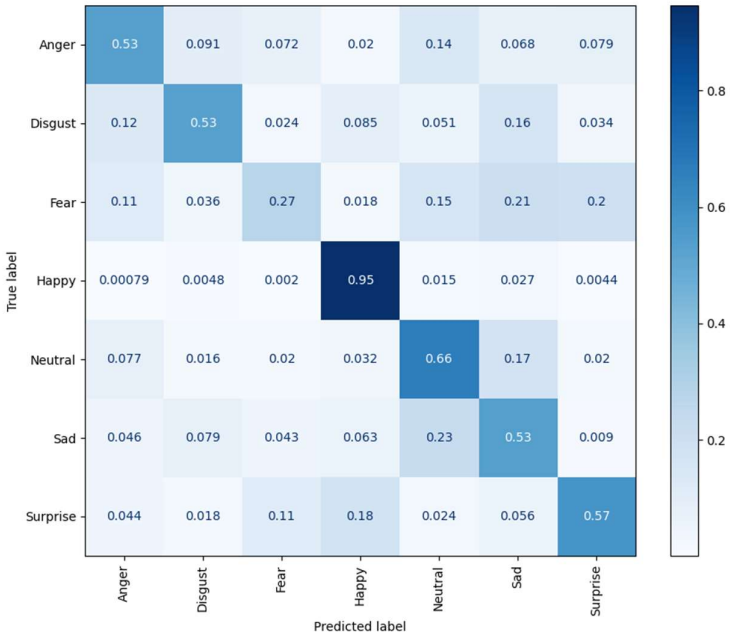


Figure 15. Confusion matrix of adults' emotion recognition accuracy for IAPD 2.0 database.

Table 6. Age-wise intensity rating for IAPD 2.0 database.

Emotions	Children (6-11 years)	Adolescents (12-17 years)	Adults (18-24 years)
Happy	3.2	3.19	3.33
Sad	3.28	2.09	3.0
Fear	3.27	3.29	2.96
Anger	3.16	3.07	3.27
Surprise	3.24	3.31	3.41
Disgust	3.23	3.2	3.27
Neutral	3.26	3.05	3.16

Table 7. Age-wise reaction time for IAPD 2.0 database.

Emotions	Children (6-11 years)	Adolescents (12-17 years)	Adults (18-24 years)
Happy	2.43	1.85	1.36
Sad	2.94	2.39	1.87
Fear	4.03	3.25	2.37
Anger	3.52	2.93	2.17
Surprise	3.5	2.62	2.17
Disgust	3.53	3.02	2.51
Neutral	2.92	2.27	1.71

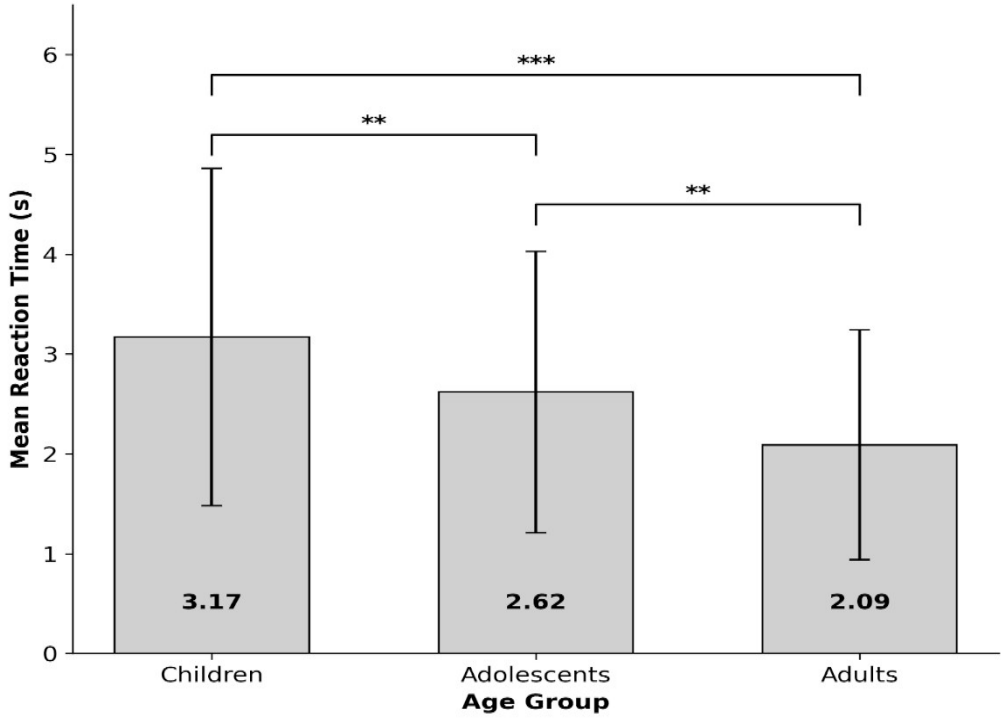


Figure 16. Mean reaction time for emotion recognition across age groups.

*Note: Error bars represent one standard deviation. Mean reaction times (in seconds) decreased significantly as age increased. Asterisks denote significant differences resulting from Tukey's HSD post hoc comparisons (** p < .01, *** p < .001).*

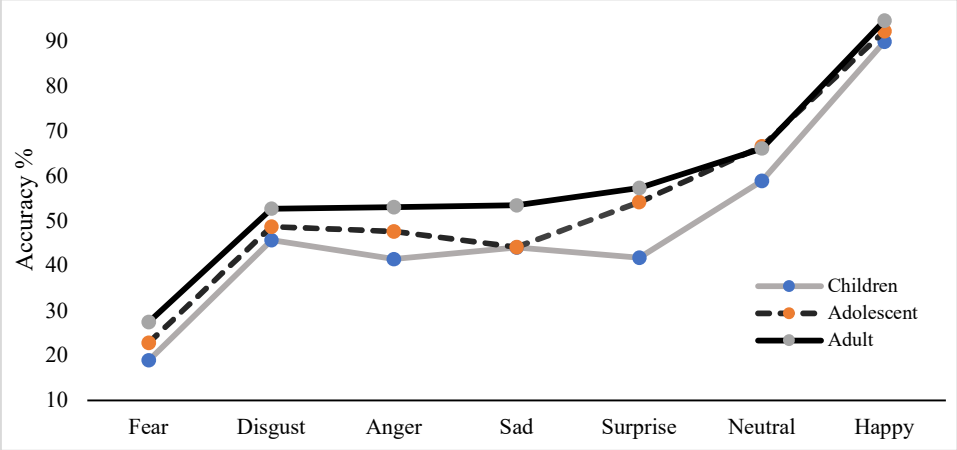


Figure 17. Developmental trend in emotion recognition across emotions with increasing age.

Conclusion

Pandey and Bhushan (2026a) provide compelling evidence of age-related improvements in both emotion recognition accuracy and cognitive processing speed. Their confusion matrix analysis reveals that fear is the most frequently misclassified emotion, often mistaken for neutral, sadness, or surprise. Certain errors were reciprocal, such as fear with surprise, sadness with neutral, and vice versa. Consistent with prior literature, reaction times decreased with age, reflecting enhanced efficiency in processing. Interestingly, children perceived emotions with greater intensity, while adolescents showed the lowest intensity ratings. As affective schemas consolidate through age and social experience, the cognitive load required to resolve structural ambiguity diminishes, underscoring the internal validity of the IAPD-2.0.

IAPD 2.0 Caricature Database

Pandey and Bhushan (2026b) also explored how emotion recognition, intensity rating, and reaction times vary across age groups using for IAPD- 2.0 caricature and exaggerated caricature databases, respectively. For caricature, the sample comprised of 312 participants (134

females, 178 males from three distinct age groups— children (6-11 years), adolescents (12-17 years), and adults (18-24 years). The findings are summarized below.

Findings

Table 8. Age-wise recognition accuracy for IAPD 2.0 caricature database.

Emotions	Children (6-11 years)	Adolescents (12-17 years)	Adults (18-24 years)
Happy	85%	93%	95%
Sad	69%	70%	77%
Fear	36%	36%	41%
Anger	69%	69%	71%
Surprise	52%	62%	64%
Disgust	38%	38%	45%
Neutral	65%	65%	72%

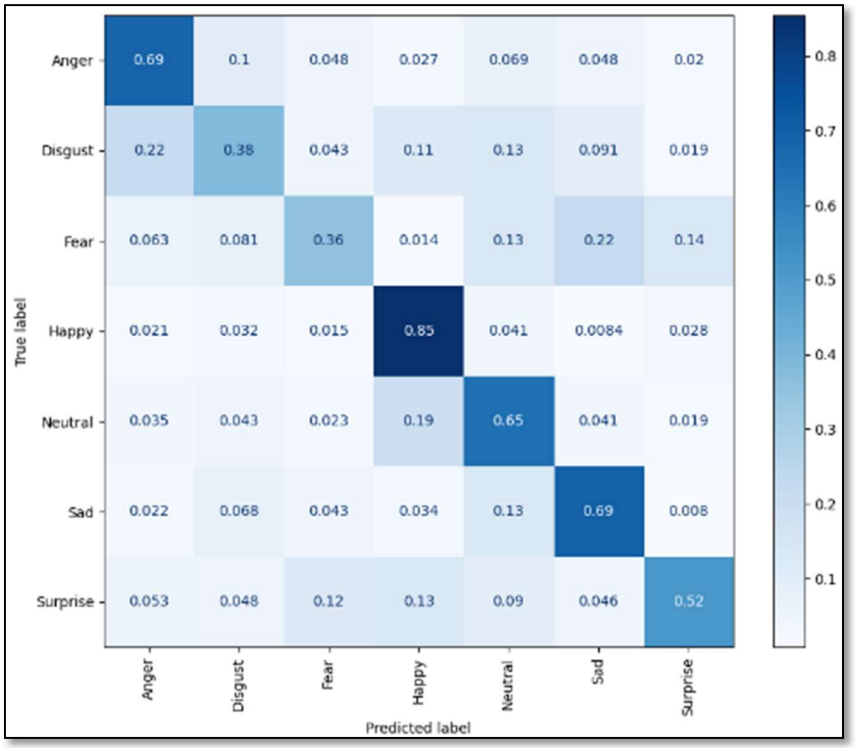


Figure 18. Confusion matrix of emotion recognition accuracy for caricatures in children.

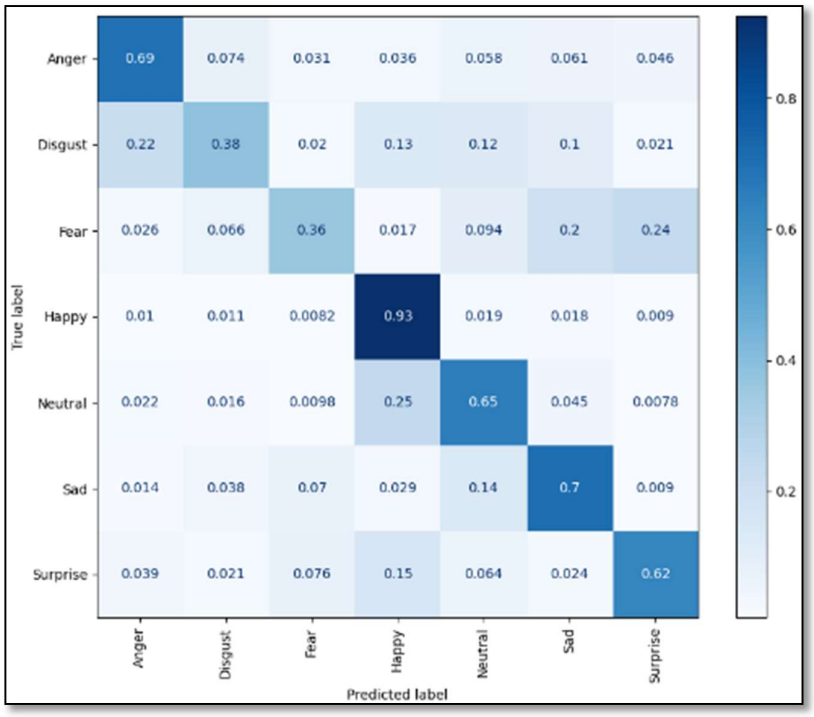


Figure 19. Confusion matrix of emotion recognition accuracy for caricatures in adolescents.

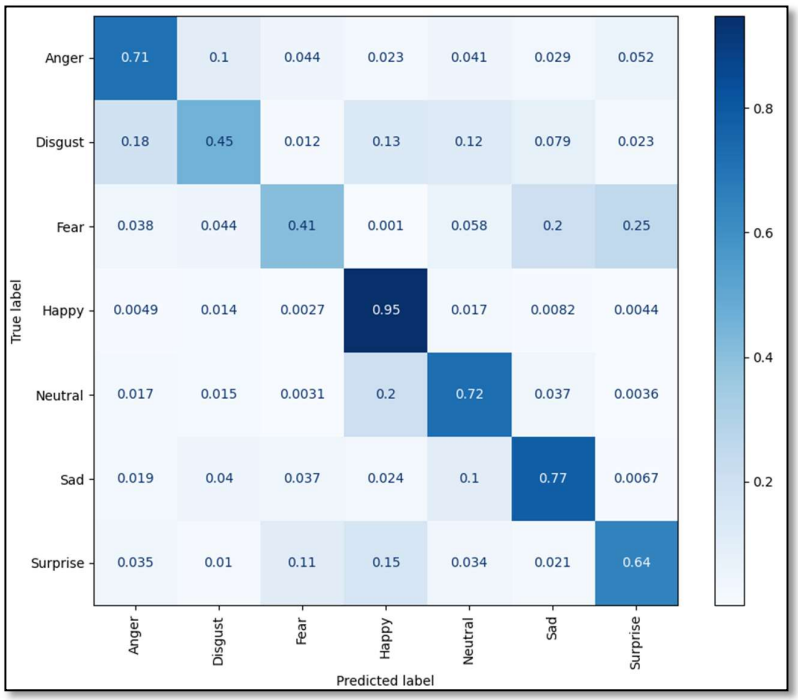


Figure 20. Confusion matrix of emotion recognition accuracy for caricatures in adults.

Table 9. Age-wise intensity rating for IAPD 2.0 caricature database.

Emotions	Children (6-11 years)	Adolescents (12-17 years)	Adults (18-24 years)
Happy	3.34	3.27	3.36
Sad	3.13	3.14	3.11
Fear	3.22	3.15	3.19
Anger	3.27	3.22	3.2
Surprise	3.48	3.37	3.56
Disgust	3.19	3.1	3.06
Neutral	3.24	2.92	3.21

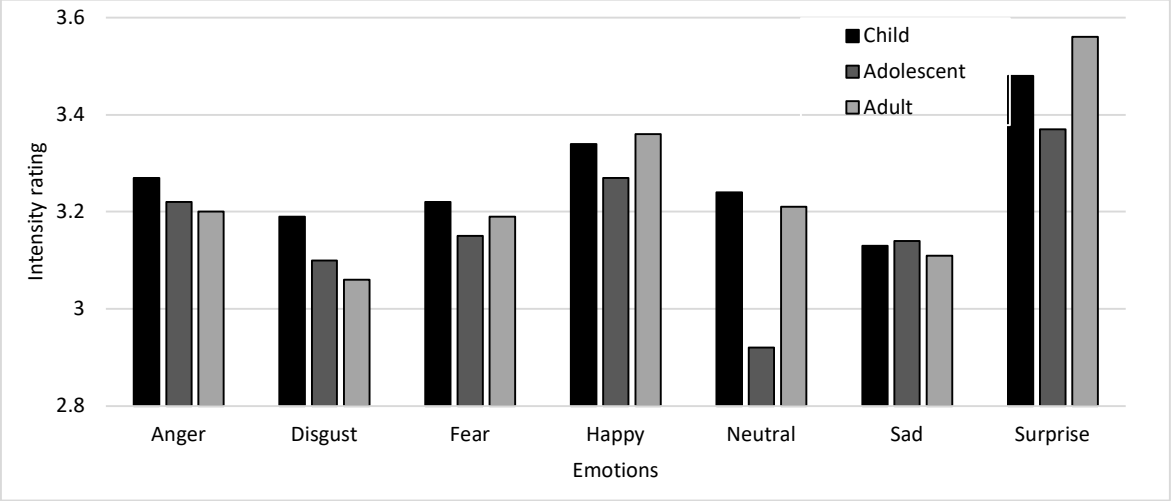


Figure 21. Emotion specific intensity rating of IAPD 2.0 caricature database by child, adolescent, and adult participants.

Table 10. Age-wise reaction time for IAPD 2.0 caricature database.

Emotions	Children (6-11 years)	Adolescents (12-17 years)	Adults (18-24 years)
Happy	2.28	1.41	0.98
Sad	2.48	1.67	1.26
Fear	3.24	1.87	1.8
Anger	2.32	1.46	1.39

Surprise	2.93	1.67	1.42
Disgust	3.13	1.96	1.73
Neutral	2.46	1.62	1.11

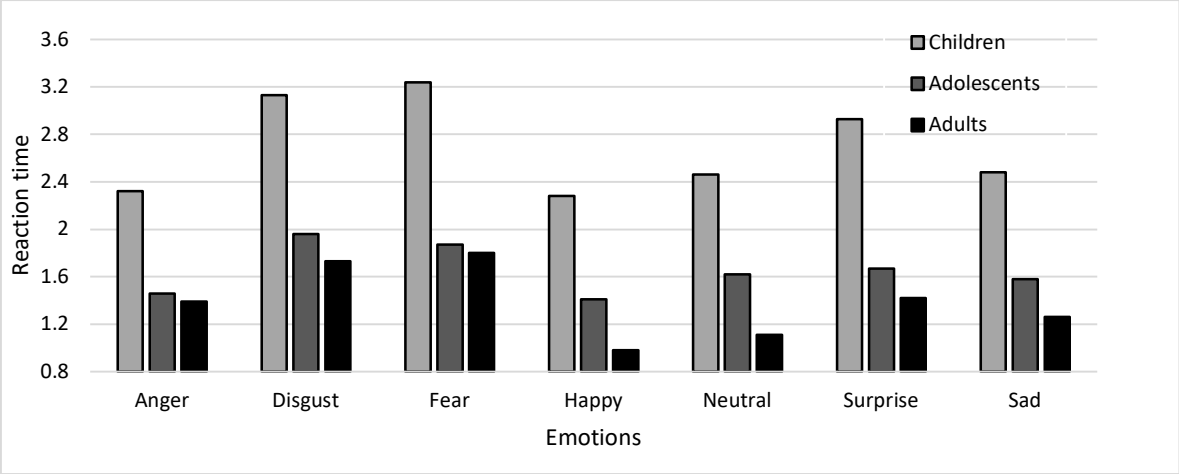


Figure 22. Emotion specific reaction time for IAPD 2.0 caricature database by child, adolescent, and adult participants.

IAPD 2.0 Exaggerated Caricature Database

Pandey and Bhushan (2026b) have reported emotion recognition, intensity rating, and reaction times vary across age groups using for IAPD- 2.0 exaggerated caricature database as well. For exaggerated caricature, the sample comprised of 268 participants (114 females, 154 males) from three distinct age groups— children (6-11 years), adolescents (12-17 years), and adults (18-24 years). The findings are summarized below.

Findings

Table 11. Age-wise recognition accuracy for IAPD 2.0 exaggerated caricature database.

Emotions	Children (6-11 years)	Adolescents (12-17 years)	Adults (18-24 years)
Happy	89%	95%	98%
Sad	77%	83%	89%
Fear	51%	40%	47%

Anger	62%	65%	75%
Surprise	55%	62%	67%
Disgust	49%	40%	47%

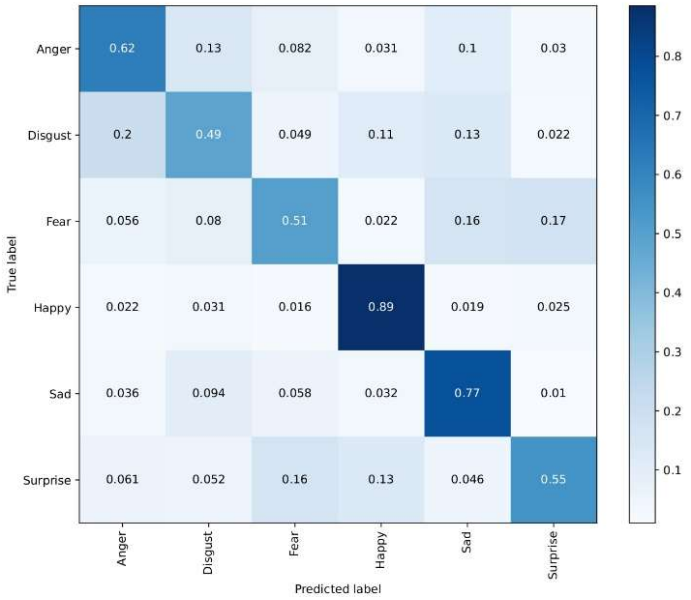


Figure 23. Confusion matrix of emotion recognition accuracy for IAPD 2.0 exaggerated caricature database for children.

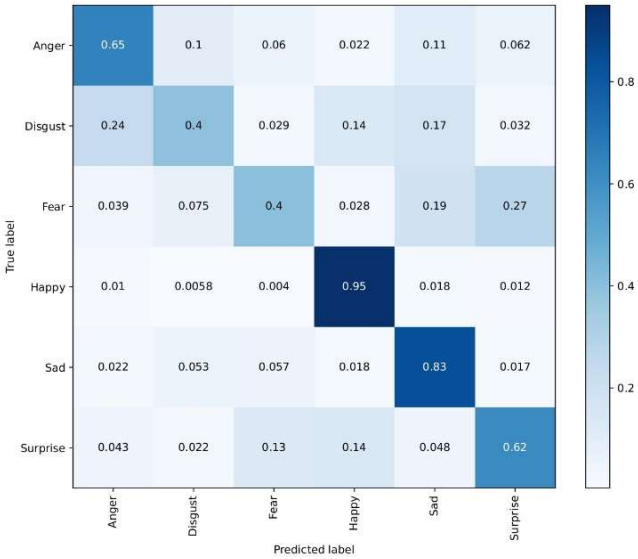


Figure 24. Confusion matrix of emotion recognition accuracy for IAPD 2.0 exaggerated caricature database for adolescents.

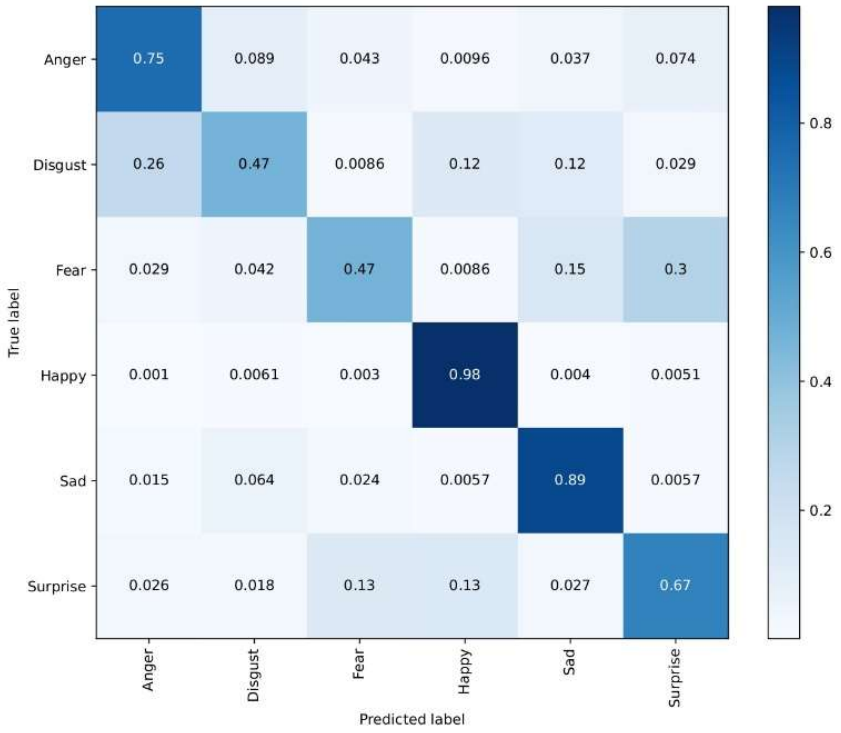


Figure 25. Confusion matrix of emotion recognition accuracy for IAPD 2.0 exaggerated caricature database for adults.

Table 12. Age-wise intensity rating for IAPD 2.0 exaggerated caricature database.

Emotions	Children (6-11 years)	Adolescents (12-17 years)	Adults (18-24 years)
Happy	3.71	3.39	3.37
Sad	3.35	3.25	3.12
Fear	3.46	3.24	3.17
Anger	3.3	3.12	2.96
Surprise	3.75	3.51	3.65
Disgust	3.26	3.01	2.74

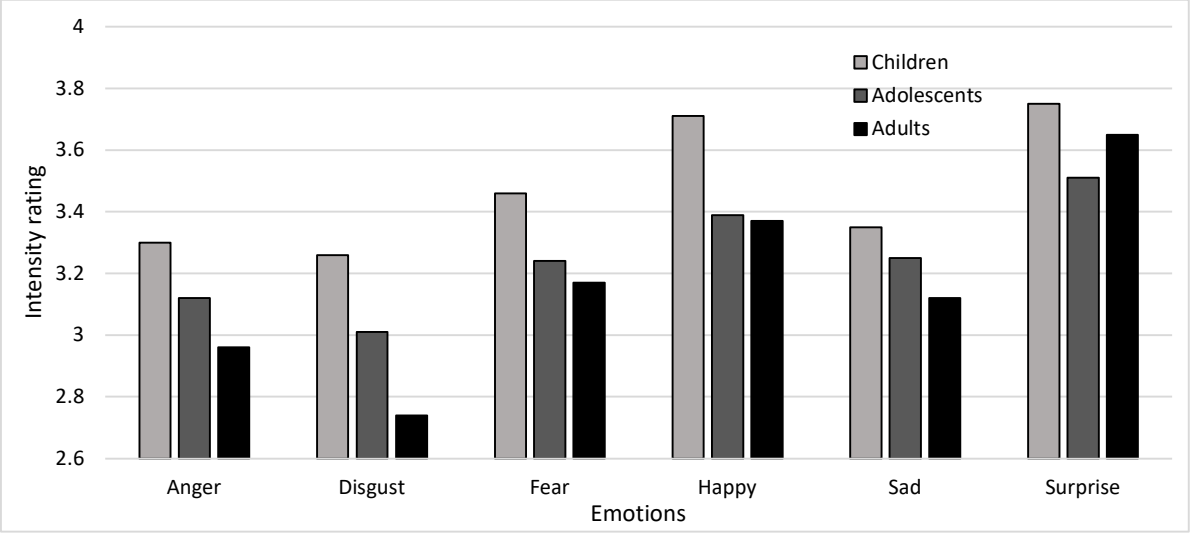


Figure 26. Emotion specific intensity rating of IAPD 2.0 exaggerated caricature database of child, adolescent, and adult participants.

Table 13. Age-wise reaction time for IAPD 2.0 exaggerated caricature database.

Emotions	Children (6-11 years)	Adolescents (12-17 years)	Adults (18-24 years)
Happy	1.82	1.48	0.81
Sad	2.17	2.05	1.04
Fear	2.4	2.05	1.47
Anger	2.5	2.06	1.26
Surprise	2.48	1.78	1.11
Disgust	2.68	2.23	1.60

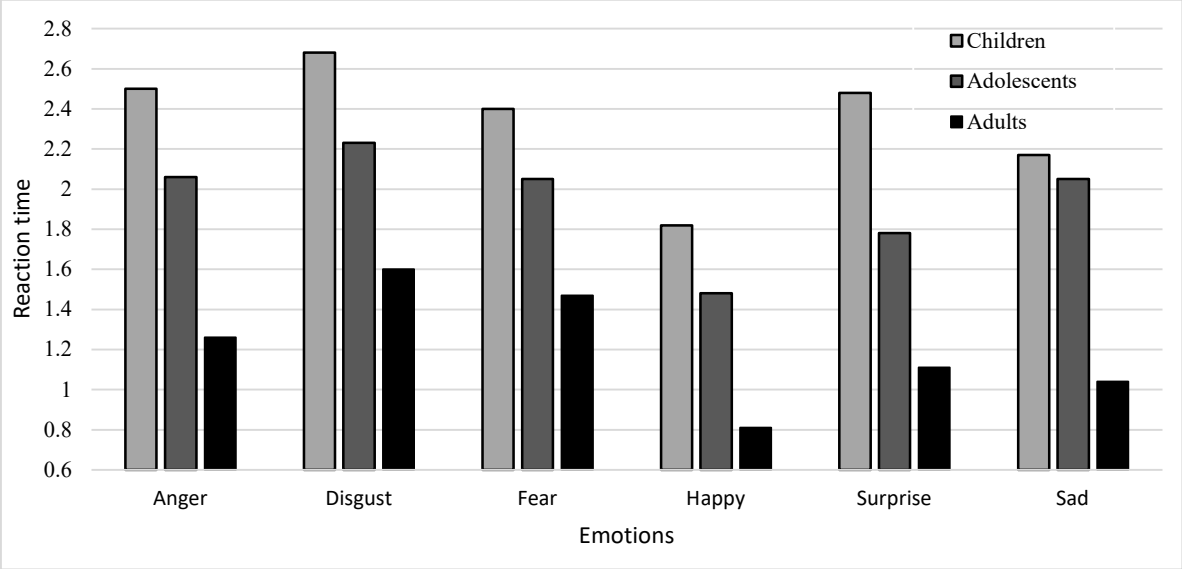


Figure 27. Emotion specific reaction time for IAPD 2.0 exaggerated caricature database of child, adolescent, and adult participants.

Reference

Pandey, R., & Bhushan, B. (2025). Developmental variations in facial emotion recognition across age groups. https://doi.org/10.31234/osf.io/mdpy9_v1

Quantifying Complexity: Fractal Geometry of Facial Expressions

The fractal dimension and Hurst coefficient are powerful mathematical tools for analyzing the complexity and self-similarity of facial expressions, making them highly relevant in emotion research. The fractal dimension quantifies the irregularity and detail of facial features across scales, capturing subtle variations in texture and contour that traditional geometric measures often miss. This helps in distinguishing nuanced emotional states, such as micro-expressions of sadness or joy, by revealing the complexity of facial patterns. The Hurst coefficient, on the other hand, measures long-range dependence and persistence in signals, offering insights into the temporal stability of facial movements. When applied to dynamic facial data, it highlights whether emotional expressions are abrupt or sustained, thereby enriching the understanding of emotion intensity and expression dynamics. Together, these measures provide a robust framework for decoding the fine-grained structure and temporal evolution of facial expressions, advancing both psychological studies and affective computing applications.

Bhushan and Munshi (2021, 2025) applied fractal analytical techniques to both the Indian Affective Picture Database (IAPD; Sharma & Bhushan, 2019) and its extended version, IAPD 2.0 (Bhushan, 2023). Their work demonstrates how mathematical measures such as the fractal dimension and Hurst coefficient can be employed to capture the complexity and temporal dynamics of facial expressions of emotion. By quantifying irregularity, self-similarity, and persistence in facial features, these analyses provide a rigorous framework for understanding subtle variations in emotional portrayal. The following section details the methodological approaches and findings from these two studies, highlighting their significance for advancing affective science and computational emotion research.

References

Bhushan, B. (2023). Exploring fractal dimension as a technique to study facial expressions of emotions. Unpublished project report SERB/HSS/2019488, Indian Institute of Technology Kanpur.

Bhushan, B. & Munshi, P. (2021). Exploring fractal dimension analysis as a technique to study the role of intensity of facial expression and viewing angle. In Proceedings of the 16th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications (VISIGRAPP 2021) - Volume 2: HUCAPP, pages 103-110. ISBN: 978-989-758-488-6 DOI: https://doi.org/10.5220/0010124301030110

Bhushan, B., & Munshi, P. (2025, July 11). Fractal Dimension and Hurst Coefficient Analysis of the Indian Affective Picture Database- Revised. https://doi.org/10.31234/osf.io/3zwht_v1

Sharma, U. & Bhushan, B. (2019). Development and validation of Indian Affective Picture Database. *International Journal of Psychology, 54: 4*, 462-467. DOI: https://doi.org/10.1002/ijop.12471

Fractal Dimension Analysis of IAPD

The study titled '*Exploring Fractal Dimension Analysis as a Technique to Study the Role of Intensity of Facial Expression and Viewing Angle'* (Bhushan & Munshi, 2021) investigates how fractal dimension analysis can be applied to understand facial expressions of emotion. It explores how intensity and viewing angle affect emotion recognition, using two Indian facial-expression databases— the Indian Dataset of Basic Emotions (IDBE: Bhushan. 2007) and the Indian Affective Picture Database (IAPD: Sharma & Bhushan, 2019). Here we present the summary of findings of this study with respect to IAPD.

This is the first study in the Indian context to apply fractal geometry to facial-expression analysis.

Objectives

The research aimed to—

1. Examine the relationship between geometric properties of facial expressions and their recognition accuracy.
2. Study how intensity and viewing angle influence recognition.
3. Test whether fractal dimension can reveal self-similarity patterns among emotions.

Two hypotheses guided the work—

(i) Geometric properties significantly affect recognition.

(ii) Front-view and angular-view expressions differ in geometry, influencing recognition accuracy.

Methodology

Datasets

Besides IDBE, the study used 140 colour images (7 emotions × 5 angles × 4 expressers) of IAPD captured at −90°, −45°, 0°, +45°, and +90° viewing angles.

Analytical Approach

Instead of collecting behavioural responses, three-tier image analysis was performed—

1. *Geometric pattern* extraction from three facial regions (eyes, nose, lips).
2. *Root Mean Square (RMS) pixel difference* to measure variation across intensity levels.
3. *Fractal dimension* computation to quantify complexity and self-similarity in facial patterns.

Key Findings

Geometric Patterns

Emotions	Findings
Happy	Lip expansion increases with intensity.
Sad	Nose and lips expand at higher intensity.
Fear	All regions become more prominent with intensity.
Anger	Nose changes at low intensity; lips and diagonals at high intensity.
Surprise	Eyebrows and lips show major vertical changes at high intensity.

Disgust	Nose and eyelash regions vary more at low intensity.

Overall, eyebrows were most expressive for surprise, while nose and lips were crucial for disgust and happiness.

RMS Pixel Difference

(i) Happiness and disgust showed identical increasing patterns, suggesting similar geometric behaviour.

(ii) Fear and sadness also exhibited parallel trends.

(iii) RMS values confirmed that happy and disgust expressions share comparable pixel-level changes.

Fractal Dimension

(i) Fractal dimensions ranged between 2.1–2.5, largely independent of viewing angle.

(ii) Recognition accuracy remained high across angles, confirming angle-independent emotion recognition.

(iii) Happiness was isotropic (consistent across angles and genders).

(iv) Neutral expressions were hardest to recognize, especially for male expressers.

Insights

Fractal dimension analysis proved effective in quantifying facial-expression complexity and revealed that—

(i) Happiness, anger, surprise, and disgust were recognized best. Happiness and anger are most accurately recognized.

(ii) Surprise, happiness, and disgust share strong self-similarity patterns. The trio exhibits strong fractal self-similarity, suggesting shared structural complexity in facial movements.

(iii) Recognition accuracy was not affected by viewing angle, validating the fractal findings.

(iv) The study supports the idea that facial recognition relies on geometric regularities and self-similar patterns, measurable through fractal analysis.

(v) Fractal geometry offers a robust, culture-neutral tool for studying emotional expressions.

Reference

Bhushan, B. & Munshi, P. (2021). Exploring fractal dimension analysis as a technique to study the role of intensity of facial expression and viewing angle. In Proceedings of the 16th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications (VISIGRAPP 2021) - Volume 2: HUCAPP, pages 103-110. ISBN: 978-989-758-488-6 DOI: https://doi.org/10.5220/0010124301030110

Bhushan, B. (2007). Subjective analysis of facial expressions: Inputs from behavioural research for automated systems. Unpublished project report INI IITK-20060049, Indian Institute of Technology, Kanpur.

Sharma, U. & Bhushan, B. (2019). Development and validation of Indian Affective Picture Database. *International Journal of Psychology, 54: 4*, 462-467. DOI: https://doi.org/10.1002/ijop.12471

Fractal Dimension Analysis of IAPD 2.0

Braj Bhushan & Prabhat Munshi

This section provides a systematic summary of the emotion-specific values of fractal dimension and Hurst coefficient, reported both for the full facial configuration and for distinct regions including the eyes, lips, and nose. By distinguishing between global and regional analyses, the results highlight how complexity and persistence vary across facial zones in the portrayal of different emotions. Such differentiation not only underscores the methodological precision of fractal and temporal measures but also offers deeper insight into the structural and dynamic signatures of emotional expression. The following tables and figures illustrate these findings in detail, enabling a comparative understanding of facial regions in relation to overall emotional complexity.

Table 14. Emotion-specific fractal dimensions and Hurst coefficients for 0 degree (Front view).

Happy				
Expresser	Fractal Dimension	Hurst Coefficient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.402	0.598	2.16 - 3.92	0 - 4.14
Expresser 2	2.472	0.528	2.06 - 3.89	0 - 4.174
Expresser 3	2.394	0.606	1.96 - 3.92	0 - 4.094
Expresser 4	2.464	0.536	2.12 - 4.03	0 - 4.06
Expresser 5	2.442	0.558	2.12 - 4.22	0 - 4.094
Expresser 6	2.391	0.609	2.03 - 4.08	0 - 4.094
Expresser 7	2.401	0.599	2.32 - 4.52	0 - 4.174
Expresser 8	2.486	0.514	2.097 - 4.268	0 - 4.043
Expresser 9	2.469	0.531	2.122 - 4.279	0 - 3.952
Expresser 10	2.467	0.533	2.079 - 4.351	0 - 4.043
Expresser 11	2.36	0.64	2.379 - 4.312	0 - 4.078
Expresser 12	2.441	0.559	2.296 - 4.240	0 - 4.078
Expresser 13	2.452	0.548	2.157 - 4.206	0 - 4.078
Expresser 14	2.394	0.606	1.991 - 4.096	0 - 4.077
Expresser 15	2.438	0.562	2.296 - 4.226	0 - 3.850
Expresser 16	2.484	0.516	2.315 - 4.336	0 - 4.043
Expresser 17	2.402	0.598	2.309 - 4.315	0 - 4.158
Expresser 18	2.393	0.607	2.340 - 4.358	0 - 4.077
Expresser 19			2.138 - 4.359	0 - 4.158
Sad				
Expresser	Fractal Dimension	Hurst Coefficient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.379	0.621	2.1 - 3.93	0 - 4.14
Expresser 2	2.438	0.562	2.01- 3.89	0 - 4.174
Expresser 3	2.384	0.616	1.91 - 3.94	0 - 4.094
Expresser 4	2.466	0.534	2.13 - 4.04	0 - 4.06
Expresser 5	2.415	0.585	2.03 - 4.15	0 - 4.094
Expresser 6	2.367	0.633	1.99 - 4.05	0 - 4.094
Expresser 7	2.4	0.6	2.27 - 4.53	0 - 4.174
Expresser 8	2.453	0.547	2.090 - 4.270	0 - 4.043
Expresser 9	2.455	0.545	2.067 - 4.083	0 - 3.952
Expresser 10	2.41	0.59	2.140 - 4.294	0 - 4.043
Expresser 11	2.377	0.623	2.414 - 4.305	0 - 4.078
Expresser 12	2.421	0.579	2.377 - 4.233	0 - 4.078
Expresser 13	2.478	0.522	2.190 - 4.204	0 - 4.078
Expresser 14	2.446	0.554	2.066 - 4.066	0 - 4.077
Expresser 15	2.406	0.594	2.261 - 3.969	0 - 3.850
Expresser 16	2.506	0.494	2.299 - 4.269	0 - 4.043
Expresser 17	2.495	0.505	2.427 - 4.347	0 - 4.158
Expresser 18	2.493	0.507	2.404 - 4.306	0 - 4.077
Expresser 19	2.419	0.581	2.223 - 4.401	0 - 4.158

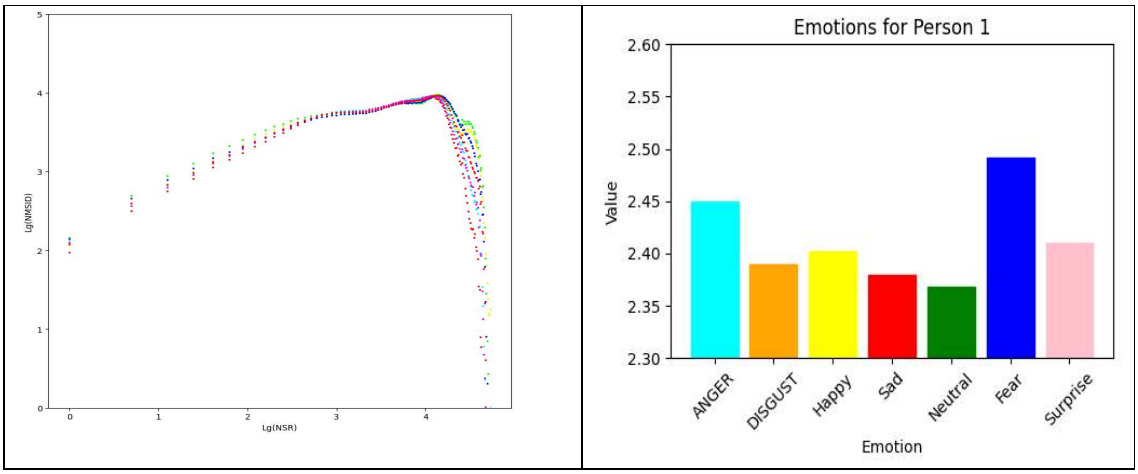
Fear				
Expresser	Fractal Dimension	Hurst Coefficient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.492	0.508	2.12 - 3.92	0 - 4.14
Expresser 2	2.48	0.52	2.01- 3.85	0 - 4.174
Expresser 3	2.39	0.61	1.92 - 3.94	0 - 4.094
Expresser 4	2.464	0.536	2.15 - 4.05	0 - 4.06
Expresser 5	2.351	0.649	2.07 - 4.20	0 - 4.094
Expresser 6	2.403	0.597	2.22 - 4.51	0 - 4.094
Expresser 7	2.433	0.567	2.113 - 4.040	0 - 4.174
Expresser 8	2.514	0.486	2.134 - 4.252	0 - 4.043
Expresser 9	2.422	0.578		0 - 3.952
Expresser 10	2.432	0.568	2.161 - 4.234	0 - 4.043
Expresser 11	2.424	0.576	2.317 - 4.299	0 - 4.078
Expresser 12	2.464	0.536	2.247 - 4.154	0 - 4.078
Expresser 13	2.454	0.546	2.124 - 40231	0 - 4.078
Expresser 14	2.44	0.56	2.032 - 4.043	0 - 4.077
Expresser 15	2.394	0.606	2.169 - 4.282	0 - 3.850
Expresser 16	2.481	0.519	2.363 - 4.202	0 - 4.043
Expresser 17	2.404	0.596	2.288 - 4.280	0 - 4.158
Expresser 18	2.493	0.507	2.320 - 4.304	0 - 4.077
Expresser 19	2.503	0.497	2.180 - 4.334	0 - 4.158

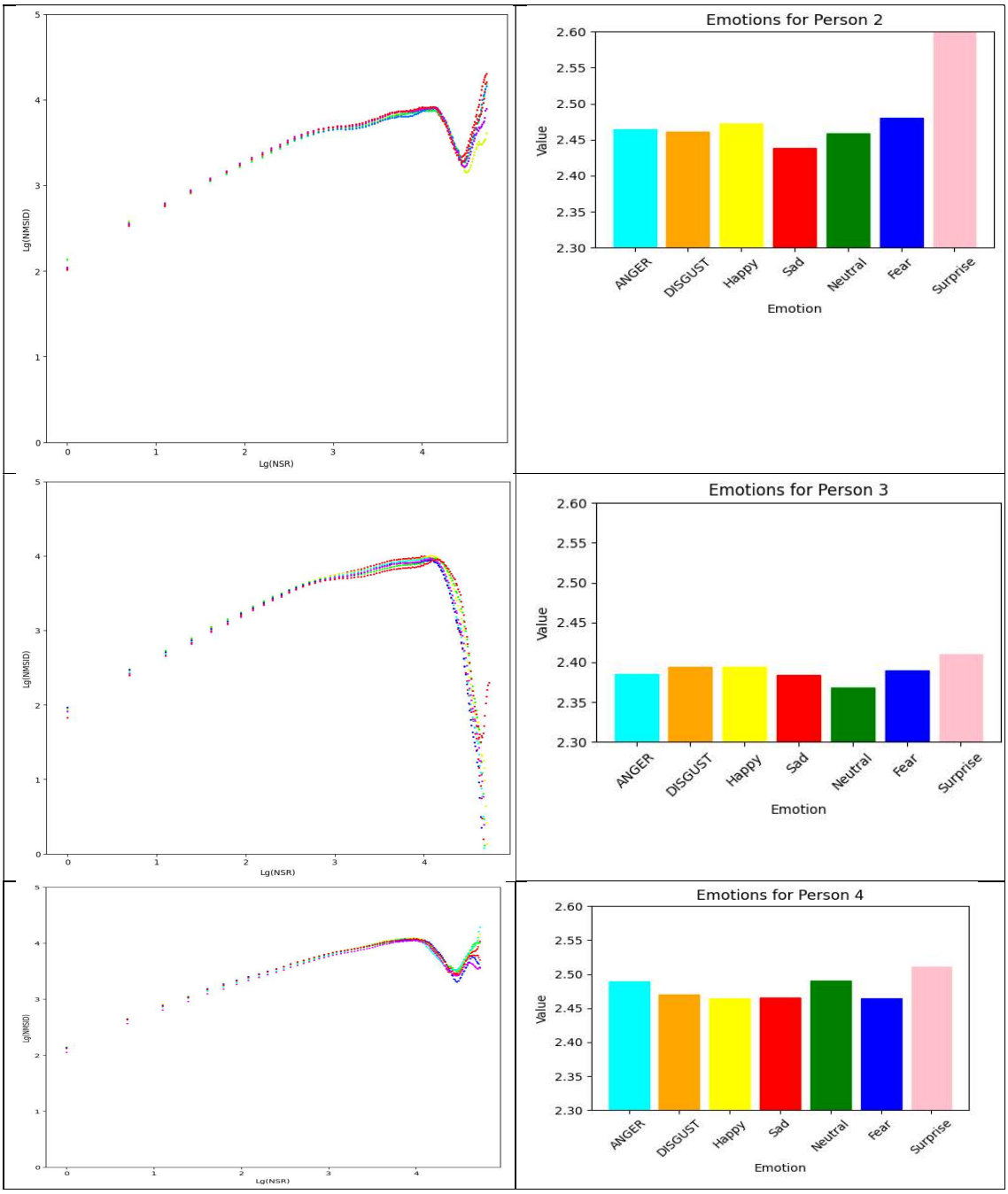
ANGER				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.45	0.55	2.07 - 3.94	0 - 4.14
Expresser 2	2.464	0.536	2.01 - 3.85	0 - 4.174
Expresser 3	2.385	0.615	1.94 - 3.99	0 - 4.094
Expresser 4	2.489	0.511	2.14 - 4.03	0 - 4.06
Expresser 5	2.393	0.607	2.05 - 4.15	0 - 4.094
Expresser 6	2.437	0.563	2.04 - 4.01	0 - 4.094
Expresser 7	2.401	0.599	2.54 - 4.50	0 - 4.174
Expresser 8	2.437	0.563	2.327 - 4.254	0 - 4.043
Expresser 9	2.433	0.567	2.287 - 4.068	0 - 3.952
Expresser 10	2.477	0.523	2.417 - 4.211	0 - 4.043
Expresser 11	2.444	0.556	2.578 - 4.352	0 - 4.078
Expresser 12	2.508	0.492	2.562 - 4.268	0 - 4.078
Expresser 13	2.436	0.564	2.17 - 4.282	0 - 4.078
Expresser 14	2.413	0.587	2.005 - 4.051	0 - 4.077
Expresser 15	2.45	0.55	2.252 - 4.059	0 - 3.850
Expresser 16	2.465	0.535	2.294 - 4.229	0 - 4.043
Expresser 17	2.466	0.534	2.625 - 4.305	0 - 4.158
Expresser 18	2.51	0.49	2.628 - 4.351	0 - 4.007
Expresser 19	2.412	0.588	2.258 - 4.363	0 - 4.158

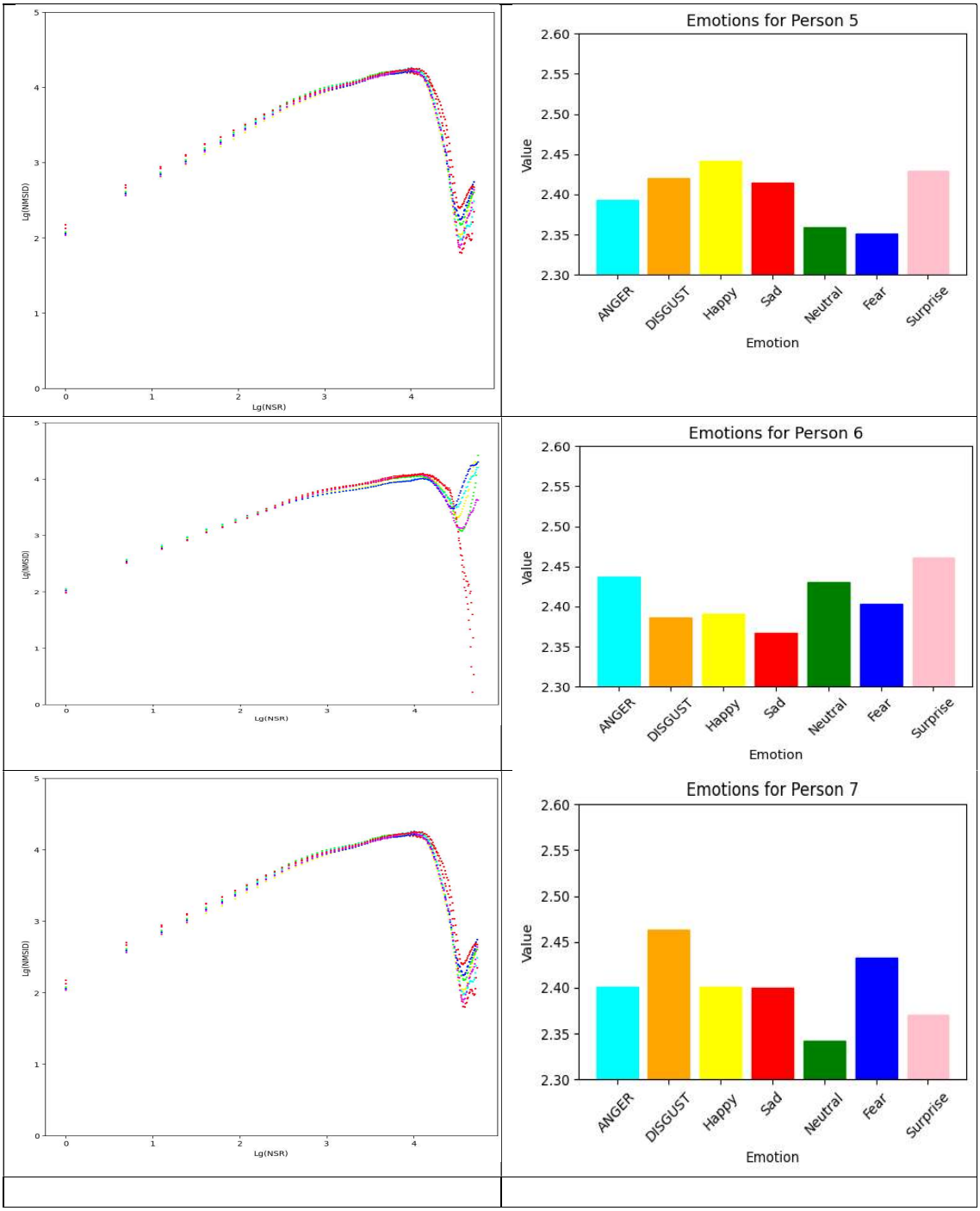
Surprise				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.41	0.59	2.14 - 3.93	0 - 4.14
Expresser 2	3	0	2.08 - 3.84	0 - 4.174
Expresser 3	2.41	0.59	1.95 - 3.94	0 - 4.094
Expresser 4	2.511	0.489	2.14 - 3.99	0 - 4.06
Expresser 5	2.429	0.571	2.17 - 4.15	0 - 4.094
Expresser 6	2.461	0.539	2.057 - 4.03	0 - 4.094
Expresser 7	2.371	0.629	2.32 - 4.51	0 - 4.174
Expresser 8	2.425	0.575	2.139 - 4.255	0 - 4.043
Expresser 9	2.422	0.578	2.161 - 4.223	0 - 3.952
Expresser 10	2.427	0.573	2.234 - 4.250	0 - 4.043
Expresser 11	2.403	0.597	2.321 - 4288	0 - 4.078
Expresser 12	2.451	0.549	2.220 - 4.128	0 - 4.078
Expresser 13	2.443	0.557	2.160 - 4.245	0 - 4.078
Expresser 14	2.434	0.566	2.038 - 4.016	0 - 4.077
Expresser 15	2.437	0.563	2.327 - 4.214	0 - 3.850
Expresser 16	2.489	0.511	2.346 - 4.290	0 - 4.043
Expresser 17	2.466	0.534	2.324 - 4.327	0 - 4.158
Expresser 18	2.482	0.518	2.326 - 4.326	0 - 4.077
Expresser 19	2.397	0.603	2.178 - 4.356	0- 4.158
DISGUST				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.39	0.61	2.06 - 3.93	0 - 4.14
Expresser 2	2.461	0.539	1.98 - 3.89	0 - 4.174
Expresser 3	2.394	0.606	1.96 - 3.96	0 - 4.094
Expresser 4	2.47	0.53	2.05 - 4.01	0 - 4.06
Expresser 5	2.42	0.58	2.05 - 4.16	0 - 4.094
Expresser 6	2.386	0.614	2.02 - 3.99	0 - 4.094
Expresser 7	2.463	0.537	2.33 - 4.52	0 - 4.174
Expresser 8	2.416	0.584	2.167 - 4.272	0 - 4.043
Expresser 9	2.386	0.614	2.072 - 4.195	0 - 3.952
Expresser 10	2.463	0.537	2.170 - 4.259	0 - 4.043
Expresser 11	2.416	0.584	2.271 - 4.269	0 - 4.078
Expresser 12	2.386	0.614	2.240 - 4.122	0 - 4.078
Expresser 13	2.463	0.537	2.0162 - 4.221	0 - 4.078
Expresser 14	2.416	0.584	1.981 - 3.982	0 - 4.077
Expresser 15	2.386	0.614	2.160 - 3.935	0 - 3.850
Expresser 16	2.463	0.537	2.346 - 4.250	0 - 4.043
Expresser 17		0.584	2.258 - 4.312	0 - 4.158
Expresser 18	2.386	0.614	2.245 - 4.354	0 - 4.077
Expresser 19	2.463	0.537	2.121 - 4.329	0 - 4.158

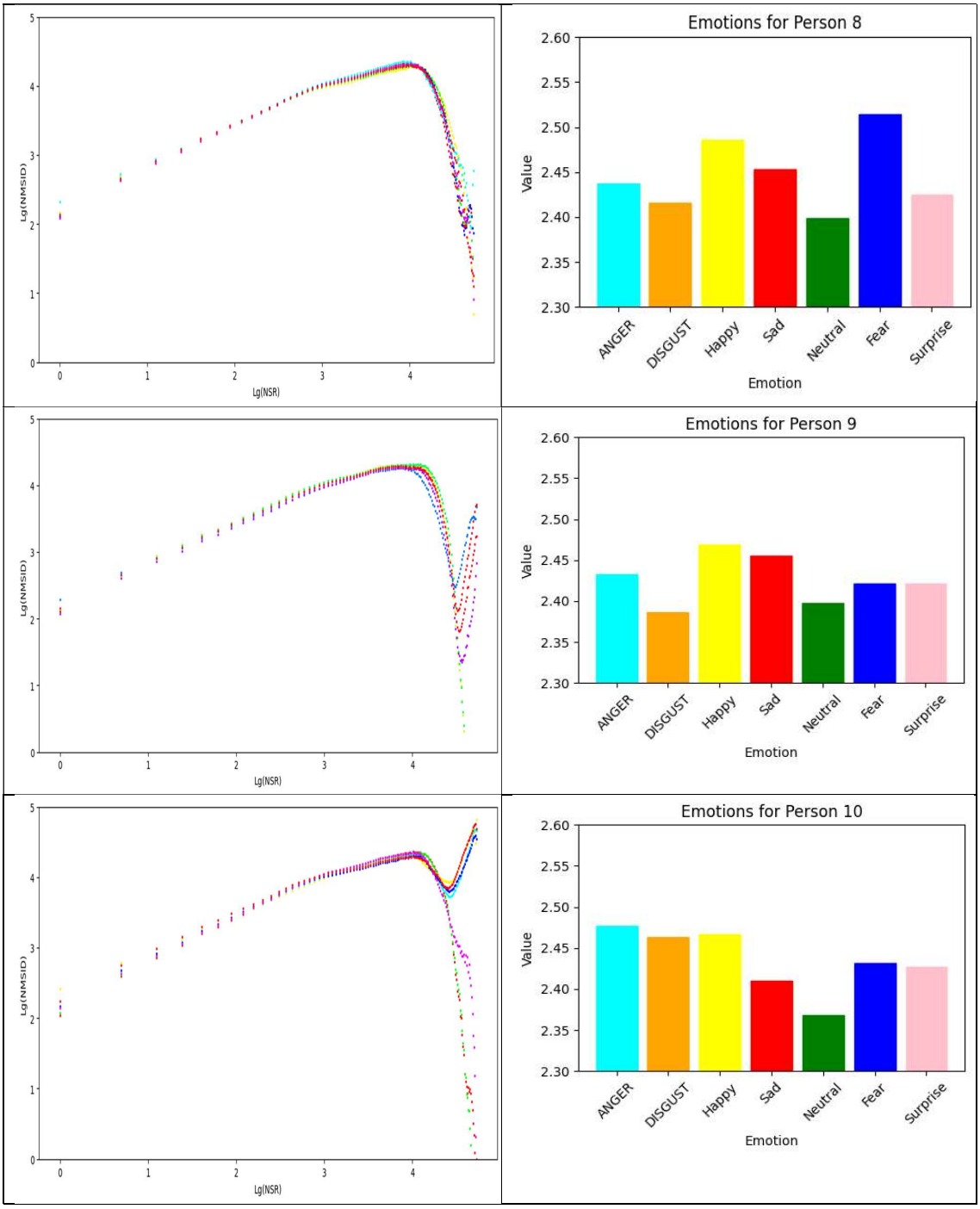
Neutral				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.368	0.632	1.97 - 3.91	0 - 4.14
Expresser 2	2.459	0.541	2.02 - 3.88	0 - 4.174
Expresser 3	2.368	0.632	1.83 - 3.94	0 - 4.094
Expresser 4	2.491	0.509	2.12 - 4.04	0 - 4.06
Expresser 5	2.359	0.641	2.05 - 4.19	0 - 4.094
Expresser 6	2.43	0.57	1.98 - 4.07	0 - 4.094
Expresser 7	2.342	0.658	2.24 - 4.50	0 - 4.174
Expresser 8	2.399	0.601	2.112 - 4.270	0 - 4.043
Expresser 9	2.398	0.602	2.104 - 4.288	0 - 3.952
Expresser 10	2.368	0.632	2.043 - 4.354	0 - 4.043
Expresser 11	2.413	0.587	2.350 - 4.342	0 - 4.078
Expresser 12	2.447	0.553	2.302 - 4.268	0 - 4.078
Expresser 13	2.346	0.654	2.067 - 4.302	0 - 4.078
Expresser 14	2.372	0.628	1.940 - 4.113	0 - 4.077
Expresser 15	2.432	0.568	2.267 - 4.148	0 - 3.850
Expresser 16	2.457	0.543	2.274 - 4.265	0 - 4.043
Expresser 17	2.424	0.576	2.286 - 4.366	0 - 4.158
Expresser 18	2.417	0.583	2.245 - 4.38	0 - 4.077
Expresser 19	2.362	0.638	2.146 - 4.390	0- 4.158

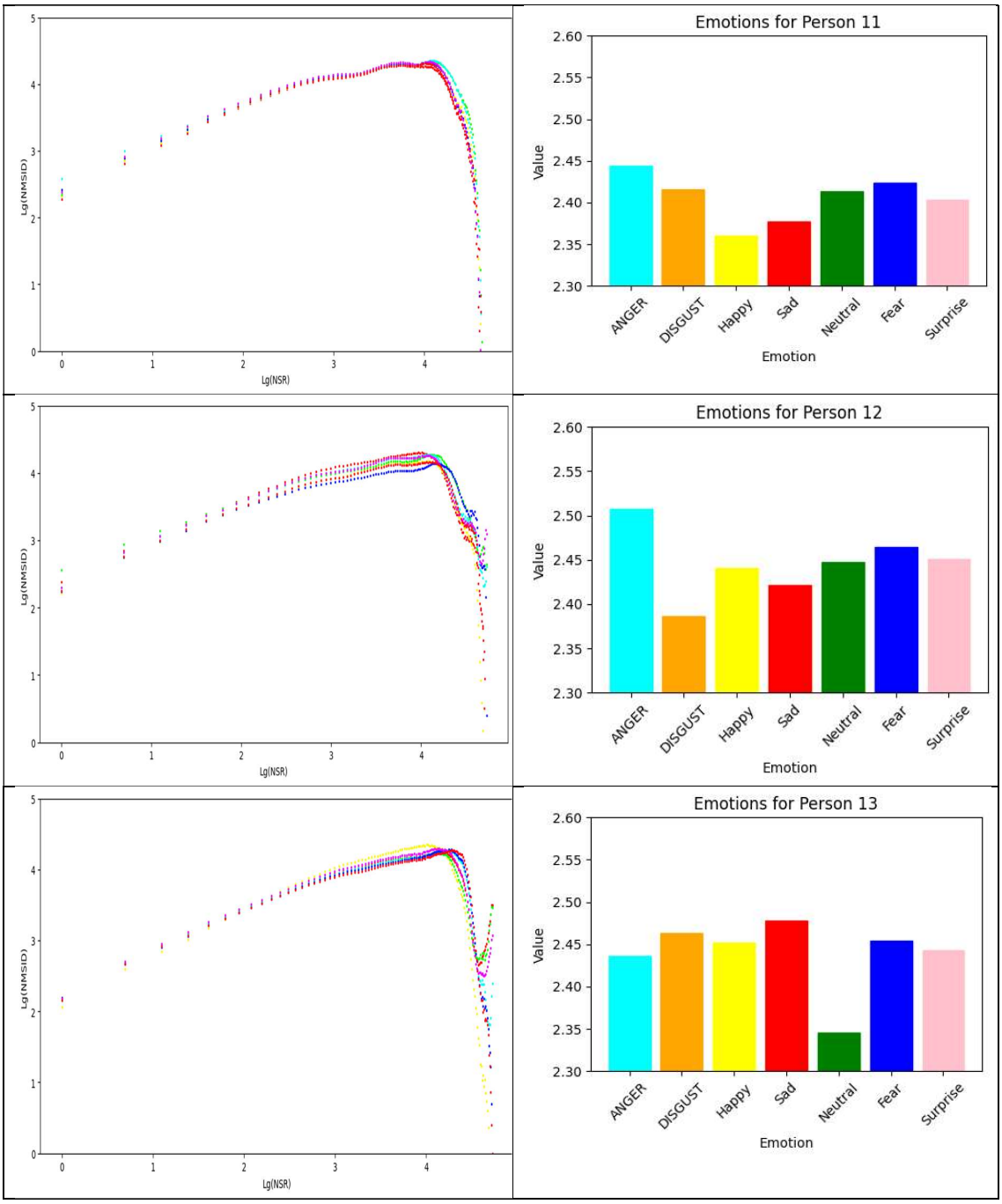
Figure 28. Expresser-specific log NMSID - log NSR plots and fractal dimensions for full face at 0 degree (Front view).

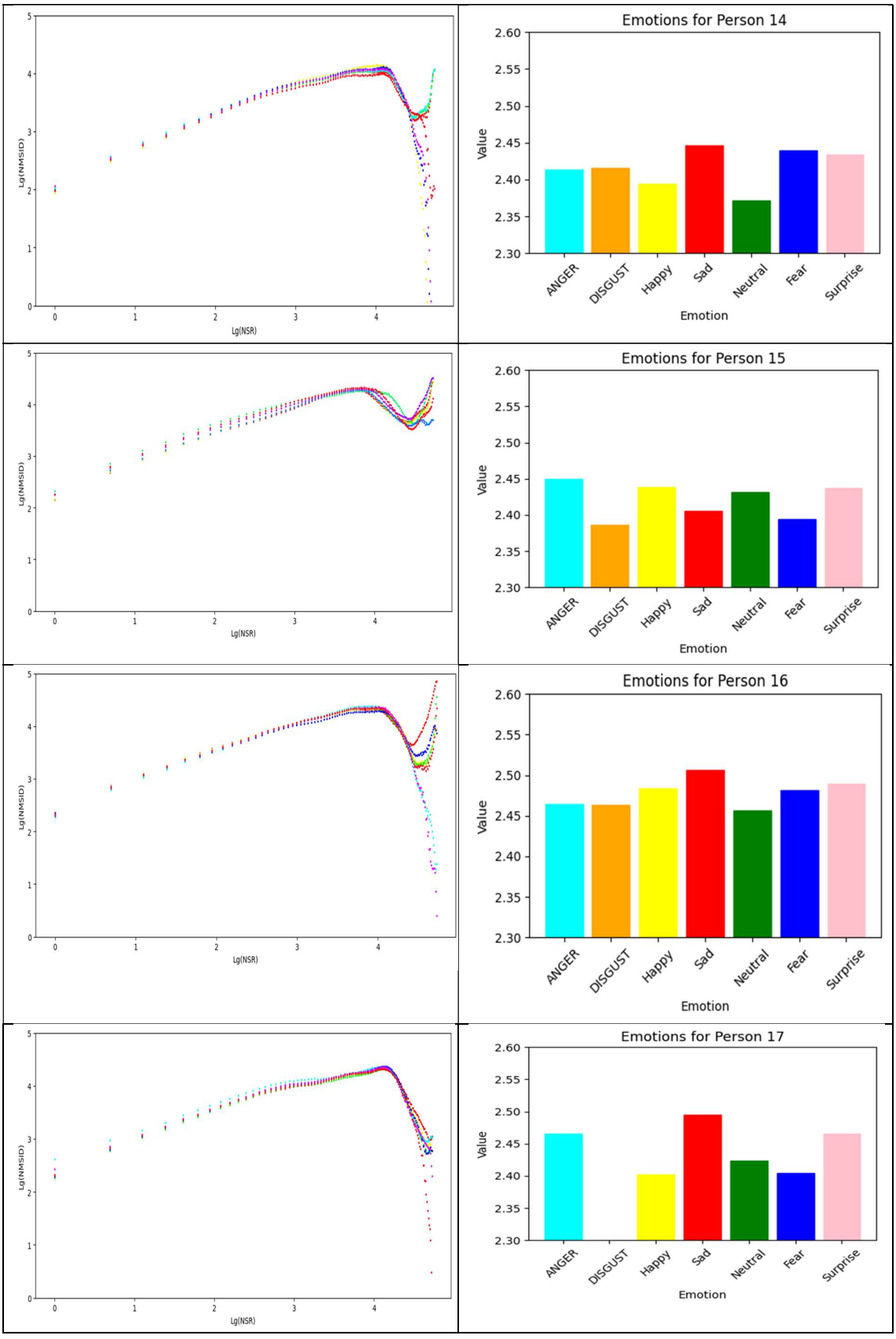



Lg(NMSID)
Lg(NSR)
Emotions for Person 2
Value
Emotion
ANGER
DISGUST
Happy
Sad
Neutral
Fear
Surprise
Emotions for Person 3
Emotions for Person 4


Lg(NMSID)
Lg(NSR)
Emotions for Person 5
Value
Emotion
ANGER
DISGUST
Happy
Sad
Neutral
Fear
Surprise
Emotions for Person 6
Emotions for Person 7


Lg(NMSID)
Lg(NSR)
Emotions for Person 8
Value
Emotion
ANGER
DISGUST
Happy
Sad
Neutral
Fear
Surprise
Emotions for Person 9
Emotions for Person 10


Lg(NMSID)
Lg(NSR)
Emotions for Person 11
Value
Emotion
ANGER
DISGUST
Happy
Sad
Neutral
Fear
Surprise
Emotions for Person 12
Emotions for Person 13


Lg(NMSID)
Lg(NSR)
Emotions for Person 14
Emotions for Person 15
Emotions for Person 16
Emotions for Person 17
Value
Emotion
ANGER
DISGUST
Happy
Sad
Neutral
Fear
Surprise

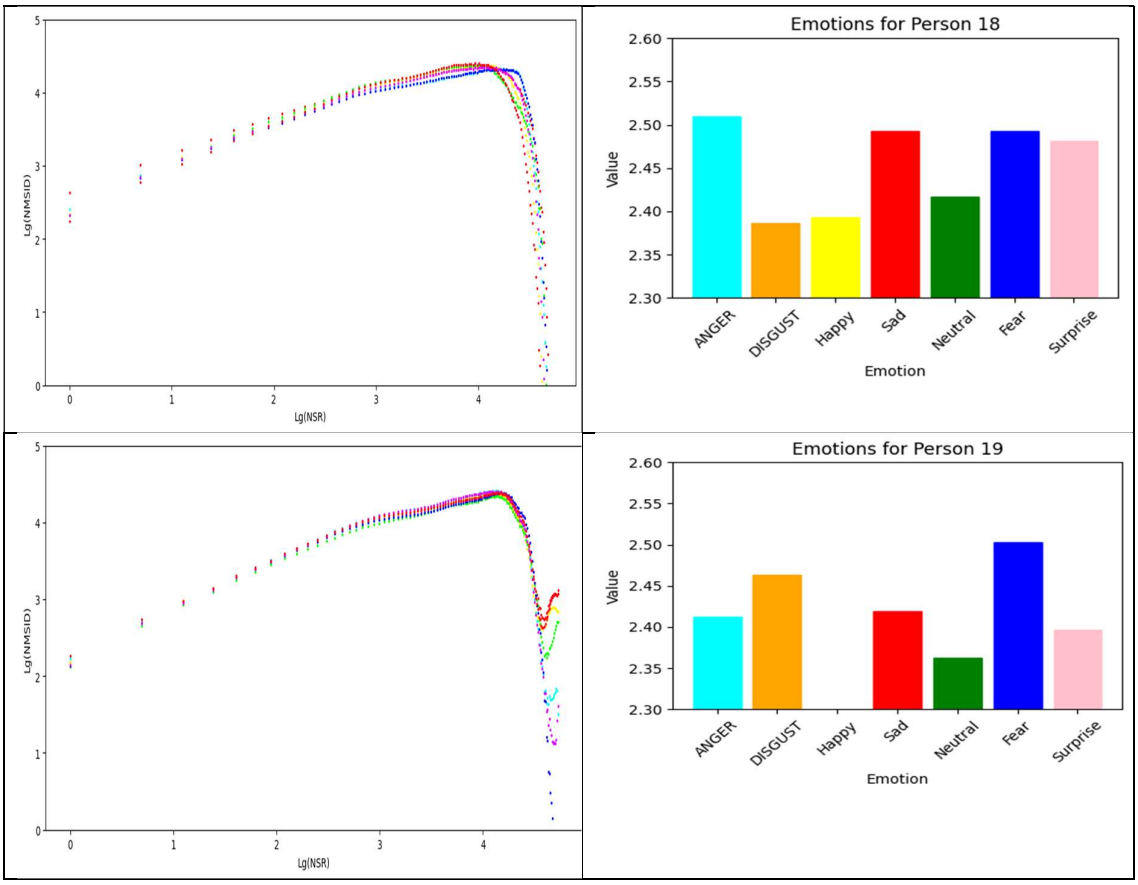

Lg(NMSID)
Lg(NSR)
Emotions for Person 18
Value
Emotion
ANGER
DISGUST
Happy
Sad
Neutral
Fear
Surprise
Lg(NMSID)
Lg(NSR)
Emotions for Person 19
Value
Emotion
ANGER
DISGUST
Happy
Sad
Neutral
Fear
Surprise

Table 15. Zone wise (eye, lips, and nose) emotion-specific fractal dimensions and Hurst coefficients for 0 degree (Front view).

Happy (Eye)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.594	0.406	0.0-3.045	2.193-3.575
Expresser 2	2.631	0.369	0.0-2.833	2.05-3.295
Expresser 3	2.546	0.454	0.0-3.178	2.144-3.487
Expresser 4	2.578	0.422	0.0-2.303	2.107-3.304
Expresser 5	2.554	0.446	0.0-2.303	2.295-3.542
Expresser 6	2.557	0.443	0.0-2.303	2.269-3.405
Expresser 7	2.566	0.434	0.0-2.708	2.5-3.678
Expresser 8	2.609	0.391	0.0-3.466	2.277-3.699
Expresser 9	2.585	0.415	0.0-3.367	2.378-3.767
Expresser 10	2.552	0.448	0.0-2.708	2.277-3.597
Expresser 11	2.576	0.424	0.0-2.303	2.581-3.822
Expresser 12	2.624	0.376	0.0-2.303	2.548-3.704
Expresser 13	2.591	0.409	0.0-2.708	2.33-3.608
Expresser 14	2.56	0.44	0.0-2.639	2.158-3.483
Expresser 15	2.528	0.472	0.0-2.708	2.449-3.847
Expresser 16	2.725	0.275	0.0-2.708	2.461-3.661
Expresser 17	2.583	0.417	0.0-2.944	2.454-3.826
Expresser 18	2.626	0.374	0.0-2.303	2.271-3.436
Expresser 19				
Happy (Lips)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.42	0.58	0.0-3.258	2.231-3.986
Expresser 2	2.489	0.511	0.0-2.303	1.6-2.956
Expresser 3	2.511	0.489	0.0-3.091	2.071-3.695
Expresser 4	2.421	0.579	0.0-2.565	1.494-2.981
Expresser 5	2.411	0.589	0.0-2.708	1.927-3.475
Expresser 6	2.42	0.58	0.0-2.833	1.858-3.373
Expresser 7	2.311	0.689	0.0-4.06	1.839-3.87
Expresser 8	2.521	0.479	0.0-2.944	1.947-3.425
Expresser 9	2.41	0.59	0.0-2.485	1.761-3.234
Expresser 10	2.473	0.527	0.0-2.708	1.636-3.041
Expresser 11	2.411	0.589	0.0-3.178	2.395-4.15
Expresser 12	2.417	0.583	0.0-3.091	2.157-3.762
Expresser 13	2.485	0.515	0.0-2.485	1.529-2.891
Expresser 14	2.375	0.625	0.0-3.258	1.379-3.065
Expresser 15	2.492	0.508	0.0-2.833	1.939-3.437
Expresser 16	2.457	0.543	0.0-2.833	2.318-3.822
Expresser 17	2.61	0.39	0.0-3.045	2.257-3.634
Expresser 18	2.418	0.582	0.0-2.833	1.681-3.293
Expresser 19				

Happy (Nose)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.434	0.566	0.0-3.761	1.533-3.422
Expresser 2	2.389	0.611	0.0-4.094	1.634-3.538
Expresser 3	2.48	0.52	0.0-3.584	1.649-3.459
Expresser 4	2.435	0.565	0.0-4.263	1.477-3.381
Expresser 5	2.292	0.708	0.0-3.664	1.434-3.548
Expresser 6	2.384	0.616	0.0-3.434	1.734-3.425
Expresser 7	2.368	0.632	0.0-4.06	1.881-3.873
Expresser 8	2.386	0.614	0.0-2.708	1.504-3.102
Expresser 9	2.361	0.639	0.0-4.094	1.74-3.773
Expresser 10	2.422	0.578	0.0-4.025	1.616-3.447
Expresser 11	2.46	0.54	0.0-4.394	1.888-4.321
Expresser 12	2.464	0.536	0.0-3.871	1.684-3.517
Expresser 13	2.468	0.532	0.0-3.178	1.695-3.292
Expresser 14	2.411	0.589	0.0-3.584	1.55-3.337
Expresser 15				
Expresser 16	2.413	0.587	0.0-2.833	1.832-3.414
Expresser 17	2.415	0.585	0.0-3.584	1.983-3.951
Expresser 18	2.435	0.565	0.0-3.932	1.719-3.545
Expresser 19	2.377	0.623	0.0-3.434	1.728-3.476

Sad (Eye)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.518	0.482	0.0-2.833	2.189-3.651
Expresser 2	2.634	0.366	0.0-2.833	2.042-3.295
Expresser 3	2.521	0.479	0.0-3.045	2.131-3.521
Expresser 4	2.593	0.407	0.0-2.303	2.098-3.305
Expresser 5	2.624	0.376	0.0-2.485	2.298-3.468
Expresser 6	2.603	0.397	0.0-2.485	2.299-3.402
Expresser 7	2.575	0.425	0.0-2.708	2.581-3.818
Expresser 8	2.559	0.441	0.0-3.526	2.268-3.777
Expresser 9	2.569	0.431	0.0-3.296	2.34-3.728
Expresser 10	2.53	0.47	0.0-2.708	2.216-3.598
Expresser 11	2.582	0.418	0.0-2.079	2.571-3.807
Expresser 12	2.594	0.406	0.0-2.079	2.575-3.807
Expresser 13	2.564	0.436	0.0-2.708	2.365-3.687
Expresser 14	2.61	0.39	0.0-2.708	2.174-3.42
Expresser 15	2.58	0.42	0.0-2.833	2.439-3.778
Expresser 16	2.541	0.459	0.0-2.833	2.39-3.817
Expresser 17	2.694	0.306	0.0-3.091	2.436-3.739
Expresser 18	2.547	0.453	0.0-2.303	2.452-3.748
Expresser 19	2.643	0.357	0.0-2.303	2.37-3.471

Sad (Lips)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.442	0.558	0.0-3.045	1.83-3.419
Expresser 2	2.572	0.428	0.0-2.303	1.634-2.858
Expresser 3	2.495	0.505	0.0-3.135	1.918-3.363
Expresser 4	2.419	0.581	0.0-2.708	1.39-2.982
Expresser 5	2.424	0.576	0.0-2.485	1.655-3.145
Expresser 6	2.356	0.644	0.0-2.708	1.48-3.075
Expresser 7	2.428	0.572	0.0-2.708	1.893-3.303
Expresser 8	2.487	0.513	0.0-2.708	1.633-3.059
Expresser 9	2.409	0.591	0.0-3.258	1.618-3.298
Expresser 10	2.386	0.614	0.0-2.708	1.515-3.023
Expresser 11	2.414	0.586	0.0-3.091	2.275-3.924
Expresser 12	2.402	0.598	0.0-2.996	2.232-3.813
Expresser 13	2.422	0.578	0.0-3.367	1.487-3.261
Expresser 14	2.305	0.695	0.0-3.367	1.277-3.216
Expresser 15	2.299	0.701	0.0-3.045	1.705-3.725
Expresser 16	2.361	0.639	0.0-3.258	1.586-3.481
Expresser 17	2.369	0.631	0.0-2.89	2.235-3.896
Expresser 18	2.569	0.431	0.0-2.303	2.054-3.204
Expresser 19	2.347	0.653	0.0-3.258	1.636-3.516
Sad (Nose)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.49	0.51	0.0-3.761	1.58-3.27
Expresser 2	2.411	0.589	0.0-4.174	1.665-3.6
Expresser 3	2.471	0.529	0.0-3.526	1.604-3.212
Expresser 4	2.425	0.575	0.0-4.304	1.347-3.513
Expresser 5	2.458	0.542	0.0-4.248	1.629-3.701
Expresser 6	2.475	0.525	0.0-4.127	1.801-3.504
Expresser 7	2.432	0.568	0.0-4.06	1.957-3.789
Expresser 8	2.406	0.594	0.0-2.708	1.652-3.162
Expresser 9	2.4	0.6	0.0-4.094	1.785-3.747
Expresser 10	2.462	0.538	0.0-4.094	1.591-3.406
Expresser 11	2.52	0.48	0.0-3.526	1.882-3.593
Expresser 12	2.481	0.519	0.0-3.932	1.797-3.501
Expresser 13	2.375	0.625	0.0-2.833	1.554-3.206
Expresser 14	2.439	0.561	0.0-3.258	1.47-3.201
Expresser 15	2.406	0.594	0.0-4.007	1.711-3.613
Expresser 16	2.483	0.517	0.0-4.043	1.759-3.572
Expresser 17	2.509	0.491	0.0-3.434	2.093-3.633
Expresser 18	2.436	0.564	0.0-3.178	1.897-3.46
Expresser 19	2.529	0.471	0.0-3.258	1.954-3.419

Fear (Eye)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.62	0.38	0.0-3.045	2.343-3.681
Expresser 2	2.618	0.382	0.0-2.944	2.136-3.438
Expresser 3	2.595	0.405	0.0-2.773	2.154-3.407
Expresser 4	2.596	0.404	0.0-2.303	2.109-3.322
Expresser 5	2.621	0.379	0.0-3.178	2.392-3.677
Expresser 6	2.559	0.441	0.0-2.303	2.319-3.479
Expresser 7	2.557	0.443	0.0-2.708	2.533-3.742
Expresser 8	2.542	0.458	0.0-3.466	2.278-3.786
Expresser 9	2.589	0.411	0.0-2.639	2.334-3.539
Expresser 10	2.658	0.342	0.0-2.485	2.43-3.577
Expresser 11	2.589	0.411	0.0-2.944	2.571-3.973
Expresser 12	2.618	0.382	0.0-2.485	2.475-3.642
Expresser 13	2.599	0.401	0.0-2.708	2.434-3.711
Expresser 14	2.644	0.356	0.0-2.708	2.254-3.472
Expresser 15	2.632	0.368	0.0-3.526	2.47-3.885
Expresser 16	2.608	0.392	0.0-2.639	2.494-3.854
Expresser 17	2.691	0.309	0.0-3.045	2.478-3.747
Expresser 18	2.556	0.444	0.0-3.045	2.532-3.932
Expresser 19	2.652	2.653	0.0-3.434	2.348-3.68

Fear (Lips)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.41	0.59	0.0-3.219	1.858-3.457
Expresser 2	2.471	0.529	0.0-2.485	1.539-2.926
Expresser 3	2.496	0.504	0.0-3.135	1.927-3.376
Expresser 4	2.417	0.583	0.0-2.708	1.567-3.169
Expresser 5	2.409	0.591	0.0-3.367	1.641-3.383
Expresser 6	2.348	0.652	0.0-2.708	1.529-3.183
Expresser 7	2.379	0.621	0.0-2.944	1.905-3.544
Expresser 8	2.45	0.55	0.0-2.708	1.707-3.135
Expresser 9	2.334	0.666	0.0-2.565	1.593-3.209
Expresser 10	2.387	0.613	0.0-2.565	1.519-3.021
Expresser 11	2.424	0.576	0.0-2.996	2.231-3.867
Expresser 12	2.4	0.6	0.0-2.833	2.179-3.723
Expresser 13	2.413	0.587	0.0-3.434	1.544-3.391
Expresser 14	2.332	0.668	0.0-2.708	1.452-3.104
Expresser 15	2.276	0.724	0.0-3.258	1.744-3.822
Expresser 16	2.341	0.659	0.0-3.258	1.701-3.577
Expresser 17	2.352	0.648	0.0-2.89	2.243-3.935
Expresser 18	2.581	0.419	0.0-2.565	2.116-3.325
Expresser 19	2.336	0.664	0.0-3.258	1.715-3.52

Fear (Nose)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.516	0.484	0.0-4.22	1.683-3.358
Expresser 2	2.448	0.552	0.0-4.394	1.587-3.715
Expresser 3	2.453	0.547	0.0-3.638	1.564-3.209
Expresser 4	2.348	0.652	0.0-2.708	1.464-3.157
Expresser 5	2.415	0.585	0.0-3.97	1.713-3.614
Expresser 6	2.439	0.561	0.0-3.258	1.717-3.231
Expresser 7	2.43	0.57	0.0-3.434	1.961-3.58
Expresser 8	2.449	0.551	0.0-2.773	1.729-3.133
Expresser 9	2.364	0.636	0.0-4.111	1.695-3.734
Expresser 10	2.468	0.532	0.0-3.434	1.538-3.18
Expresser 11	2.477	0.523	0.0-3.434	1.911-3.722
Expresser 12	2.461	0.539	0.0-3.871	1.804-3.567
Expresser 13	2.408	0.592	0.0-3.045	1.683-3.297
Expresser 14	2.455	0.545	0.0-3.258	1.62-3.22
Expresser 15	2.346	0.654	0.0-2.833	1.636-3.409
Expresser 16	2.54	0.46	0.0-4.344	1.888-3.779
Expresser 17	2.503	0.497	0.0-3.367	2.084-3.644
Expresser 18	2.426	0.574	0.0-3.434	1.864-3.462
Expresser 19	2.502	0.498	0.0-3.367	1.986-3.484

Anger (Eye)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.644	0.356	0.0-3.045	2.337-3.677
Expresser 2	2.501	0.499	0.0-2.565	2.048-3.514
Expresser 3	2.524	0.476	0.0-3.045	2.168-3.58
Expresser 4	2.637	0.363	0.0-2.833	2.184-3.511
Expresser 5	2.729	0.271	0.0-2.079	2.479-3.451
Expresser 6	2.672	0.328	0.0-2.079	2.46-3.523
Expresser 7	2.551	0.449	0.0-2.708	2.606-3.817
Expresser 8	2.562	0.438	0.0-3.401	2.173-3.722
Expresser 9	2.44	0.56	0.0-2.485	2.351-3.852
Expresser 10	2.503	0.497	0.0-2.485	2.37-3.724
Expresser 11	2.577	0.423	0.0-2.833	2.586-3.984
Expresser 12	2.529	0.471	0.0-2.708	2.473-3.927
Expresser 13	2.505	0.495	0.0-2.303	2.456-3.78
Expresser 14	2.643	0.357	0.0-2.708	2.183-3.441
Expresser 15	2.606	0.394	0.0-2.833	2.517-3.799
Expresser 16	2.509	0.491	0.0-2.639	2.444-3.876
Expresser 17	2.55	0.45	0.0-2.944	2.418-3.859
Expresser 18	2.403	0.597	0.0-2.485	2.426-3.967
Expresser 19	2.648	0.352	0.0-3.434	2.391-3.755

Anger (Lips)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.419	0.581	0.0-2.708	1.998-3.577
Expresser 2	2.467	0.533	0.0-2.485	1.642-3.023
Expresser 3	2.453	0.547	0.0-3.258	1.979-3.51
Expresser 4	2.399	0.601	0.0-2.833	1.749-3.418
Expresser 5	2.35	0.65	0.0-3.178	2.019-3.824
Expresser 6	2.311	0.689	0.0-2.833	1.603-3.407
Expresser 7	2.507	0.493	0.0-2.944	2.216-3.637
Expresser 8	2.578	0.422	0.0-2.708	1.949-3.329
Expresser 9	2.555	0.445	0.0-2.833	1.989-3.308
Expresser 10	2.335	0.665	0.0-2.708	1.867-3.59
Expresser 11	2.447	0.553	0.0-2.833	2.386-3.868
Expresser 12	2.404	0.596	0.0-2.89	2.178-3.699
Expresser 13	2.398	0.602	0.0-3.526	1.478-3.319
Expresser 14	2.332	0.668	0.0-2.833	1.49-3.298
Expresser 15	2.303	0.697	0.0-3.045	1.846-3.845
Expresser 16	2.322	0.678	0.0-3.045	1.664-3.591
Expresser 17	2.402	0.598	0.0-2.89	2.216-3.807
Expresser 18	2.556	0.444	0.0-2.833	2.191-3.507
Expresser 19	2.407	0.593	0.0-2.833	1.895-3.49

Anger (Nose)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.511	0.489	0.0-4.143	1.625-3.294
Expresser 2	2.386	0.614	0.0-4.22	1.552-3.543
Expresser 3	2.412	0.588	0.0-3.714	1.496-3.258
Expresser 4	2.44	0.56	0.0-4.357	1.491-3.552
Expresser 5	2.367	0.633	0.0-3.045	1.586-3.355
Expresser 6	2.456	0.544	0.0-4.263	1.731-3.547
Expresser 7	2.417	0.583	0.0-4.025	1.951-3.753
Expresser 8	2.472	0.528	0.0-2.773	1.706-3.134
Expresser 9	2.433	0.567	0.0-4.22	1.98-3.805
Expresser 10	2.497	0.503	0.0-3.434	1.716-3.198
Expresser 11	2.476	0.524	0.0-3.584	1.763-3.674
Expresser 12	2.508	0.492	0.0-3.932	1.802-3.506
Expresser 13	2.465	0.535	0.0-3.258	1.714-3.291
Expresser 14	2.421	0.579	0.0-3.526	1.412-3.185
Expresser 15	2.378	0.622	0.0-3.97	1.727-3.675
Expresser 16	2.446	0.554	0.0-2.833	1.843-3.357
Expresser 17	2.465	0.535	0.0-3.526	2.013-3.703
Expresser 18	2.492	0.508	0.0-4.234	1.93-3.712
Expresser 19	2.463	0.537	0.0-3.434	1.923-3.499

Surprise (Eye)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.608	0.392	0.0-2.303	2.356-3.523
Expresser 2	2.649	0.351	0.0-3.178	2.19-3.4
Expresser 3	2.616	0.384	0.0-2.89	2.18-3.43
Expresser 4	2.631	0.369	0.0-2.303	2.177-3.342
Expresser 5	2.617	0.383	0.0-2.485	2.367-3.511
Expresser 6	2.655	0.345	0.0-2.639	2.462-3.491
Expresser 7	2.572	0.428	0.0-2.708	2.552-3.733
Expresser 8	2.586	0.414	0.0-3.466	2.223-3.728
Expresser 9	2.573	0.427	0.0-2.708	2.332-3.553
Expresser 10	2.602	0.398	0.0-2.708	2.411-3.62
Expresser 11	2.63	0.37	0.0-3.045	2.64-3.951
Expresser 12	2.625	0.375	0.0-2.303	2.495-3.653
Expresser 13	2.589	0.411	0.0-2.708	2.447-3.721
Expresser 14	2.549	0.451	0.0-2.639	2.18-3.439
Expresser 15	2.521	0.479	0.0-2.708	2.439-3.859
Expresser 16	2.643	0.357	0.0-2.708	2.526-3.804
Expresser 17	2.704	0.296	0.0-3.258	2.53-3.813
Expresser 18	2.567	0.433	0.0-2.833	2.555-3.914
Expresser 19	2.626	0.374	0.0-2.565	2.322-3.526

Surprise (Lips)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.443	0.557	0.0-2.996	1.82-3.378
Expresser 2	2.539	0.461	0.0-2.303	1.518-2.785
Expresser 3	2.461	0.539	0.0-3.135	1.794-3.366
Expresser 4	2.379	0.621	0.0-2.708	1.469-3.102
Expresser 5	2.437	0.563	0.0-3.434	1.614-3.364
Expresser 6	2.382	0.618	0.0-2.708	1.496-3.087
Expresser 7	2.369	0.631	0.0-2.708	2.004-3.553
Expresser 8	2.453	0.547	0.0-2.833	1.658-3.125
Expresser 9	2.438	0.562	0.0-2.303	1.821-3.284
Expresser 10	2.412	0.588	0.0-2.565	1.631-3.068
Expresser 11	2.383	0.617	0.0-3.091	2.191-3.896
Expresser 12	2.332	0.668	0.0-2.89	2.131-3.864
Expresser 13	2.406	0.594	0.0-3.434	1.58-3.339
Expresser 14	2.315	0.685	0.0-3.258	1.131-3.068
Expresser 15	2.302	0.698	0.0-3.091	1.704-3.722
Expresser 16	2.39	0.61	0.0-3.258	1.662-3.511
Expresser 17	2.414	0.586	0.0-2.89	2.248-3.81
Expresser 18	2.543	0.457	0.0-2.303	2.123-3.334
Expresser 19	2.417	0.583	0.0-3.258	1.691-3.391

Surprise (Nose)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.35	0.65	0.0-2.833	1.415-3.163
Expresser 2	2.459	0.541	0.0-4.078	1.719-3.492
Expresser 3	2.392	0.608	0.0-2.639	1.502-3.11
Expresser 4	2.34	0.66	0.0-2.833	1.851-3.567
Expresser 5	2.381	0.619	0.0-2.833	1.608-3.247
Expresser 6	2.472	0.528	0.0-3.526	1.596-3.255
Expresser 7	2.486	0.514	0.0-3.258	2.012-3.618
Expresser 8	2.51	0.49	0.0-4.382	1.732-3.575
Expresser 9	2.42	0.58	0.0-2.944	1.603-3.175
Expresser 10	2.532	0.468	0.0-3.584	1.946-3.74
Expresser 11	2.464	0.536	0.0-3.258	1.739-3.169
Expresser 12	2.352	0.648	0.0-3.258	1.575-3.498
Expresser 13	2.356	0.644	0.0-4.159	1.76-3.795
Expresser 14	2.526	0.474	0.0-4.248	1.853-3.637
Expresser 15	2.385	0.615	0.0-3.871	1.726-3.585
Expresser 16	2.473	0.527	0.0-3.829	1.836-3.524
Expresser 17	2.489	0.511	0.0-4.234	1.903-3.631
Expresser 18	2.334	0.666	0.0-4.248	1.552-3.681
Expresser 19	2.499	0.501	0.0-4.331	1.893-3.904

Disgust (Eye)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.586	0.414	0.0-3.045	2.251-3.646
Expresser 2	2.717	0.283	0.0-2.708	2.111-3.306
Expresser 3	2.521	0.479	0.0-2.944	2.122-3.492
Expresser 4	2.608	0.392	0.0-2.079	1.927-3.196
Expresser 5	2.635	0.365	0.0-2.565	2.263-3.461
Expresser 6	2.546	0.454	0.0-2.708	2.295-3.655
Expresser 7	2.583	0.417	0.0-2.708	2.502-3.726
Expresser 8	2.529	0.471	0.0-3.466	2.23-3.715
Expresser 9	2.631	0.369	0.0-2.639	2.297-3.473
Expresser 10	2.549	0.451	0.0-2.565	2.318-3.631
Expresser 11	2.426	0.574	0.0-2.708	2.456-4.042
Expresser 12	2.627	0.373	0.0-2.398	2.44-3.623
Expresser 13	2.532	0.468	0.0-2.565	2.349-3.686
Expresser 14	2.571	0.429	0.0-2.708	2.15-3.408
Expresser 15	2.471	0.529	0.0-2.708	2.329-3.825
Expresser 16	2.625	0.375	0.0-2.944	2.438-3.781
Expresser 17	2.669	0.331	0.0-3.045	2.408-3.719
Expresser 18	2.462	0.538	0.0-2.708	2.447-3.921
Expresser 19	2.603	0.397	0.0-2.708	2.18-3.392

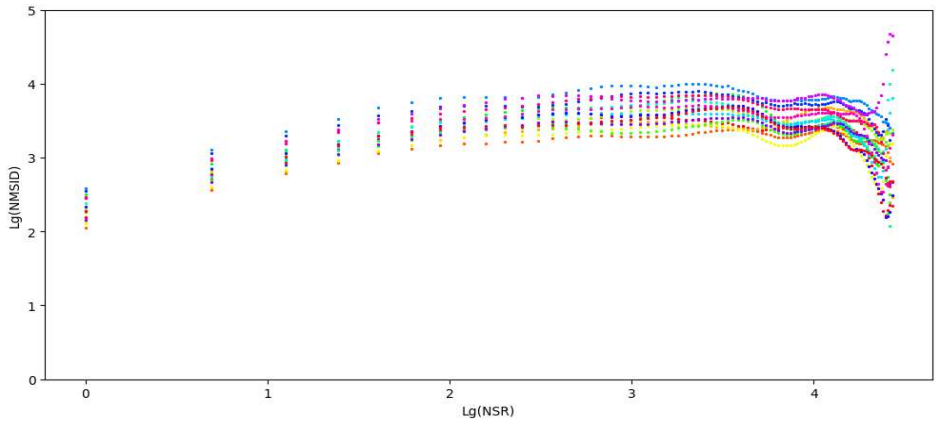
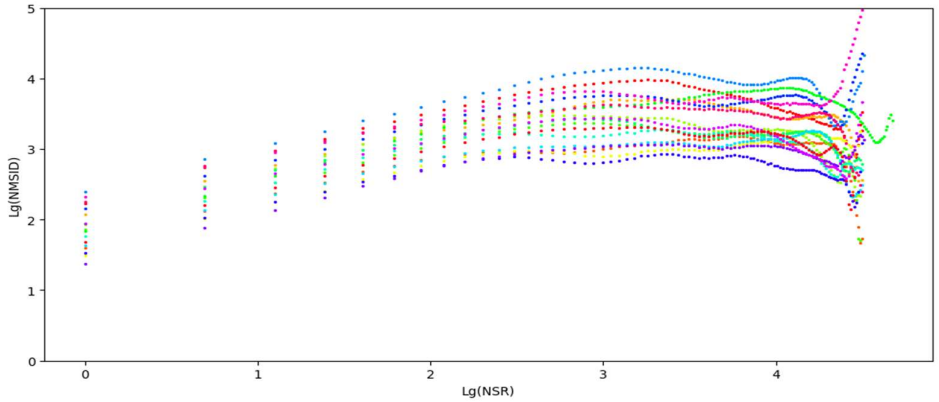
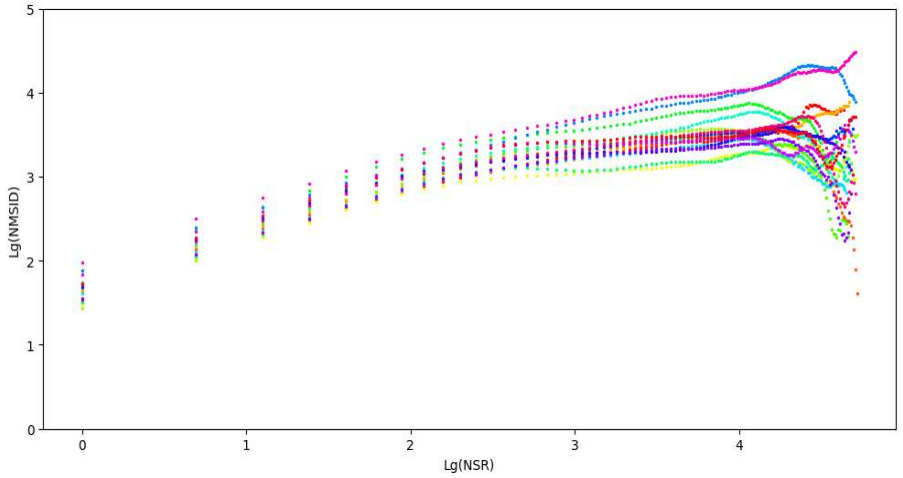
Disgust (Lips)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.419	0.581	0.0-3.045	1.757-3.408
Expresser 2	2.473	0.527	0.0-2.485	1.414-2.784
Expresser 3	2.519	0.481	0.0-3.219	1.891-3.336
Expresser 4	2.461	0.539	0.0-2.833	1.19-2.701
Expresser 5	2.394	0.606	0.0-2.708	1.559-3.084
Expresser 6	2.388	0.612	0.0-2.639	1.622-3.12
Expresser 7	2.506	0.494	0.0-2.708	2.214-3.574
Expresser 8	2.526	0.474	0.0-2.89	1.762-3.092
Expresser 9	2.522	0.478	0.0-2.303	1.751-3.052
Expresser 10	2.557	0.443	0.0-2.708	1.736-2.964
Expresser 11	2.43	0.57	0.0-3.178	2.252-3.912
Expresser 12	2.361	0.639	0.0-2.944	2.041-3.725
Expresser 13	2.406	0.594	0.0-2.485	1.583-3.13
Expresser 14	2.432	0.568	0.0-3.584	1.332-3.059
Expresser 15	2.263	0.737	0.0-2.833	1.687-3.653
Expresser 16	2.448	0.552	0.0-3.466	1.547-3.193
Expresser 17	2.422	0.578	0.0-2.996	2.24-3.802
Expresser 18	2.574	0.426	0.0-2.303	2.192-3.389
Expresser 19	2.412	0.588	0.0-2.708	1.603-3.162
Disgust (Nose)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.441	0.559	0.0-3.584	1.563-3.444
Expresser 2	2.356	0.644	0.0-3.584	1.558-3.428
Expresser 3	2.451	0.549	0.0-3.638	1.614-3.347
Expresser 4	2.35	0.65	0.0-2.833	1.266-3.03
Expresser 5	2.387	0.613	0.0-3.178	1.642-3.446
Expresser 6	2.41	0.59	0.0-3.951	1.804-3.552
Expresser 7	2.333	0.667	0.0-3.932	1.808-3.82
Expresser 8	2.435	0.565	0.0-2.996	1.644-3.173
Expresser 9	2.348	0.652	0.0-4.143	1.731-3.789
Expresser 10	2.428	0.572	0.0-3.912	1.74-3.539
Expresser 11	2.465	0.535	0.0-4.394	1.928-4.373
Expresser 12	2.484	0.516	0.0-3.871	1.715-3.587
Expresser 13	2.405	0.595	0.0-3.258	1.6-3.358
Expresser 14	2.411	0.589	0.0-4.263	1.471-3.481
Expresser 15	2.372	0.628	0.0-3.871	1.651-3.584
Expresser 16	2.486	0.514	0.0-4.394	1.744-3.855
Expresser 17	2.504	0.496	0.0-3.434	2.045-3.688
Expresser 18	2.479	0.521	0.0-4.331	1.956-3.809
Expresser 19	2.469	0.531	0.0-3.584	1.839-3.451

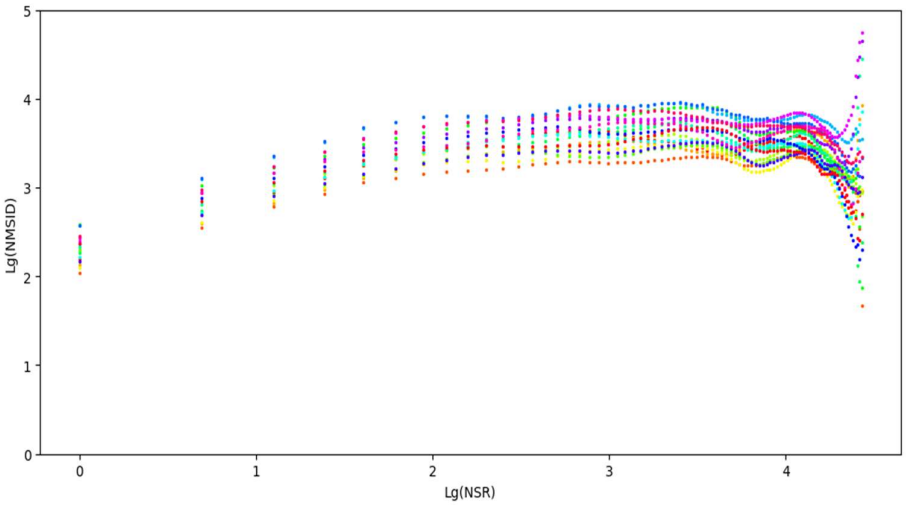
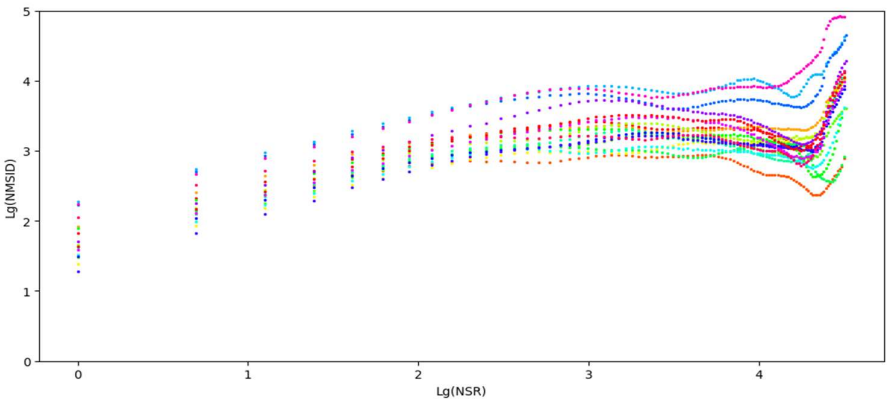
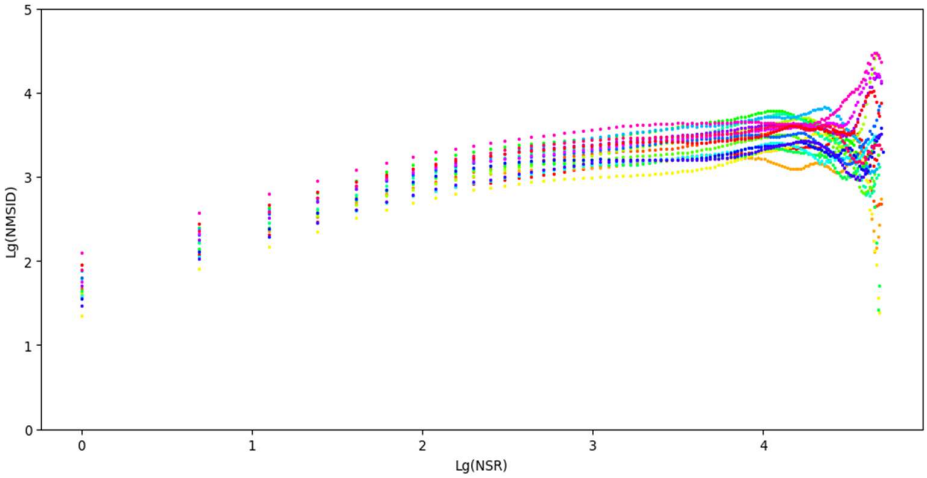
Neutral (Eye)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.625	0.375	0.0-2.197	2.346-3.5
Expresser 2	2.652	0.348	0.0-2.833	2.124-3.379
Expresser 3	2.497	0.503	0.0-3.091	2.106-3.567
Expresser 4	2.597	0.403	0.0-2.303	2.125-3.324
Expresser 5	2.617	0.383	0.0-2.485	2.337-3.524
Expresser 6	2.574	0.426	0.0-2.485	2.304-3.454
Expresser 7	2.575	0.425	0.0-2.833	2.536-3.739
Expresser 8	2.594	0.406	0.0-3.555	2.367-3.817
Expresser 9	2.557	0.443	0.0-3.367	2.364-3.771
Expresser 10	2.584	0.416	0.0-2.708	2.317-3.58
Expresser 11	2.584	0.416	0.0-2.197	2.622-3.86
Expresser 12	2.608	0.392	0.0-2.303	2.592-3.797
Expresser 13	2.624	0.376	0.0-2.833	2.395-3.632
Expresser 14	2.606	0.394	0.0-2.833	2.232-3.507
Expresser 15	2.62	0.38	0.0-3.466	2.442-3.892
Expresser 16	2.553	0.447	0.0-2.639	2.493-3.899
Expresser 17	2.713	0.287	0.0-2.708	2.508-3.661
Expresser 18	2.495	0.505	0.0-2.708	2.51-3.951
Expresser 19	2.655	0.345	0.0-2.303	2.418-3.514

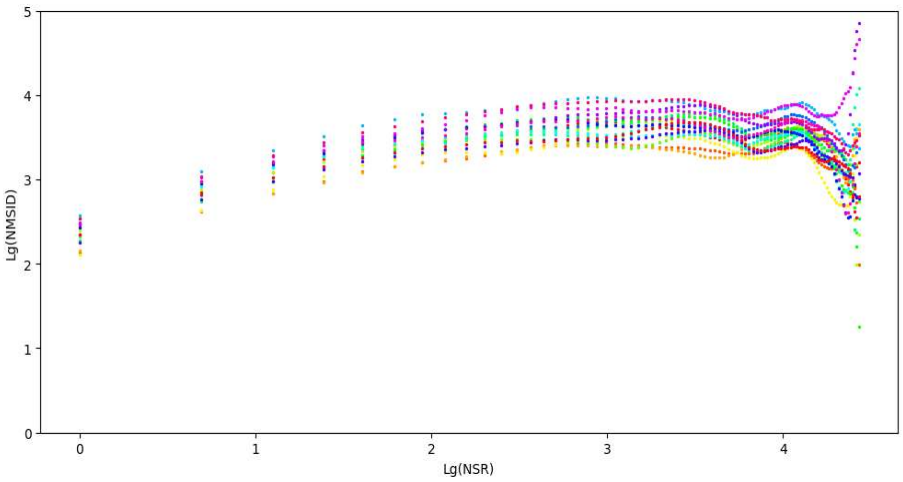
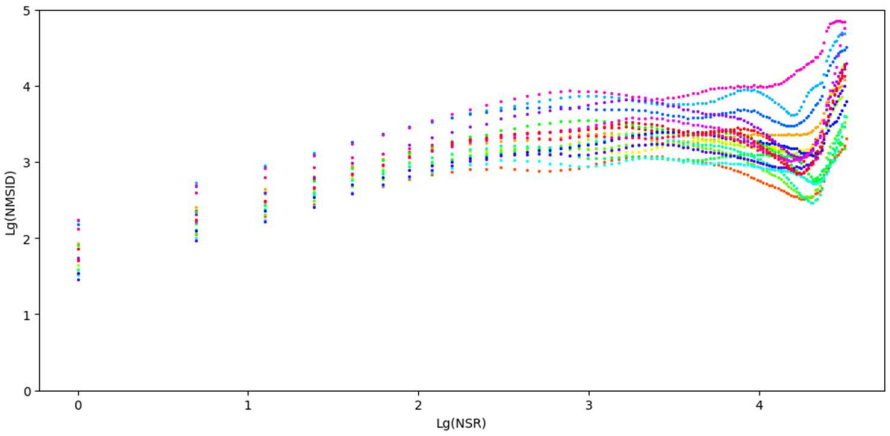
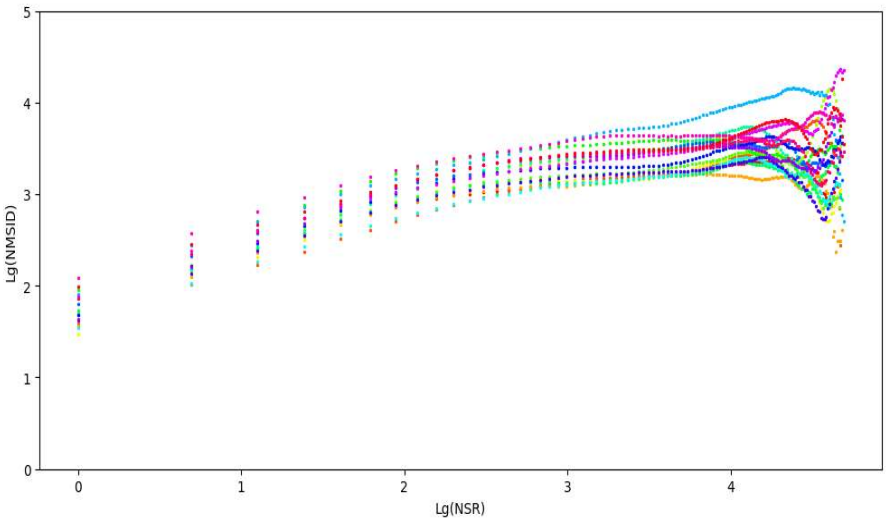
Neutral (Lips)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.423	0.577	0.0-3.045	1.84-3.421
Expresser 2	2.437	0.563	0.0-2.303	1.551-2.972
Expresser 3	2.516	0.484	0.0-3.135	1.896-3.315
Expresser 4	2.365	0.635	0.0-2.708	1.392-3.047
Expresser 5	2.414	0.586	0.0-2.708	1.631-3.154
Expresser 6	2.381	0.619	0.0-2.833	1.511-3.141
Expresser 7	2.382	0.618	0.0-2.944	1.868-3.528
Expresser 8	2.45	0.55	0.0-2.708	1.756-3.158
Expresser 9	2.335	0.665	0.0-2.708	1.587-3.175
Expresser 10	2.377	0.623	0.0-2.485	1.601-3.111
Expresser 11	2.416	0.584	0.0-3.045	2.243-3.944
Expresser 12	2.408	0.592	0.0-2.996	2.181-3.779
Expresser 13	2.403	0.597	0.0-2.708	1.544-3.07
Expresser 14	2.332	0.668	0.0-2.833	1.338-3.062
Expresser 15	2.295	0.705	0.0-3.045	1.724-3.792
Expresser 16	2.366	0.634	0.0-3.178	1.67-3.492
Expresser 17	2.401	0.599	0.0-2.944	2.213-3.847
Expresser 18	2.589	0.411	0.0-2.565	2.086-3.235
Expresser 19	2.348	0.652	0.0-3.258	1.752-3.573

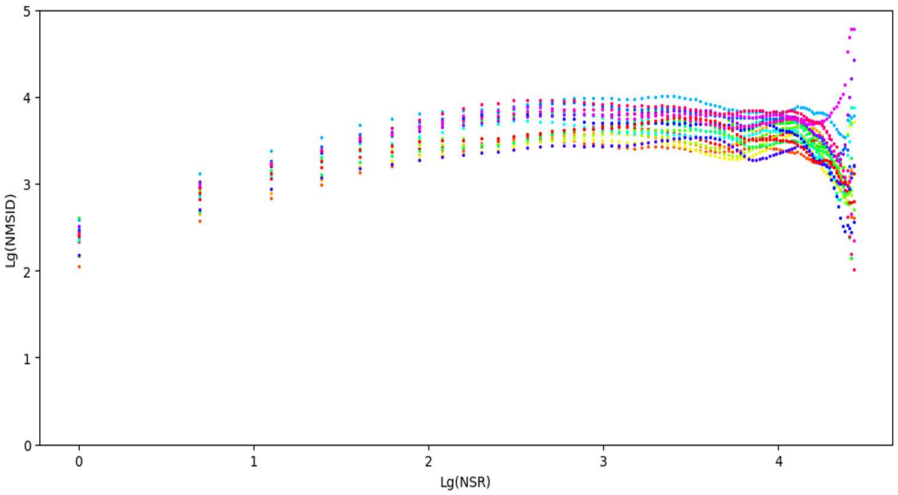
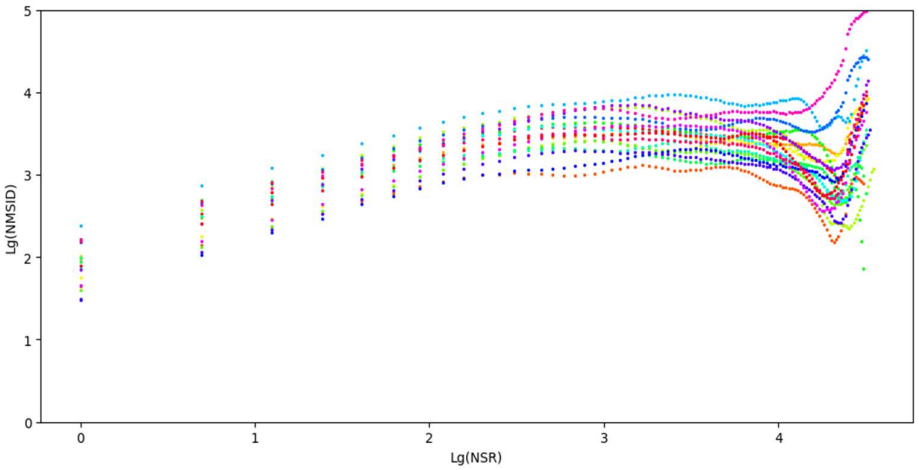
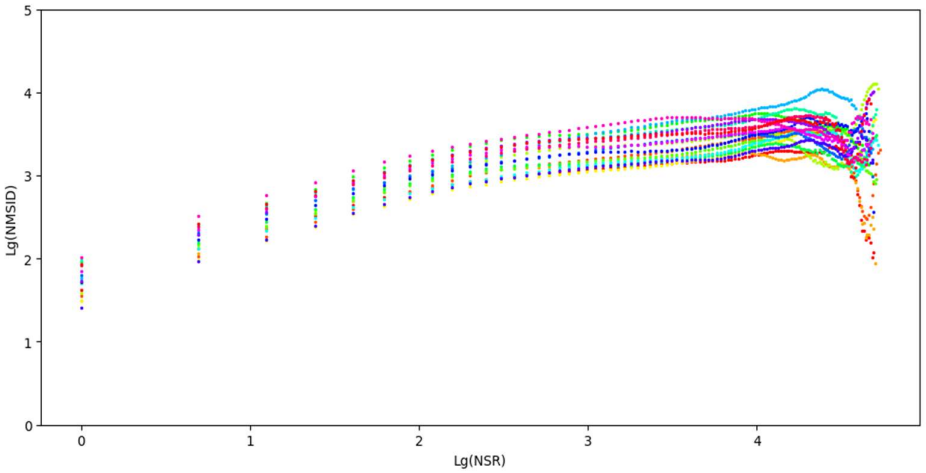
Neutral (Nose)				
Expresser	Fractal Dimension	Hurst Coffecient	Range of log (NMSID) [min value - max value]	Range of log (NSR) [min value - max value]
Expresser 1	2.476	0.524	0.0-4.111	1.603-3.453
Expresser 2	2.421	0.579	0.0-4.205	1.644-3.497
Expresser 3	2.489	0.511	0.0-3.434	1.637-3.207
Expresser 4	2.364	0.636	0.0-2.833	1.365-3.038
Expresser 5	2.455	0.545	0.0-4.174	1.672-3.651
Expresser 6	2.459	0.541	0.0-4.094	1.735-3.585
Expresser 7	2.415	0.585	0.0-3.664	1.84-3.629
Expresser 8	2.46	0.54	0.0-2.773	1.774-3.149
Expresser 9	2.418	0.582	0.0-4.094	1.79-3.727
Expresser 10	2.462	0.538	0.0-4.043	1.629-3.42
Expresser 11	2.537	0.463	0.0-3.434	1.968-3.608
Expresser 12	2.418	0.582	0.0-2.833	1.687-3.283
Expresser 13	2.491	0.509	0.0-3.258	1.725-3.198
Expresser 14	2.495	0.505	0.0-4.248	1.565-3.437
Expresser 15	2.376	0.624	0.0-2.833	1.676-3.367
Expresser 16	2.422	0.578	0.0-2.833	1.832-3.336
Expresser 17	2.437	0.563	0.0-3.526	2.009-3.732
Expresser 18	2.441	0.559	0.0-4.263	1.852-3.731
Expresser 19	2.445	0.555	0.0-3.526	1.866-3.512

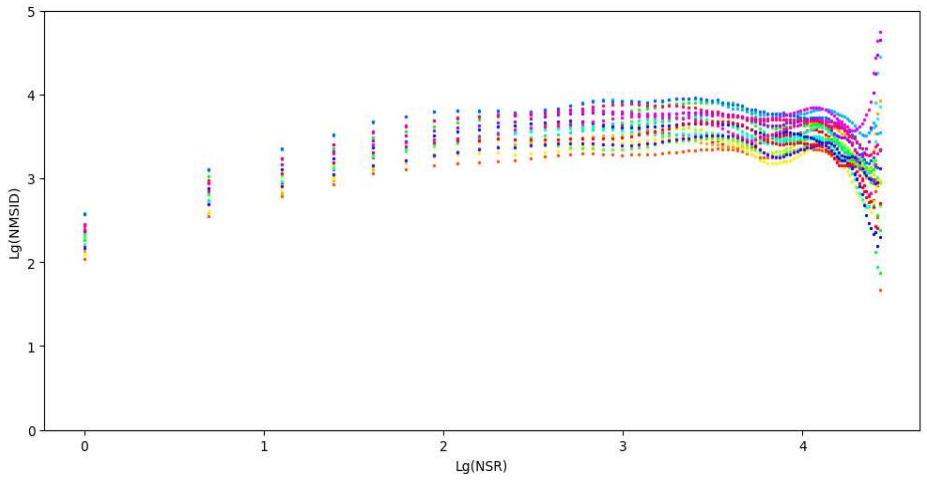
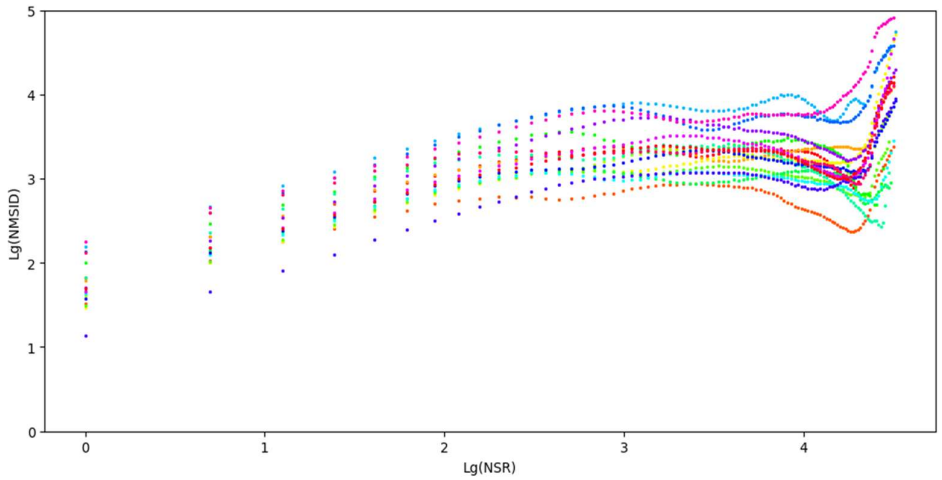
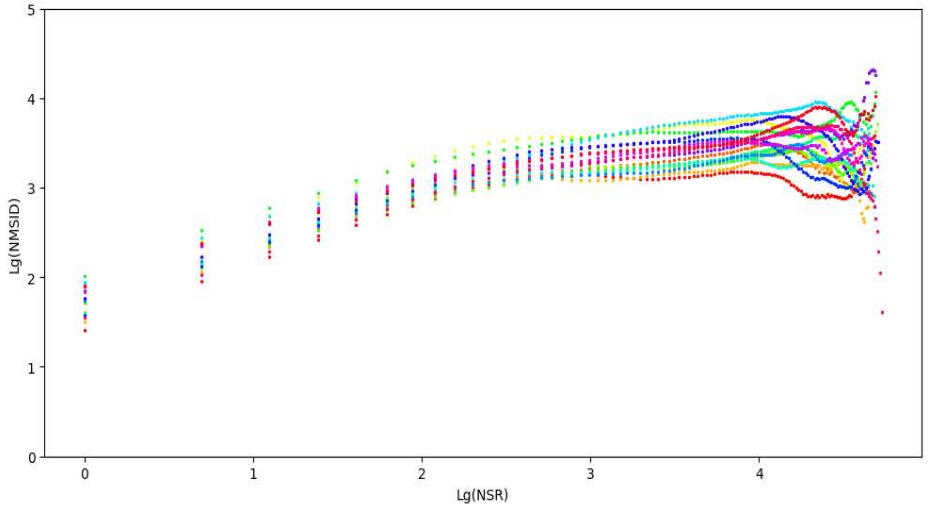
Figure 29. Zone wise (eye, lips, and nose) expresser-specific log NMSID - log NSR plots for full face at 0 degree (Front view).

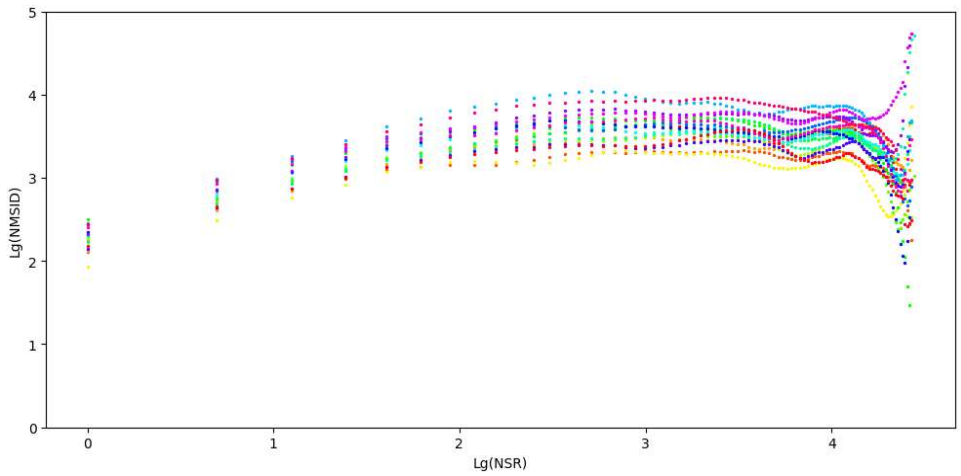
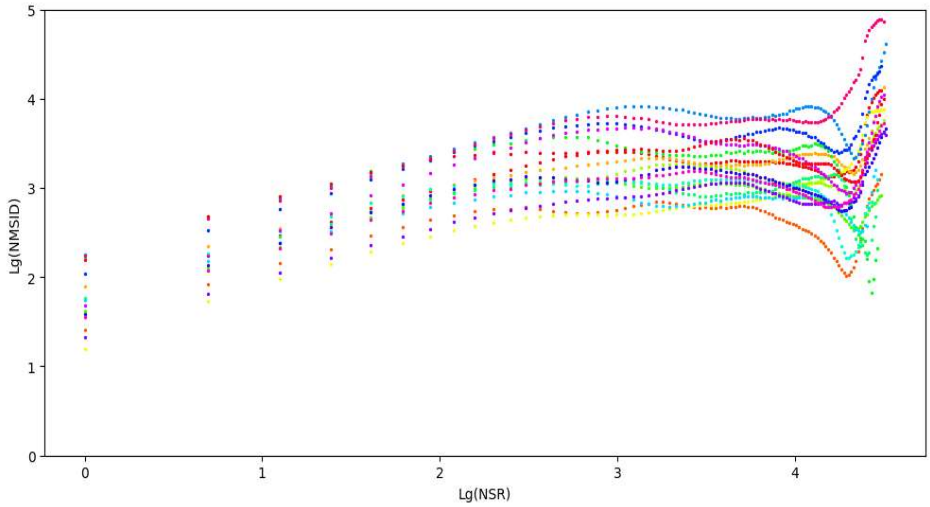
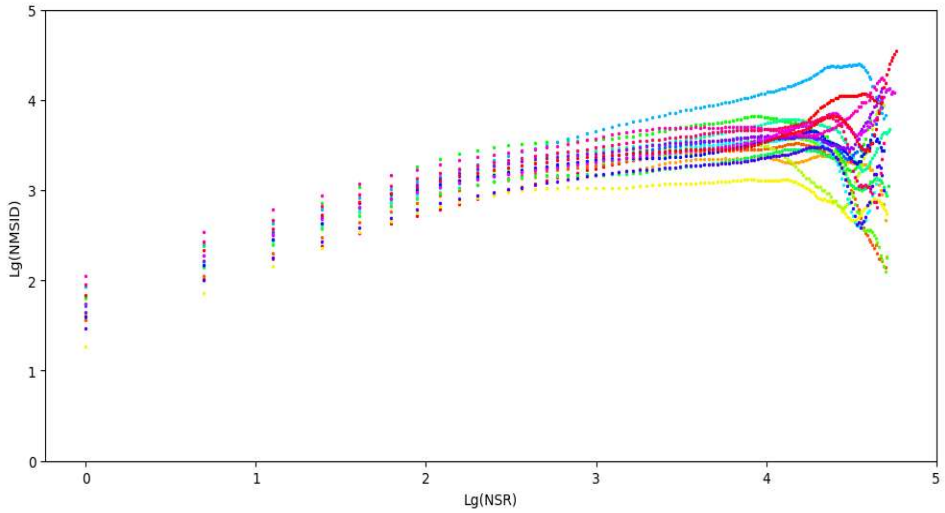
Happy	
Eye	
Lips	
Nose	

Sad	
Eye	
Lips	
Nose	

Fear	
Eye	
Lips	
Nose	

Anger	
Eye	
Lips	
Nose	

Surprise	
Eye	
Lips	
Nose	

Disgust	
Eye	
Lips	
Nose	

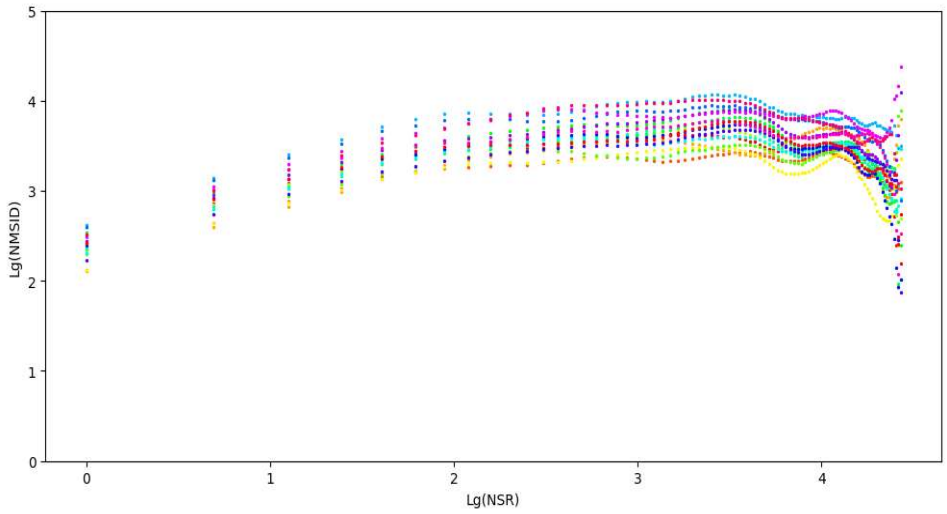
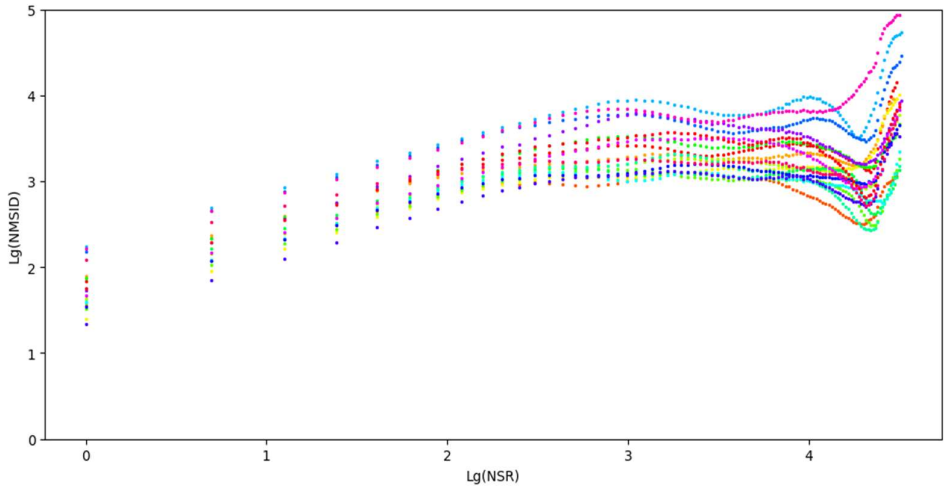
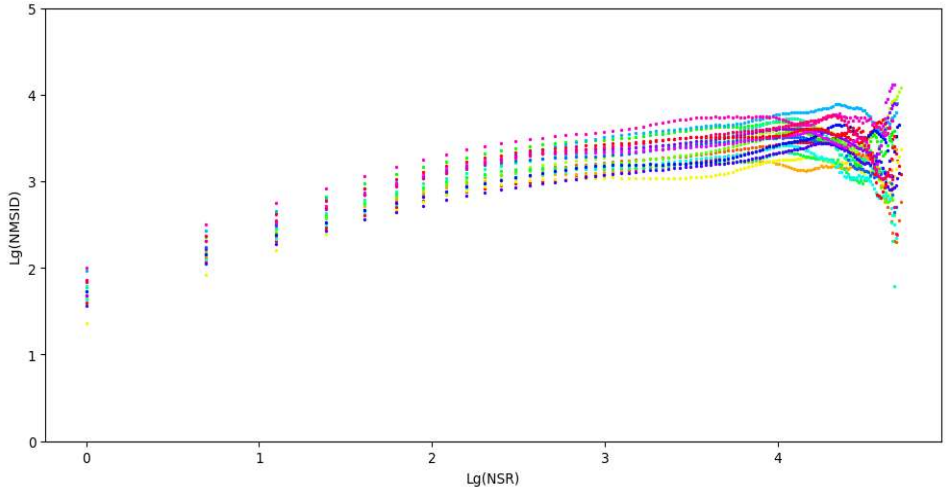
Neutral	
Eye	
Lips	
Nose	

Table 16. Emotion-specific fractal dimensions and Hurst coefficients for full face at ± 45 degree views.

Happy (Full Face)											
+45						−45					
Hurst Coefficient	Fractal Dimension	Range of log (NMSID) [min value]	Range of log (NMSID) [max value]	Range of log (NSR) [min value]	Range of log (NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log (NMSID) [min value]	Range of log (NMSID) [max value]	Range of log (NSR) [min value]	Range of log (NSR) [max value]
0.272859923	2.727140077	2.871735954	3.622078091	1.386294361	3.496507561	0.310305136	2.689694864	3.11234645	3.885860383	1.386294361	3.496507561
0.374029889	2.625970111	2.775981829	3.684124623	1.386294361	3.496507561	0.340273761	2.659726239	3.042949256	3.854612229	1.386294361	3.496507561
0.330428361	2.669571639	2.913632698	3.774041365	1.386294361	3.496507561	0.347013157	2.652986843	3.136820966	3.982721075	1.386294361	3.496507561
0.445393014	2.554606986	2.864752326	3.881638439	1.386294361	3.496507561	0.448439037	2.551560963	3.061370571	4.050150008	1.386294361	3.496507561
0.361884639	2.638115361	2.998461813	3.856354349	1.386294361	3.496507561	0.321317506	2.678682494	3.123580837	3.875842812	1.386294361	3.496507561
0.451143171	2.548856829	2.805549887	3.828128717	1.386294361	3.496507561	0.418794207	2.581205793	2.941757165	3.924332834	1.386294361	3.496507561
0.322489935	2.677510065	3.249375302	4.068745339	1.386294361	3.496507561	0.362469575	2.637530425	3.138607162	4.036533656	1.386294361	3.496507561
0.325313498	2.674686502	3.002356857	3.787783954	1.386294361	3.496507561	0.366602309	2.633397691	2.947931567	3.796348531	1.386294361	3.496507561
0.369574101	2.630425899	3.100434907	4.004000532	1.386294361	3.496507561	0.381925783	2.618074217	3.035177712	3.917135038	1.386294361	3.496507561
0.316588183	2.683411817	3.001257212	3.793289384	1.386294361	3.496507561	0.344140776	2.655859224	3.080885262	3.917813417	1.386294361	3.496507561
0.302589963	2.697410037	3.317086241	4.10608116	1.386294361	3.496507561	0.310523753	2.689476247	3.342420629	4.089487973	1.386294361	3.496507561
0.37643996	2.62356004	3.269965025	4.15455074	1.386294361	3.496507561	0.368483616	2.631516384	3.151234704	3.976516777	1.386294361	3.496507561
0.335340662	2.664659338	3.001563469	3.826732168	1.386294361	3.496507561	0.378413149	2.621586851	3.100926587	4.013896858	1.386294361	3.496507561
0.358620261	2.641379739	2.911665665	3.770288258	1.386294361	3.496507561	0.372969443	2.627030557	3.020098536	3.882797156	1.386294361	3.496507561
-	-	-	-	-	-	-	-	-	-	-	-
0.336746666	2.663253334	3.134628746	3.942089938	1.386294361	3.496507561	0.344134453	2.655865547	3.153857186	3.966792033	1.386294361	3.496507561
0.289952753	2.710047247	3.210566579	3.986051411	1.386294361	3.496507561	0.268115898	2.731884102	3.243244484	3.937457751	1.386294361	3.496507561
0.276106439	2.723893561	3.108533764	3.807983961	1.386294361	3.496507561	0.3784983	2.6215017	3.129655676	4.027020167	1.386294361	3.496507561
0.325052289	2.674947711	3.115721575	3.883223603	1.386294361	3.496507561	0.326186706	2.673813294	3.146241332	3.896860673	1.386294361	3.496507561

Sad (Full Face)											
+45						−45					
Hurst Coefficient	Fractal Dimension	Range of log (NMSID) [min value]	Range of log (NMSID) [max value]	Range of log (NSR) [min value]	Range of log (NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log (NMSID) [min value]	Range of log (NMSID) [max value]	Range of log (NSR) [min value]	Range of log (NSR) [max value]
0.313643114	2.686356886	2.819450789	3.623862138	1.386294361	3.496507561	0.362981659	2.637018341	3.022615312	3.911794685	1.386294361	3.496507561
0.422463682	2.577536318	2.720995289	3.722414891	1.386294361	3.496507561	0.35751138	2.64248862	3.031426902	3.839851569	1.386294361	3.496507561
0.366583106	2.633416894	2.874646129	3.790492167	1.386294361	3.496507561	0.382115257	2.617884743	3.141226168	3.962065215	1.386294361	3.496507561
0.433065084	2.566934916	2.896795576	3.919629399	1.386294361	3.496507561	0.466880751	2.533119249	3.085077697	4.114171097	1.386294361	3.496507561
0.422330561	2.577669439	2.918729359	3.905650512	1.386294361	3.496507561	0.357783809	2.642216191	3.051703068	3.866312818	1.386294361	3.496507561
0.424655111	2.575344889	2.802238605	3.750559747	1.386294361	3.496507561	0.441176172	2.558823828	2.964781266	3.952026298	1.386294361	3.496507561
0.307111773	2.692888227	3.2322645	3.96802489	1.386294361	3.496507561	0.386395365	2.613604635	3.054946057	3.960418717	1.386294361	3.496507561
0.351797823	2.648202177	2.939054141	3.765535252	1.386294361	3.496507561	0.422339504	2.577660496	2.888418342	3.831819096	1.386294361	3.496507561
0.347538036	2.652461964	3.070209117	3.893028798	1.386294361	3.496507561	0.458764814	2.541235186	3.041912323	4.076314607	1.386294361	3.496507561
0.352244303	2.647755697	2.904448217	3.75102164	1.386294361	3.496507561	0.40201032	2.59798968	3.040434414	3.956736427	1.386294361	3.496507561
0.353538486	2.646461514	3.25459762	4.087293483	1.386294361	3.496507561	0.357915956	2.642084044	3.307291114	4.124444868	1.386294361	3.496507561
0.3976443	2.6023557	3.267502933	4.146173537	1.386294361	3.496507561	0.387471172	2.612528828	3.203751252	4.059474501	1.386294361	3.496507561
0.32441323	2.67558677	2.964566857	3.740025252	1.386294361	3.496507561	0.430214323	2.569785677	3.098629439	4.090942781	1.386294361	3.496507561
0.443284637	2.556715363	2.840025895	3.845006279	1.386294361	3.496507561	0.425506337	2.574493663	3.047530429	3.989998813	1.386294361	3.496507561
0.339214771	2.660785229	3.136319537	3.955930756	1.386294361	3.496507561	0.409665048	2.590334952	3.090195222	4.051995885	1.386294361	3.496507561
0.357797244	2.642202756	3.112907942	3.948594732	1.386294361	3.496507561	0.394274248	2.605725752	3.191885461	4.096529461	1.386294361	3.496507561
0.326447537	2.673552463	3.231133262	4.026859337	1.386294361	3.496507561	0.354107712	2.645892288	3.309723541	4.098974298	1.386294361	3.496507561
0.380356457	2.619643543	2.989152913	3.870428456	1.386294361	3.496507561	0.32500137	2.67499863	3.161270572	3.907901787	1.386294361	3.496507561
0.34051337	2.65948663	3.094414802	3.892580656	1.386294361	3.496507561	0.392771096	2.607228904	3.156279711	4.037640527	1.386294361	3.496507561

Fear (Full Face)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log (NMSID) [min value]	Range of log (NMSID) [max value]	Range of log (NSR) [min value]	Range of log (NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log (NMSID) [min value]	Range of log (NMSID) [max value]	Range of log (NSR) [min value]	Range of log (NSR) [max value]
0.368569332	2.631430668	2.842290877	3.725800877	1.386294361	3.496507561	0.415481278	2.584518722	3.048733605	3.964502635	1.386294361	3.496507561
0.340123783	2.659876217	2.789606329	3.631788832	1.386294361	3.496507561	0.492632205	2.507367795	2.96770046	4.039679415	1.386294361	3.496507561
0.351717785	2.648282215	2.890406399	3.743697802	1.386294361	3.496507561	0.617446297	2.382553703	2.34754379	3.656972577	1.386294361	3.496507561
0.453285983	2.546714017	2.889426525	3.939144919	1.386294361	3.496507561	0.451646256	2.548353744	3.094609953	4.084559893	1.386294361	3.496507561
0.352072719	2.647927281	2.999355572	3.826625309	1.386294361	3.496507561	0.411448386	2.588551614	3.057111995	4.010526087	1.386294361	3.496507561
0.436796794	2.563203206	2.849073801	3.815189417	1.386294361	3.496507561	0.444769578	2.555230422	2.956031191	3.950613218	1.386294361	3.496507561
0.309927565	2.690072435	3.210629072	3.970255273	1.386294361	3.496507561	0.454871801	2.545128199	3.057428265	4.111230594	1.386294361	3.496507561
0.345413236	2.654586764	2.934023098	3.737191773	1.386294361	3.496507561	0.396693704	2.603306296	2.938808139	3.819500357	1.386294361	3.496507561
0.406999295	2.593000705	3.035720694	3.976412679	1.386294361	3.496507561	0.464266353	2.535733647	3.041579375	4.089708676	1.386294361	3.496507561
0.37864846	2.62135154	2.936500183	3.828735996	1.386294361	3.496507561	0.377533687	2.622466313	3.078898939	3.950500384	1.386294361	3.496507561
0.363135439	2.636864561	3.241697947	4.104123895	1.386294361	3.496507561	0.41678175	2.58321825	3.317728	4.235856622	1.386294361	3.496507561
0.360950184	2.639049816	3.265489353	4.067680411	1.386294361	3.496507561	0.405794366	2.594205634	3.168665167	4.073398212	1.386294361	3.496507561
0.386827651	2.613172349	3.023402288	3.910895528	1.386294361	3.496507561	0.441653656	2.558346344	3.125227315	4.138280885	1.386294361	3.496507561
0.418468954	2.581531046	2.918361943	3.869411218	1.386294361	3.496507561	0.402645381	2.597354619	3.039060177	3.938488721	1.386294361	3.496507561
0.362391262	2.637608738	3.155295136	4.020107908	1.386294361	3.496507561	0.440606982	2.559393018	3.076156602	4.082013966	1.386294361	3.496507561
0.374924091	2.625075909	3.137363146	4.020504146	1.386294361	3.496507561	0.379247159	2.620752841	3.203442731	4.08060837	1.386294361	3.496507561
0.319381207	2.680618793	3.182649875	3.977252035	1.386294361	3.496507561	0.326910301	2.673089699	3.264740975	4.028160091	1.386294361	3.496507561
0.378703762	2.621296238	2.987206176	3.876493931	1.386294361	3.496507561	0.325379753	2.674620247	3.174439797	3.942227421	1.386294361	3.496507561
0.330294681	2.669705319	3.107329489	3.885835231	1.386294361	3.496507561	0.345224911	2.654775089	3.199444075	3.986917424	1.386294361	3.496507561

Anger (Full Face)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.336315769	2.663684231	2.855409963	3.640122365	1.386294361	3.496507561	0.374072508	2.625927492	3.088471909	3.946183039	1.386294361	3.496507561
0.318239569	2.681760431	2.777387336	3.579030367	1.386294361	3.496507561	0.391525766	2.608474234	3.030307672	3.921834638	1.386294361	3.496507561
0.444396242	2.555603758	2.827529614	3.863410862	1.386294361	3.496507561	0.390337532	2.609662468	3.146594012	3.985449172	1.386294361	3.496507561
0.475575026	2.524424974	2.86320455	3.943071529	1.386294361	3.496507561	0.476318301	2.523681699	3.080998052	4.123125597	1.386294361	3.496507561
0.406919014	2.593080986	3.997633599	3.05971292	1.386294361	3.496507561	0.430796556	2.569203444	2.953508454	3.966137427	1.386294361	3.496507561
0.407307317	2.592692683	2.845352676	3.768147169	1.386294361	3.496507561	0.439910643	2.560089357	2.924339128	3.929249037	1.386294361	3.496507561
0.344664316	2.655335684	3.196826573	4.03912958	1.386294361	3.496507561	0.397639688	2.602360312	3.078985875	3.996760695	1.386294361	3.496507561
0.356914075	2.643085925	2.902160124	3.730537506	1.386294361	3.496507561	0.411020555	2.588979445	2.924777384	3.843011537	1.386294361	3.496507561
0.408399871	2.591600129	3.099930215	4.063051873	1.386294361	3.496507561	0.449157801	2.550842199	3.099531729	4.13781016	1.386294361	3.496507561
0.353242525	2.646757475	2.949944335	3.802294588	1.386294361	3.496507561	0.396144702	2.603855298	3.102283834	4.028682608	1.386294361	3.496507561
0.332720019	2.667279981	3.2217009	4.051758996	1.386294361	3.496507561	0.376110682	2.623889318	3.302109431	4.178362043	1.386294361	3.496507561
0.40769397	2.59230603	3.203457315	4.128654815	1.386294361	3.496507561	0.429600524	2.570399476	3.12876115	4.09056473	1.386294361	3.496507561
0.361059997	2.638940003	3.044572825	3.908457755	1.386294361	3.496507561	0.397257737	2.602742263	3.155866034	4.090525912	1.386294361	3.496507561
0.421289218	2.578710782	2.883615808	3.864073397	1.386294361	3.496507561	0.395916564	2.604083436	2.982046402	3.875124517	1.386294361	3.496507561
0.332623877	2.667376123	3.169378597	3.989502212	1.386294361	3.496507561	0.428668087	2.571331913	3.08070911	4.08225719	1.386294361	3.496507561
0.324708044	2.675291956	3.11290374	3.908596109	1.386294361	3.496507561	0.365753771	2.634246229	3.18325785	4.043767205	1.386294361	3.496507561
0.333786531	2.666213469	3.206376736	4.047380809	1.386294361	3.496507561	0.32320586	2.67679414	3.248722608	4.027864989	1.386294361	3.496507561
0.307663904	2.692336096	2.981427468	3.764232904	1.386294361	3.496507561	0.418111898	2.581888102	3.122574337	4.078171017	1.386294361	3.496507561
0.317165006	2.682834994	3.130609671	3.892178521	1.386294361	3.496507561	0.397523089	2.602476911	3.193651231	4.095338957	1.386294361	3.496507561

Surprise (Full Face)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.326410664	2.673589336	2.902539762	3.688550998	1.386294361	3.496507561	0.377917535	2.622082465	3.094147693	3.934129277	1.386294361	3.496507561
0.448385305	2.551614695	2.764588713	3.780985572	1.386294361	3.496507561	0.341301507	2.658698493	3.061855304	3.816484996	1.386294361	3.496507561
0.4339133	2.5660867	2.850971225	3.865823705	1.386294361	3.496507561	0.442301205	2.557698795	3.072898697	4.015742832	1.386294361	3.496507561
0.45326597	2.54673403	2.922800668	3.943036485	1.386294361	3.496507561	0.479570128	2.520429872	3.089896888	4.124179687	1.386294361	3.496507561
0.414127131	2.585872869	2.98445812	3.941630585	1.386294361	3.496507561	0.409253489	2.590746511	3.081920718	3.999930529	1.386294361	3.496507561
0.384997001	2.615002999	2.889798423	3.769701227	1.386294361	3.496507561	0.483238036	2.516761964	2.935492224	4.023712274	1.386294361	3.496507561
0.334661542	2.665338458	3.23744762	4.089684627	1.386294361	3.496507561	0.348668895	2.651331105	3.100442565	3.952738546	1.386294361	3.496507561
0.325024741	2.674975259	2.990787336	3.771771659	1.386294361	3.496507561	0.378044951	2.621955049	2.954706145	3.832766352	1.386294361	3.496507561
0.384326221	2.615673779	3.075927298	3.987200635	1.386294361	3.496507561	0.402051617	2.597948383	3.058562816	3.975123767	1.386294361	3.496507561
0.349993437	2.650006563	2.994699088	3.841249444	1.386294361	3.496507561	0.393899118	2.606100882	3.145101176	4.062481794	1.386294361	3.496507561
0.340571938	2.659428062	3.23118851	4.038345584	1.386294361	3.496507561	0.3798393	2.6201607	3.25332198	4.089149949	1.386294361	3.496507561
0.370788524	2.629211476	3.193977511	4.015819241	1.386294361	3.496507561	0.385441985	2.614558015	3.141140394	3.971772983	1.386294361	3.496507561
0.362547342	2.637452658	2.998028302	3.867025977	1.386294361	3.496507561	0.393936184	2.606063816	3.127328407	4.046242569	1.386294361	3.496507561
0.403234144	2.596765856	2.898057901	3.81436783	1.386294361	3.496507561	0.403271707	2.596728293	3.049083886	3.952100656	1.386294361	3.496507561
0.33944097	2.66055903	3.179761648	4.01876185	1.386294361	3.496507561	0.434774892	2.565225108	3.092606998	4.090965991	1.386294361	3.496507561
0.352907439	2.647092561	3.128082694	3.940291488	1.386294361	3.496507561	0.367935093	2.632064907	3.172549499	4.010412307	1.386294361	3.496507561
0.326933092	2.673066908	3.221828266	3.986306961	1.386294361	3.496507561	0.326450427	2.673549573	3.321498989	4.047089034	1.386294361	3.496507561
0.305606242	2.694393758	2.942736915	3.660830509	1.386294361	3.496507561	0.41597085	2.58402915	3.09890558	4.029988902	1.386294361	3.496507561
0.315513088	2.684486912	3.163438775	3.906504522	1.386294361	3.496507561	0.365598148	2.634401852	3.150504969	3.99474517	1.386294361	3.496507561

Disgust (Full Face)											
+45						−45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.32041948	2.67958052	2.812268006	3.66378217	1.386294361	3.496507561	0.380348858	2.619651142	2.984622452	3.892761331	1.386294361	3.496507561
0.316935032	2.683064968	2.764669661	3.561759799	1.386294361	3.496507561	0.357019365	2.642980635	2.984159004	3.826114526	1.386294361	3.496507561
0.360969984	2.639030016	2.867335951	3.789672886	1.386294361	3.496507561	0.393380652	2.606619348	3.109944787	3.992788289	1.386294361	3.496507561
0.462767214	2.537232786	2.794234023	3.861974767	1.386294361	3.496507561	0.450387243	2.549612757	2.979308121	3.966774483	1.386294361	3.496507561
0.381174538	2.618825462	2.945121976	3.836525315	1.386294361	3.496507561	0.371914668	2.628085332	3.048176128	3.906786186	1.386294361	3.496507561
0.369967726	2.630032274	2.786898567	3.654310144	1.386294361	3.496507561	0.402965266	2.597034734	2.868446084	3.813271764	1.386294361	3.496507561
0.280895233	2.719104767	3.253413255	3.983364617	1.386294361	3.496507561	0.343575067	2.656424933	3.117013711	3.932978024	1.386294361	3.496507561
0.346587782	2.653412218	2.945209429	3.785998355	1.386294361	3.496507561	0.375894772	2.624105228	2.895066806	3.761048235	1.386294361	3.496507561
0.382545383	2.617454617	3.055049345	3.955516861	1.386294361	3.496507561	0.448472404	2.551527596	2.980276728	3.987330458	1.386294361	3.496507561
0.341953145	2.658046855	2.914452863	3.752486051	1.386294361	3.496507561	0.34965842	2.65034158	3.087031962	3.924951125	1.386294361	3.496507561
0.319978485	2.680021515	3.246075199	4.073778689	1.386294361	3.496507561	0.373195367	2.626804633	3.276547735	4.1321868	1.386294361	3.496507561
0.361056754	2.638943246	3.155749304	3.975140097	1.386294361	3.496507561	0.370488193	2.629511807	3.070565983	3.912268667	1.386294361	3.496507561
0.378868045	2.621131955	2.988185254	3.864451888	1.386294361	3.496507561	0.447242074	2.552757926	3.057080896	4.080967791	1.386294361	3.496507561
0.431124875	2.568875125	2.770467791	3.76288852	1.386294361	3.496507561	0.407711774	2.592288226	2.947831467	3.866010948	1.386294361	3.496507561
0.399445459	2.600554541	3.108438387	4.043847361	1.386294361	3.496507561	0.327355374	2.672644626	3.187951713	4.008111535	1.386294361	3.496507561
0.309258114	2.690741886	3.081254819	3.78664895	1.386294361	3.496507561	0.386977588	2.613022412	3.090334472	3.964414352	1.386294361	3.496507561
0.322561443	2.677438557	3.160075291	3.961534319	1.386294361	3.496507561	0.315627153	2.684372847	3.281959025	4.005110518	1.386294361	3.496507561
0.301070593	2.698929407	3.069582758	3.828551349	1.386294361	3.496507561	0.432599804	2.567400196	3.109164037	4.101987061	1.386294361	3.496507561
0.296684736	2.703315264	3.144305876	3.873827313	1.386294361	3.496507561	0.337220342	2.662779658	3.103747797	3.899823883	1.386294361	3.496507561

Neutral (Full Face)											
+45						−45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.327342345	2.672657655	2.854498546	3.619789367	1.386294361	3.496507561	0.386558426	2.613441574	3.092948246	3.935205885	1.386294361	3.496507561
0.325879407	2.674120593	2.815643587	3.603467902	1.386294361	3.496507561	0.434818584	2.565181416	3.028750343	3.994828014	1.386294361	3.496507561
0.40103143	2.59896857	2.847915654	3.809315354	1.386294361	3.496507561	0.375158948	2.624841052	3.172192393	3.976782739	1.386294361	3.496507561
0.445768367	2.554231633	2.854932606	3.895498303	1.386294361	3.496507561	0.465165941	2.534834059	3.084139779	4.100935578	1.386294361	3.496507561
0.370295196	2.629704804	2.967057023	3.843018684	1.386294361	3.496507561	0.385115668	2.614884332	3.056568061	3.947346844	1.386294361	3.496507561
0.523274228	2.476725772	2.769841528	3.905497511	1.386294361	3.496507561	0.431249478	2.568750522	2.920657099	3.894084587	1.386294361	3.496507561
0.342692368	2.657307632	3.18294059	4.015659324	1.386294361	3.496507561	0.397047022	2.602952978	3.076555797	3.987272883	1.386294361	3.496507561
0.356783715	2.643216285	2.905112524	3.727624781	1.386294361	3.496507561	0.412181921	2.587818079	2.925243834	3.8324876	1.386294361	3.496507561
0.370782848	2.629217152	3.056084315	3.932500973	1.386294361	3.496507561	0.406342344	2.593657656	3.068800575	3.998117986	1.386294361	3.496507561
0.366164075	2.633835925	2.909622675	3.798063795	1.386294361	3.496507561	0.407806993	2.592193007	3.097184421	4.036899394	1.386294361	3.496507561
0.373378588	2.626621412	3.253543217	4.116419783	1.386294361	3.496507561	0.386753494	2.613246506	3.341137268	4.208743371	1.386294361	3.496507561
0.397450814	2.602549186	3.276915106	4.148169032	1.386294361	3.496507561	0.383106836	2.616893164	3.194659177	4.03883633	1.386294361	3.496507561
0.364123062	2.635876938	2.986207063	3.852310803	1.386294361	3.496507561	0.419226364	2.580773636	3.102937578	4.070623158	1.386294361	3.496507561
0.418039082	2.581960918	2.890340265	3.855114587	1.386294361	3.496507561	0.404724188	2.595275812	3.033860799	3.9337466	1.386294361	3.496507561
0.347677525	2.652322475	3.175959724	4.019750851	1.386294361	3.496507561	0.411739857	2.588260143	3.090480577	4.048174819	1.386294361	3.496507561
0.379164042	2.620835958	3.186074312	4.054246821	1.386294361	3.496507561	0.353374864	2.646625136	3.097001726	3.939250361	1.386294361	3.496507561
0.319255756	2.680744244	3.223184582	4.016684046	1.386294361	3.496507561	0.328600706	2.671399294	3.286991751	4.046565187	1.386294361	3.496507561
0.408140623	2.591859377	2.984526913	3.950216895	1.386294361	3.496507561	0.340290743	2.659709257	3.191386042	4.008475767	1.386294361	3.496507561
0.315513088	2.684486912	3.163438775	3.906504522	1.386294361	3.496507561	0.365598148	2.634401852	3.150504969	3.99474517	1.386294361	3.496507561

Table 17. Zone wise (eye, lips, and nose) emotion-specific fractal dimensions and Hurst coefficients for full face at ± 45 degree views.

Happy (Eyes)											
+45						−45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.399456866	2.600543134	2.565485562	3.58885106	1.386294361	3.496507561	0.411362108	2.588637892	2.692800287	3.723395216	1.386294361	3.496507561
0.492484582	2.507515418	2.346482811	3.485433873	1.386294361	3.496507561	0.410872991	2.589127009	2.542798404	3.508697779	1.386294361	3.496507561
0.602550981	2.397449019	2.461105164	3.751953773	1.386294361	3.496507561	0.356575216	2.643424784	2.579139192	3.479700443	1.386294361	3.496507561
0.298617651	2.701382349	2.502925746	3.319911721	1.386294361	3.496507561	0.399557957	2.600442043	2.55433193	3.521835382	1.386294361	3.496507561
0.452663089	2.547336911	2.558041693	3.59135022	1.386294361	3.496507561	0.38602844	2.61397156	2.721937428	3.644818039	1.386294361	3.496507561
0.341247023	2.658752977	2.59939922	3.502428386	1.386294361	3.496507561	0.277934096	2.722065904	2.625059301	3.504326824	1.386294361	3.496507561
0.41004859	2.58995141	2.855642578	3.786670645	1.386294361	3.496507561	0.386106737	2.613893263	2.593042872	3.470892767	1.386294361	3.496507561
0.400121525	2.599878475	2.560666858	3.506755095	1.386294361	3.496507561	0.347888842	2.652111158	2.579720837	3.46818875	1.386294361	3.496507561
0.291695847	2.708304153	2.704289185	3.50777861	1.386294361	3.496507561	0.385042173	2.614957827	2.643018926	3.579921109	1.386294361	3.496507561
0.49630168	2.50369832	2.567839132	3.700682408	1.386294361	3.496507561	0.457352243	2.542647757	2.692657021	3.736662362	1.386294361	3.496507561
0.405983785	2.594016215	2.863752366	3.919863944	1.386294361	3.496507561	0.323421307	2.676578693	2.941967548	3.863918097	1.386294361	3.496507561
0.349150091	2.650849909	3.032815304	3.977744863	1.386294361	3.496507561	0.381543259	2.618456741	2.775000921	3.787367741	1.386294361	3.496507561
0.435174065	2.564825935	2.720451726	3.716361015	1.386294361	3.496507561	0.432669509	2.567330491	2.703506176	3.696895554	1.386294361	3.496507561
0.469381208	2.530618792	2.616948304	3.690610947	1.386294361	3.496507561	0.457126094	2.542873906	2.707068401	3.762766429	1.386294361	3.496507561
-	-	-	-	-	-	-	-	-	-	-	-
0.491909054	2.508090946	2.895806284	4.061343136	1.386294361	3.496507561	0.375850852	2.624149148	2.911485811	3.867466788	1.386294361	3.496507561
0.305201679	2.694798321	2.872583716	3.754548321	1.386294361	3.496507561	0.280653652	2.719346348	2.841801705	3.688622832	1.386294361	3.496507561
0.525717325	2.474282675	2.670932512	3.830841888	1.386294361	3.496507561	0.561371689	2.438628311	2.645911831	3.865937722	1.386294361	3.496507561
0.332731482	2.667268518	2.832114565	3.668293158	1.386294361	3.496507561	0.289914726	2.710085274	2.859300774	3.641096072	1.386294361	3.496507561

Happy (Lips)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.434592985	2.565407015	2.796277514	3.786538577	1.386294361	3.496507561	0.433956493	2.566043507	3.102135196	4.07720468	1.386294361	3.496507561
0.326704143	2.673295857	2.38283941	3.230094425	1.386294361	3.496507561	0.321534898	2.678465102	2.705338138	3.544758259	1.386294361	3.496507561
0.365315133	2.634684867	2.65805887	3.492658083	1.386294361	3.496507561	0.330606001	2.669393999	2.965712441	3.729774088	1.386294361	3.496507561
0.363382689	2.636617311	2.325811982	3.239915122	1.386294361	3.496507561	0.381340567	2.618659433	2.507560748	3.434271743	1.386294361	3.496507561
0.302566802	2.697433198	2.658674476	3.543226845	1.386294361	3.496507561	0.262303592	2.737696408	2.699212147	3.443309119	1.386294361	3.496507561
0.409771243	2.590228757	2.37749244	3.334133985	1.386294361	3.496507561	0.369880754	2.630119246	2.442156417	3.314855153	1.386294361	3.496507561
0.289515877	2.710484123	3.072073588	3.817443318	1.386294361	3.496507561	0.283352133	2.716647867	2.8368259	3.556305648	1.386294361	3.496507561
0.279621945	2.720378055	2.715231189	3.446685866	1.386294361	3.496507561	0.271288664	2.728711336	2.805392183	3.495222527	1.386294361	3.496507561
0.31595125	2.68404875	2.699855015	3.563058833	1.386294361	3.496507561	0.283250049	2.716749951	2.610472358	3.40965017	1.386294361	3.496507561
0.372343557	2.627656443	2.406714928	3.386891668	1.386294361	3.496507561	0.285595884	2.714404116	2.661918342	3.450388091	1.386294361	3.496507561
0.610324877	2.389675123	2.860724845	4.121107544	1.386294361	3.496507561	0.577992672	2.422007328	2.969902696	4.189401071	1.386294361	3.496507561
0.539404513	2.460595487	2.727040352	3.904170089	1.386294361	3.496507561	0.491814096	2.508185904	2.613261408	3.712396997	1.386294361	3.496507561
0.343102805	2.656897195	2.233681972	3.131103319	1.386294361	3.496507561	0.24610668	2.75389332	2.557879221	3.22675028	1.386294361	3.496507561
0.468712404	2.531287596	2.158964482	3.259490443	1.386294361	3.496507561	0.427660686	2.572339314	2.352314204	3.355268344	1.386294361	3.496507561
-	-	-	-	-	-	-	-	-	-	-	-
0.469506029	2.530493971	2.655092034	3.706748302	1.386294361	3.496507561	0.392985183	2.607014817	2.749680606	3.648133522	1.386294361	3.496507561
0.606297992	2.393702008	2.619210107	3.888220324	1.386294361	3.496507561	0.594383308	2.405616692	2.665740636	3.883404189	1.386294361	3.496507561
0.284510931	2.715489069	2.844363895	3.60007881	1.386294361	3.496507561	0.26628342	2.73371658	2.904252566	3.60726602	1.386294361	3.496507561
0.43959376	2.56040624	2.605887045	3.698985025	1.386294361	3.496507561	0.400237872	2.599762128	2.707888945	3.653801894	1.386294361	3.496507561

Happy (Nose)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.599381227	2.400618773	2.244209721	3.590857168	1.386294361	3.496507561	0.421541866	2.578458134	2.705961933	3.654940015	1.386294361	3.496507561
0.61792085	2.38207915	2.066951733	3.481271702	1.386294361	3.496507561	0.400862969	2.599137031	2.700807123	3.67731962	1.386294361	3.496507561
0.456767187	2.543232813	2.295015227	3.369792756	1.386294361	3.496507561	0.345348607	2.654651393	2.591594654	3.413450851	1.386294361	3.496507561
0.495055796	2.504944204	2.20459607	3.369412821	1.386294361	3.496507561	0.362912746	2.637087254	2.638163432	3.528295075	1.386294361	3.496507561
0.485381057	2.514618943	2.462705169	3.642217417	1.386294361	3.496507561	0.506694205	2.493305795	2.549856069	3.725573781	1.386294361	3.496507561
0.532404384	2.467595616	2.359312276	3.55409776	1.386294361	3.496507561	0.428856957	2.571143043	2.601598737	3.575872783	1.386294361	3.496507561
0.422451426	2.577548574	2.6729138	3.700142176	1.386294361	3.496507561	0.52323714	2.47676286	2.816775293	4.060792229	1.386294361	3.496507561
0.485931443	2.514068557	2.322616666	3.469628431	1.386294361	3.496507561	0.24459125	2.75540875	2.528572561	3.180496334	1.386294361	3.496507561
0.613958058	2.386041942	2.248138205	3.669133329	1.386294361	3.496507561	0.510272193	2.489727807	2.394238282	3.583309575	1.386294361	3.496507561
0.637173156	2.362826844	2.240804565	3.66485431	1.386294361	3.496507561	0.418681186	2.581318814	2.64551363	3.646479146	1.386294361	3.496507561
0.59049703	2.40950297	2.498907545	3.864265143	1.386294361	3.496507561	0.530090124	2.469909876	2.740794917	3.92035026	1.386294361	3.496507561
0.467246945	2.532753055	2.484838938	3.628798332	1.386294361	3.496507561	0.359167885	2.640832115	2.723768206	3.548560303	1.386294361	3.496507561
0.388755127	2.611244873	2.541525515	3.523588595	1.386294361	3.496507561	0.373983126	2.626016874	2.670695853	3.527792906	1.386294361	3.496507561
0.506047314	2.493952686	2.724817995	3.916624773	1.386294361	3.496507561	0.441435554	2.558564446	2.57326947	3.625093169	1.386294361	3.496507561
-	-	-	-	-	-	-	-	-	-	-	-
0.412391439	2.587608561	2.50355962	3.531300522	1.386294361	3.496507561	0.352695126	2.647304874	2.70474176	3.547528434	1.386294361	3.496507561
0.477580989	2.522419011	2.691948061	3.817883619	1.386294361	3.496507561	0.36198941	2.63801059	2.839609613	3.714466439	1.386294361	3.496507561
0.530817874	2.469182126	2.315132177	3.568604613	1.386294361	3.496507561	0.494698968	2.505301032	2.726751082	3.831487869	1.386294361	3.496507561
0.495198822	2.504801178	2.655428019	3.817308388	1.386294361	3.496507561	0.446072057	2.553927943	2.597847672	3.63967127	1.386294361	3.496507561

Sad (Eyes)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.544854392	2.455145608	2.446744167	3.700454219	1.386294361	3.496507561	0.475241403	2.524758597	2.62542742	3.738783524	1.386294361	3.496507561
0.501228326	2.498771674	2.348275156	3.498734691	1.386294361	3.496507561	0.411564533	2.588435467	2.58078583	3.558469068	1.386294361	3.496507561
0.605788797	2.394211203	2.425196282	3.710402838	1.386294361	3.496507561	0.393198108	2.606801892	2.542602223	3.480476608	1.386294361	3.496507561
0.318789116	2.681210884	2.469038113	3.329661126	1.386294361	3.496507561	0.349366028	2.650633972	2.549727681	3.499944738	1.386294361	3.496507561
0.379095732	2.620904268	2.590749363	3.498335718	1.386294361	3.496507561	0.376353996	2.623646004	2.686107574	3.584032512	1.386294361	3.496507561
0.323579896	2.676420104	2.609545577	3.43640645	1.386294361	3.496507561	0.271887265	2.728112735	2.673706783	3.510616969	1.386294361	3.496507561
0.359129203	2.640870797	2.90111797	3.756711405	1.386294361	3.496507561	0.435382067	2.564617933	2.596271175	3.574202797	1.386294361	3.496507561
0.365795161	2.634204839	2.656160685	3.569620913	1.386294361	3.496507561	0.43921793	2.56078207	2.481215177	3.485806782	1.386294361	3.496507561
0.276145785	2.723854215	2.690646568	3.461853788	1.386294361	3.496507561	0.430250971	2.569749029	2.601570712	3.627578298	1.386294361	3.496507561
0.46136267	2.53863733	2.576014591	3.656475391	1.386294361	3.496507561	0.457621607	2.542378393	2.658409745	3.705897993	1.386294361	3.496507561
0.326781706	2.673218294	2.855307769	3.821773239	1.386294361	3.496507561	0.317914206	2.682085794	2.901452325	3.868963886	1.386294361	3.496507561
0.32888106	2.67111894	3.049534323	3.960610787	1.386294361	3.496507561	0.332438935	2.667561065	2.838239185	3.777687488	1.386294361	3.496507561
0.397381627	2.602618373	2.818408975	3.748874396	1.386294361	3.496507561	0.4034821	2.5965179	2.849240079	3.795845303	1.386294361	3.496507561
0.39959344	2.60040656	2.680155056	3.641020931	1.386294361	3.496507561	0.360065893	2.639934107	2.764820827	3.641741151	1.386294361	3.496507561
0.413852301	2.586147699	2.883163362	3.893904631	1.386294361	3.496507561	0.329112415	2.670887585	2.820905706	3.680757645	1.386294361	3.496507561
0.434609063	2.565390937	2.897912049	3.979304131	1.386294361	3.496507561	0.33703998	2.66296002	2.889707037	3.85167774	1.386294361	3.496507561
0.37465884	2.62534116	2.826971651	3.82810052	1.386294361	3.496507561	0.310979515	2.689020485	2.830124127	3.702079204	1.386294361	3.496507561
0.415499806	2.584500194	2.750786842	3.714268894	1.386294361	3.496507561	0.395424868	2.604575132	2.726136414	3.677963175	1.386294361	3.496507561
0.313428356	2.686571644	2.785709208	3.620291709	1.386294361	3.496507561	0.314670251	2.685329749	2.802392222	3.628691117	1.386294361	3.496507561

Sad (Lips)											
+45						−45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.375908633	2.624091367	2.451392386	3.349434452	1.386294361	3.496507561	0.403832595	2.596167405	2.676583883	3.598446541	1.386294361	3.496507561
0.273229122	2.726770878	2.450691966	3.224891451	1.386294361	3.496507561	0.248201696	2.751798304	2.811995559	3.503005873	1.386294361	3.496507561
0.31376309	2.68623691	2.471779661	3.314196972	1.386294361	3.496507561	0.271947662	2.728052338	2.727472866	3.467196811	1.386294361	3.496507561
0.320042598	2.679957402	2.354182279	3.253879036	1.386294361	3.496507561	0.36049871	2.63950129	2.602157664	3.47177766	1.386294361	3.496507561
0.358598301	2.641401699	2.579736591	3.536873528	1.386294361	3.496507561	0.305797979	2.694202021	2.594683724	3.42560341	1.386294361	3.496507561
0.300421595	2.699578405	2.425627443	3.390004137	1.386294361	3.496507561	0.331240882	2.668759118	2.541189178	3.399331917	1.386294361	3.496507561
0.43118031	2.56881969	2.791107607	3.83190174	1.386294361	3.496507561	0.44133214	2.55866786	2.570526911	3.583672683	1.386294361	3.496507561
0.331993857	2.668006143	2.432039462	3.313412269	1.386294361	3.496507561	0.310376087	2.689623913	2.506632075	3.307195616	1.386294361	3.496507561
0.400398815	2.599601185	2.509770385	3.537754875	1.386294361	3.496507561	0.371802815	2.628197185	2.493172345	3.443606927	1.386294361	3.496507561
0.450636084	2.549363916	2.177619328	3.246057838	1.386294361	3.496507561	0.328732608	2.671267392	2.484563318	3.304401681	1.386294361	3.496507561
0.658682906	2.341317094	2.488168711	3.841021817	1.386294361	3.496507561	0.63085105	2.36914895	2.69718046	3.998668635	1.386294361	3.496507561
0.479979125	2.520020875	2.792112228	3.88639674	1.386294361	3.496507561	0.459188173	2.540811827	2.579129161	3.634218473	1.386294361	3.496507561
0.382957687	2.617042313	2.342697868	3.357674467	1.386294361	3.496507561	0.308132069	2.691867931	2.692122149	3.510504698	1.386294361	3.496507561
0.475561313	2.524438687	2.128459329	3.284857264	1.386294361	3.496507561	0.386928571	2.613071429	2.419918729	3.3520239	1.386294361	3.496507561
0.560487463	2.439512537	2.741762442	4.022384968	1.386294361	3.496507561	0.490259765	2.509740235	2.800757401	3.939740833	1.386294361	3.496507561
0.478715988	2.521284012	2.638433576	3.773615933	1.386294361	3.496507561	0.389483196	2.610516804	2.791605988	3.737249309	1.386294361	3.496507561
0.580755699	2.419244301	2.554005752	3.801782744	1.386294361	3.496507561	0.553110169	2.446889831	2.646280393	3.807937946	1.386294361	3.496507561
0.190353871	2.809646129	2.697785182	3.374507642	1.386294361	3.496507561	0.192626382	2.807373618	2.73980815	3.297825746	1.386294361	3.496507561
0.457235624	2.542764376	2.608719504	3.747831698	1.386294361	3.496507561	0.357058219	2.642941781	2.71401101	3.596746661	1.386294361	3.496507561

Sad (Nose)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.525953916	2.474046084	2.210851707	3.429778914	1.386294361	3.496507561	0.400737779	2.599262221	2.732209597	3.660701738	1.386294361	3.496507561
0.642063025	2.357936975	2.004784352	3.449343367	1.386294361	3.496507561	0.387907426	2.612092574	2.630784666	3.568633581	1.386294361	3.496507561
0.365298635	2.634701365	2.279372668	3.177732594	1.386294361	3.496507561	0.307186623	2.692813377	2.599807787	3.357581765	1.386294361	3.496507561
0.447616795	2.552383205	2.3073468	3.388040198	1.386294361	3.496507561	0.358958884	2.641041116	2.617879281	3.468116342	1.386294361	3.496507561
0.512409831	2.487590169	2.322911106	3.521794218	1.386294361	3.496507561	0.535282376	2.464717624	2.482379304	3.680751433	1.386294361	3.496507561
0.528829644	2.471170356	2.224254761	3.41345829	1.386294361	3.496507561	0.466762096	2.533237904	2.468610867	3.487132901	1.386294361	3.496507561
0.487112835	2.512887165	2.734578776	3.869388135	1.386294361	3.496507561	0.430894399	2.569105601	2.75475366	3.767066508	1.386294361	3.496507561
0.482079043	2.517920957	2.359460451	3.483149962	1.386294361	3.496507561	0.269815043	2.730184957	2.647698428	3.341947251	1.386294361	3.496507561
0.622491841	2.377508159	2.21509468	3.634028552	1.386294361	3.496507561	0.507347137	2.492652863	2.387568004	3.547670156	1.386294361	3.496507561
0.609350411	2.390649589	2.218954111	3.598745794	1.386294361	3.496507561	0.377592746	2.622407254	2.683428225	3.595885229	1.386294361	3.496507561
0.52596136	2.47403864	2.542334641	3.754488878	1.386294361	3.496507561	0.45739743	2.54260257	2.80944686	3.84434526	1.386294361	3.496507561
0.410438504	2.589561496	2.584994607	3.613812111	1.386294361	3.496507561	0.357453264	2.642546736	2.676858142	3.50348481	1.386294361	3.496507561
0.329243696	2.670756304	2.595458027	3.453581582	1.386294361	3.496507561	0.327051601	2.672948399	2.835623534	3.611789986	1.386294361	3.496507561
0.477009814	2.522990186	2.705019777	3.832920066	1.386294361	3.496507561	0.428511799	2.571488201	2.677619434	3.682409402	1.386294361	3.496507561
0.555823054	2.444176946	2.495892218	3.783728747	1.386294361	3.496507561	0.470887264	2.529112736	2.675880344	3.766966885	1.386294361	3.496507561
0.446774332	2.553225668	2.414812496	3.49846678	1.386294361	3.496507561	0.374533967	2.625466033	2.635470162	3.524234417	1.386294361	3.496507561
0.497352673	2.502647327	2.659466924	3.821120847	1.386294361	3.496507561	0.380650615	2.619349385	2.795720297	3.710719972	1.386294361	3.496507561
0.47162913	2.52837087	2.293963704	3.396058505	1.386294361	3.496507561	0.531428981	2.468571019	2.635398368	3.829737575	1.386294361	3.496507561
0.477009814	2.522990186	2.705019777	3.832920066	1.386294361	3.496507561	0.428511799	2.571488201	2.677619434	3.682409402	1.386294361	3.496507561

Fear (Eyes)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.397680846	2.602319154	2.602245887	3.611733189	1.386294361	3.496507561	0.470147951	2.529852049	2.747614612	3.870116395	1.386294361	3.496507561
0.530070849	2.469929151	2.419485098	3.599453996	1.386294361	3.496507561	0.425056651	2.574943349	2.621900785	3.632456096	1.386294361	3.496507561
0.550675902	2.449324098	2.507329816	3.709281792	1.386294361	3.496507561	0.360962591	2.639037409	2.634007538	3.543526778	1.386294361	3.496507561
0.250635226	2.749364774	2.55977601	3.373131337	1.386294361	3.496507561	0.322051603	2.677948397	2.664784787	3.541339031	1.386294361	3.496507561
0.408187464	2.591812536	2.624634908	3.573470424	1.386294361	3.496507561	0.345454583	2.654545417	2.72880013	3.59498044	1.386294361	3.496507561
0.272089256	2.727910744	2.751533705	3.527554061	1.386294361	3.496507561	0.291539036	2.708460964	2.814944252	3.595149275	1.386294361	3.496507561
0.386417991	2.613582009	2.896076662	3.802495551	1.386294361	3.496507561	0.447925912	2.552074088	2.592722012	3.608006576	1.386294361	3.496507561
0.394527809	2.605472191	2.658999998	3.629893271	1.386294361	3.496507561	0.332775889	2.667224111	2.573825725	3.424125325	1.386294361	3.496507561
0.309364827	2.690635173	2.73352691	3.528078505	1.386294361	3.496507561	0.367187967	2.632812033	2.62985882	3.52019068	1.386294361	3.496507561
0.406758684	2.593241316	2.681208915	3.63715036	1.386294361	3.496507561	0.428093911	2.571906089	2.763148399	3.773107748	1.386294361	3.496507561
0.345356471	2.654643529	2.978945972	3.848132594	1.386294361	3.496507561	0.309936365	2.690063635	2.972339975	3.791436507	1.386294361	3.496507561
0.291846847	2.708153153	3.019281271	3.833689491	1.386294361	3.496507561	0.291603079	2.708396921	2.841641901	3.716500203	1.386294361	3.496507561
0.425905196	2.574094804	2.788405076	3.790821465	1.386294361	3.496507561	0.42680723	2.57319277	2.843621668	3.821304879	1.386294361	3.496507561
0.404635357	2.595364643	2.699386245	3.673484451	1.386294361	3.496507561	0.384804265	2.615195735	2.740349834	3.678238772	1.386294361	3.496507561
0.273599472	2.726400528	2.968691047	3.763159773	1.386294361	3.496507561	0.317077038	2.682922962	2.819944257	3.669161957	1.386294361	3.496507561
0.480467035	2.519532965	2.993944084	4.122860266	1.386294361	3.496507561	0.415141015	2.584858985	2.910497578	3.951347908	1.386294361	3.496507561
0.370245317	2.629754683	2.894290184	3.844022763	1.386294361	3.496507561	0.342324618	2.657675382	2.874797546	3.78567601	1.386294361	3.496507561
0.439070277	2.560929723	2.806725026	3.800419506	1.386294361	3.496507561	0.45302931	2.54697069	2.769670984	3.798695788	1.386294361	3.496507561
0.367612841	2.632387159	2.819722339	3.70797765	1.386294361	3.496507561	0.322085914	2.677914086	2.868320532	3.680692172	1.386294361	3.496507561

Fear (Lips)											
+45						−45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.373506044	2.626493956	2.540906329	3.467760835	1.386294361	3.496507561	0.390979522	2.609020478	2.752787276	3.703363758	1.386294361	3.496507561
0.261758557	2.738241443	2.466670762	3.295943633	1.386294361	3.496507561	0.2267372	2.7732628	2.827747571	3.601520653	1.386294361	3.496507561
0.303767506	2.696232494	2.499595177	3.335179601	1.386294361	3.496507561	0.278492205	2.721507795	2.674853407	3.436069402	1.386294361	3.496507561
0.278296993	2.721703007	2.553505993	3.426725337	1.386294361	3.496507561	0.326887791	2.673112209	2.741840388	3.59886781	1.386294361	3.496507561
0.31764321	2.68235679	2.43537408	3.41569707	1.386294361	3.496507561	0.293747636	2.706252364	2.647410699	3.507085986	1.386294361	3.496507561
0.302255318	2.697744682	2.539180708	3.512980689	1.386294361	3.496507561	0.272833201	2.727166799	2.652989901	3.58884131	1.386294361	3.496507561
0.459970872	2.540029128	2.712472089	3.804018989	1.386294361	3.496507561	0.425415536	2.574584464	2.644253629	3.657469556	1.386294361	3.496507561
0.347039495	2.652960505	2.463543624	3.392523689	1.386294361	3.496507561	0.334277299	2.665722701	2.557980221	3.398576414	1.386294361	3.496507561
0.35147537	2.64852463	2.66870623	3.667897689	1.386294361	3.496507561	0.322510723	2.677489277	2.561502948	3.471641641	1.386294361	3.496507561
0.388020706	2.611979294	2.276870881	3.277703003	1.386294361	3.496507561	0.328143925	2.671856075	2.590247797	3.411790174	1.386294361	3.496507561
0.600923901	2.399076099	2.569915306	3.822790154	1.386294361	3.496507561	0.625641422	2.374358578	2.62233732	3.937676177	1.386294361	3.496507561
0.341441217	2.658558783	2.888600289	3.793533219	1.386294361	3.496507561	0.316974418	2.683025582	2.745283435	3.585431414	1.386294361	3.496507561
0.386388083	2.613611917	2.487378932	3.518567844	1.386294361	3.496507561	0.26317856	2.73682144	2.792138865	3.523866787	1.386294361	3.496507561
0.54300233	2.45699767	2.139054174	3.38591727	1.386294361	3.496507561	0.376612699	2.623387301	2.486733143	3.390124468	1.386294361	3.496507561
0.483235404	2.516764596	2.890797871	4.067923172	1.386294361	3.496507561	0.466752636	2.533247364	2.791878254	3.911323352	1.386294361	3.496507561
0.436111926	2.563888074	2.708801969	3.79269728	1.386294361	3.496507561	0.404884258	2.595115742	2.789612134	3.76279535	1.386294361	3.496507561
0.49368268	2.50631732	2.684775243	3.82400546	1.386294361	3.496507561	0.540937443	2.459062557	2.630956125	3.787523354	1.386294361	3.496507561
0.178941814	2.821058186	2.811708275	3.541643121	1.386294361	3.496507561	0.195429618	2.804570382	2.777459028	3.359661809	1.386294361	3.496507561
0.393892107	2.606107893	2.686397256	3.730247338	1.386294361	3.496507561	0.349206851	2.650793149	2.716271232	3.65305435	1.386294361	3.496507561

Fear (Nose)												
+ 45						− 45						
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.466054409	2.533945591	2.303270773	3.395792268	1.386294361	3.496507561	0.343301891	2.656698109	2.696881147	3.524256931	1.386294361	3.496507561
0.542107562	2.457892438	2.16595757	3.411354339	1.386294361	3.496507561	0.342307245	2.657692755	2.739199016	3.579749216	1.386294361	3.496507561
0.357458827	2.642541173	2.306336409	3.186430874	1.386294361	3.496507561	0.257303103	2.742696897	2.665214835	3.359417963	1.386294361	3.496507561
0.445704035	2.554295965	2.310024942	3.396768186	1.386294361	3.496507561	0.351085014	2.648914986	2.678926309	3.508580863	1.386294361	3.496507561
0.537067996	2.462932004	2.31075802	3.567483154	1.386294361	3.496507561	0.47085481	2.52914519	2.534236247	3.613802398	1.386294361	3.496507561
0.487627806	2.512372194	2.327883108	3.448564537	1.386294361	3.496507561	0.443246395	2.556753605	2.523750952	3.513148611	1.386294361	3.496507561
0.510235326	2.489764674	2.689440921	3.86230453	1.386294361	3.496507561	0.41600739	2.58399261	2.77505747	3.752428	1.386294361	3.496507561
0.466350298	2.533649702	2.396318814	3.493929707	1.386294361	3.496507561	0.270721691	2.729278309	2.63959976	3.328485033	1.386294361	3.496507561
0.605316927	2.394683073	2.307850673	3.682816734	1.386294361	3.496507561	0.488661097	2.511338903	2.429481251	3.553970336	1.386294361	3.496507561
0.608991517	2.391008483	2.276256094	3.650859279	1.386294361	3.496507561	0.412912106	2.587087894	2.66853457	3.659193559	1.386294361	3.496507561
0.485212554	2.514787446	2.585952952	3.717407576	1.386294361	3.496507561	0.427244559	2.572755441	2.802213382	3.790040254	1.386294361	3.496507561
0.389228593	2.610771407	2.564908658	3.554063751	1.386294361	3.496507561	0.342796363	2.657203637	2.669615141	3.496739331	1.386294361	3.496507561
0.421579339	2.578420661	2.526133687	3.556602327	1.386294361	3.496507561	0.377039845	2.622960155	2.818108858	3.668303836	1.386294361	3.496507561
0.494376431	2.505623569	2.679784517	3.83759284	1.386294361	3.496507561	0.45853119	2.54146881	2.647820186	3.713261991	1.386294361	3.496507561
0.486770853	2.513229147	2.583042327	3.74330842	1.386294361	3.496507561	0.460237077	2.539762923	2.676914025	3.736789206	1.386294361	3.496507561
0.401758884	2.598241116	2.535415148	3.52387841	1.386294361	3.496507561	0.393037789	2.606962211	2.665860217	3.587382721	1.386294361	3.496507561
0.512326207	2.487673793	2.618030914	3.811211568	1.386294361	3.496507561	0.387356024	2.612643976	2.778175671	3.703506072	1.386294361	3.496507561
0.459060666	2.540939334	2.273267938	3.357619591	1.386294361	3.496507561	0.53369783	2.46630217	2.609089513	3.809788791	1.386294361	3.496507561
0.494376431	2.505623569	2.679784517	3.83759284	1.386294361	3.496507561	0.45853119	2.54146881	2.647820186	3.713261991	1.386294361	3.496507561

Anger (Eyes)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.466439465	2.533560535	2.558385579	3.682007862	1.386294361	3.496507561	0.461173981	2.538826019	2.708254254	3.797693333	1.386294361	3.496507561
0.603196078	2.396803922	2.338214992	3.625727684	1.386294361	3.496507561	0.5448313	2.4551687	2.644488574	3.844858554	1.386294361	3.496507561
0.596504584	2.403495416	2.502359557	3.784153207	1.386294361	3.496507561	0.483192234	2.516807766	2.540886973	3.665095483	1.386294361	3.496507561
0.413216629	2.586783371	2.515229673	3.573960673	1.386294361	3.496507561	0.511098947	2.488901053	2.674404035	3.85736424	1.386294361	3.496507561
0.386006052	2.613993948	2.795954528	3.714842334	1.386294361	3.496507561	0.282883575	2.717116425	2.76342018	3.503006479	1.386294361	3.496507561
0.340439933	2.659560067	2.731158927	3.592804189	1.386294361	3.496507561	0.350008939	2.649991061	2.819410219	3.695160842	1.386294361	3.496507561
0.466317197	2.533682803	2.777357952	3.806840558	1.386294361	3.496507561	0.498295745	2.501704255	2.55425113	3.643272591	1.386294361	3.496507561
0.394026246	2.605973754	2.560363183	3.552450262	1.386294361	3.496507561	0.357237448	2.642762552	2.462381507	3.392714285	1.386294361	3.496507561
0.509277868	2.490722132	2.666024454	3.835969874	1.386294361	3.496507561	0.567858576	2.432141424	2.640319847	3.897353516	1.386294361	3.496507561
0.466298323	2.533701677	2.653516846	3.723412816	1.386294361	3.496507561	0.519284643	2.480715357	2.732706251	3.895453248	1.386294361	3.496507561
0.487654109	2.512345891	2.791235124	3.972914655	1.386294361	3.496507561	0.389153836	2.610846164	2.909248807	3.924699287	1.386294361	3.496507561
0.528353883	2.471646117	2.922050382	4.155361222	1.386294361	3.496507561	0.484694379	2.515305621	2.807700404	3.945218965	1.386294361	3.496507561
0.450309168	2.549690832	2.850045916	3.861691646	1.386294361	3.496507561	0.438710252	2.561289748	2.886697143	3.895550357	1.386294361	3.496507561
0.46076009	2.53923991	2.666495991	3.738173863	1.386294361	3.496507561	0.411787526	2.588212474	2.674876847	3.657823151	1.386294361	3.496507561
0.36994396	2.63005604	3.01767154	3.916885765	1.386294361	3.496507561	0.299035956	2.700964044	2.966733205	3.768874421	1.386294361	3.496507561
0.49965647	2.50034353	2.884884315	4.058758976	1.386294361	3.496507561	0.486477843	2.513522157	2.817546742	3.979217761	1.386294361	3.496507561
0.410686036	2.589313964	2.807926145	3.826770948	1.386294361	3.496507561	0.425936651	2.574063349	2.821906703	3.859992627	1.386294361	3.496507561
0.554842218	2.445157782	2.58912332	3.798351388	1.386294361	3.496507561	0.590614284	2.409385716	2.668956459	3.944292357	1.386294361	3.496507561
0.372915952	2.627084048	2.833643407	3.762959795	1.386294361	3.496507561	0.342856392	2.657143608	2.842909711	3.691727218	1.386294361	3.496507561

Anger (Lips)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.432375419	2.567624581	2.482472438	3.477619012	1.386294361	3.496507561	0.336641918	2.663358082	2.738657931	3.586166552	1.386294361	3.496507561
0.246273416	2.753726584	2.491987889	3.322894499	1.386294361	3.496507561	0.237993282	2.762006718	2.837641798	3.584695783	1.386294361	3.496507561
0.387754785	2.612245215	2.390239033	3.339953171	1.386294361	3.496507561	0.319325576	2.680674424	2.616603277	3.435687072	1.386294361	3.496507561
0.318514659	2.681485341	2.431795393	3.340524137	1.386294361	3.496507561	0.34861553	2.65138447	2.676638481	3.581329383	1.386294361	3.496507561
0.274720581	2.725279419	2.613794476	3.452605054	1.386294361	3.496507561	0.317967907	2.682032093	2.459799741	3.430834023	1.386294361	3.496507561
0.317551222	2.682448778	2.414417197	3.359205687	1.386294361	3.496507561	0.286403002	2.713596998	2.632886418	3.450335412	1.386294361	3.496507561
0.45805659	2.54194341	2.667437088	3.707016011	1.386294361	3.496507561	0.419578641	2.580421359	2.672272956	3.612469106	1.386294361	3.496507561
0.323298173	2.676701827	2.403891257	3.266913433	1.386294361	3.496507561	0.327637112	2.672362888	2.521672206	3.319146527	1.386294361	3.496507561
0.401900741	2.598099259	2.776653661	3.832922047	1.386294361	3.496507561	0.326775015	2.673224985	2.784105236	3.715290109	1.386294361	3.496507561
0.388485988	2.611514012	2.31471597	3.31541758	1.386294361	3.496507561	0.297782015	2.702217985	2.612358003	3.407827675	1.386294361	3.496507561
0.64432552	2.35567448	2.502438472	3.846533098	1.386294361	3.496507561	0.632780867	2.367219133	2.56181211	3.922809804	1.386294361	3.496507561
0.507969321	2.492030679	2.720916944	3.847703788	1.386294361	3.496507561	0.472252039	2.527747961	2.651443391	3.691516507	1.386294361	3.496507561
0.360089664	2.639910336	2.437273416	3.404172715	1.386294361	3.496507561	0.312107143	2.687892857	2.670856682	3.454592482	1.386294361	3.496507561
0.570709321	2.429290679	1.937768124	3.21719889	1.386294361	3.496507561	0.508595659	2.491404341	2.303185797	3.404928396	1.386294361	3.496507561
0.549778669	2.450221331	2.799049747	4.05193614	1.386294361	3.496507561	0.504299323	2.495700677	2.75402484	3.907576015	1.386294361	3.496507561
0.508398181	2.491601819	2.561098852	3.706256376	1.386294361	3.496507561	0.445272078	2.554727922	2.744615691	3.747977106	1.386294361	3.496507561
0.626043655	2.373956345	2.444147901	3.784603261	1.386294361	3.496507561	0.516777409	2.483222591	2.680180963	3.78759646	1.386294361	3.496507561
0.232227774	2.767772226	2.741126467	3.407964358	1.386294361	3.496507561	0.203426075	2.796573925	2.839139016	3.475442723	1.386294361	3.496507561
0.449257307	2.550742693	2.573402077	3.674427353	1.386294361	3.496507561	0.378972646	2.621027354	2.650688582	3.560430537	1.386294361	3.496507561

Anger (Nose)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.459636872	2.540363128	2.328842522	3.41621	1.386294361	3.496507561	0.328633613	2.671366387	2.723766966	3.519440137	1.386294361	3.496507561
0.566130989	2.433869011	2.17738378	3.471222438	1.386294361	3.496507561	0.367088696	2.632911304	2.713982208	3.611294824	1.386294361	3.496507561
0.336909206	2.663090794	2.394831192	3.24257344	1.386294361	3.496507561	0.27691875	2.72308125	2.689276635	3.408935341	1.386294361	3.496507561
0.561148044	2.438851956	2.169745585	3.452844191	1.386294361	3.496507561	0.401156678	2.598843322	2.607569654	3.544037741	1.386294361	3.496507561
0.484400126	2.515599874	2.567338991	3.656991372	1.386294361	3.496507561	0.571554459	2.428445541	2.239865458	3.534712726	1.386294361	3.496507561
0.546299763	2.453700237	2.317676046	3.526916172	1.386294361	3.496507561	0.473857759	2.526142241	2.502899455	3.565453138	1.386294361	3.496507561
0.429884533	2.570115467	2.773713566	3.798595613	1.386294361	3.496507561	0.348209868	2.651790132	2.755280101	3.612427175	1.386294361	3.496507561
0.500905626	2.499094374	2.40067766	3.576773539	1.386294361	3.496507561	0.334392989	2.665607011	2.588515888	3.424536135	1.386294361	3.496507561
0.614303639	2.385696361	2.396821075	3.789579868	1.386294361	3.496507561	0.500144708	2.499855292	2.521099831	3.697592595	1.386294361	3.496507561
0.657363262	2.342636738	2.208697505	3.668390454	1.386294361	3.496507561	0.469556726	2.530443274	2.646891238	3.742135157	1.386294361	3.496507561
0.636182756	2.363817244	2.519910003	3.92766877	1.386294361	3.496507561	0.512683989	2.487316011	2.878115507	4.056733927	1.386294361	3.496507561
0.501280202	2.498719798	2.515753507	3.697643386	1.386294361	3.496507561	0.422020926	2.577979074	2.673735464	3.611355425	1.386294361	3.496507561
0.356949954	2.643050046	2.610766747	3.512797294	1.386294361	3.496507561	0.325523681	2.674476319	2.90373375	3.688882144	1.386294361	3.496507561
0.501169813	2.498830187	2.675181517	3.857233217	1.386294361	3.496507561	0.433470772	2.566529228	2.683080854	3.702588444	1.386294361	3.496507561
0.517435309	2.482564691	2.625276904	3.847185784	1.386294361	3.496507561	0.513900989	2.486099011	2.638590226	3.806608098	1.386294361	3.496507561
0.378772822	2.621227178	2.609270295	3.576986381	1.386294361	3.496507561	0.344946346	2.655053654	2.671460542	3.499841525	1.386294361	3.496507561
0.497586801	2.502413199	2.750880985	3.913944987	1.386294361	3.496507561	0.409368736	2.590631264	2.81894242	3.786865393	1.386294361	3.496507561
0.53227877	2.46772123	2.265016919	3.459635096	1.386294361	3.496507561	0.50299647	2.49700353	2.700326104	3.823756364	1.386294361	3.496507561
0.501169813	2.498830187	2.675181517	3.857233217	1.386294361	3.496507561	0.433470772	2.566529228	2.683080854	3.702588444	1.386294361	3.496507561

Surprise (Eyes)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.375911818	2.624088182	2.602027416	3.582070577	1.386294361	3.496507561	0.306245042	2.693754958	2.823748616	3.65984196	1.386294361	3.496507561
0.327993882	2.672006118	2.504225528	3.333337734	1.386294361	3.496507561	0.312354883	2.687645117	2.657662828	3.47103501	1.386294361	3.496507561
0.558616229	2.441383771	2.404352183	3.605555449	1.386294361	3.496507561	0.291864217	2.708135783	2.712055622	3.551109571	1.386294361	3.496507561
0.242505654	2.757494346	2.575583241	3.345737484	1.386294361	3.496507561	0.309688741	2.690311259	2.685296017	3.530334609	1.386294361	3.496507561
0.387403001	2.612596999	2.606874371	3.520141584	1.386294361	3.496507561	0.380112574	2.619887426	2.708139637	3.601587211	1.386294361	3.496507561
0.253964151	2.746035849	2.747627931	3.466817733	1.386294361	3.496507561	0.237968836	2.762031164	2.814499274	3.566721546	1.386294361	3.496507561
0.354157475	2.645842525	2.916748819	3.717934924	1.386294361	3.496507561	0.415448065	2.584551935	2.649397686	3.588147206	1.386294361	3.496507561
0.353127925	2.646872075	2.682265543	3.558213508	1.386294361	3.496507561	0.404885484	2.595114516	2.511788156	3.4686989	1.386294361	3.496507561
0.30151891	2.69848109	2.720640825	3.48879215	1.386294361	3.496507561	0.26960878	2.73039122	2.653804154	3.406144494	1.386294361	3.496507561
0.386950515	2.613049485	2.851002891	3.777367762	1.386294361	3.496507561	0.373911389	2.626088611	2.700732257	3.607196702	1.386294361	3.496507561
0.368742386	2.631257614	2.928826214	3.864946171	1.386294361	3.496507561	0.260581561	2.739418439	3.026628293	3.852324242	1.386294361	3.496507561
0.290564572	2.709435428	2.949679233	3.788631835	1.386294361	3.496507561	0.302767752	2.697232248	2.800778068	3.696749953	1.386294361	3.496507561
0.36558911	2.63441089	2.833932235	3.703047194	1.386294361	3.496507561	0.389456256	2.610543744	2.802330319	3.717547964	1.386294361	3.496507561
0.339732691	2.660267309	2.658912673	3.538293715	1.386294361	3.496507561	0.36708174	2.63291826	2.732392797	3.645844823	1.386294361	3.496507561
0.493593985	2.506406015	2.865564058	3.99368679	1.386294361	3.496507561	0.372722868	2.627277132	2.839578689	3.758866633	1.386294361	3.496507561
0.346461951	2.653538049	2.977847197	3.89692656	1.386294361	3.496507561	0.358619241	2.641380759	2.904662458	3.834388053	1.386294361	3.496507561
0.206145221	2.793854779	2.972265502	3.64765884	1.386294361	3.496507561	0.221496274	2.778503726	2.949247799	3.63699866	1.386294361	3.496507561
0.356028625	2.643971375	2.806847143	3.671934107	1.386294361	3.496507561	0.411639787	2.588360213	2.806062824	3.771465125	1.386294361	3.496507561
0.327078641	2.672921359	2.825024732	3.641820301	1.386294361	3.496507561	0.271787946	2.728212054	2.854894538	3.587678425	1.386294361	3.496507561

Surprise (Lips)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.341906552	2.658093448	2.768583082	3.645919194	1.386294361	3.496507561	0.363310778	2.636689222	2.972281945	3.862998303	1.386294361	3.496507561
0.285015859	2.714984141	2.448189257	3.289464487	1.386294361	3.496507561	0.24493249	2.75506751	2.645776434	3.423747482	1.386294361	3.496507561
0.387610979	2.612389021	2.670015638	3.583594561	1.386294361	3.496507561	0.352672022	2.647327978	2.868514756	3.698501599	1.386294361	3.496507561
0.270209453	2.729790547	2.659171979	3.502529602	1.386294361	3.496507561	0.313975483	2.686024517	2.894241037	3.75547309	1.386294361	3.496507561
0.342647625	2.657352375	2.913304444	3.801644973	1.386294361	3.496507561	0.392791827	2.607208173	3.017107567	3.985157136	1.386294361	3.496507561
0.440216086	2.559783914	2.434551403	3.528466048	1.386294361	3.496507561	0.36691872	2.63308128	2.665638127	3.611654457	1.386294361	3.496507561
0.391045439	2.608954561	2.823126788	3.73052151	1.386294361	3.496507561	0.381317575	2.618682425	2.847996702	3.712578678	1.386294361	3.496507561
0.280893991	2.719106009	2.858734261	3.588118053	1.386294361	3.496507561	0.318004599	2.681995401	2.882929658	3.685783489	1.386294361	3.496507561
0.255940163	2.744059837	2.816185293	3.52434064	1.386294361	3.496507561	0.282078554	2.717921446	2.850754996	3.608174523	1.386294361	3.496507561
0.353761588	2.646238412	2.668390406	3.651838284	1.386294361	3.496507561	0.417388528	2.582611472	2.913781403	3.994389128	1.386294361	3.496507561
0.533362335	2.466637665	2.636949585	3.803954385	1.386294361	3.496507561	0.467978349	2.532021651	2.797946151	3.825212459	1.386294361	3.496507561
0.380125353	2.619874647	2.737297206	3.681785047	1.386294361	3.496507561	0.353874197	2.646125803	2.694262478	3.553351334	1.386294361	3.496507561
0.423130431	2.576869569	2.358506751	3.430421014	1.386294361	3.496507561	0.310441995	2.689558005	2.543212933	3.3509556	1.386294361	3.496507561
0.496915594	2.503084406	2.395490909	3.553911893	1.386294361	3.496507561	0.454171406	2.545828594	2.675713815	3.730230654	1.386294361	3.496507561
0.528040147	2.471959853	2.895112778	4.130185825	1.386294361	3.496507561	0.492337484	2.507662516	2.812005777	3.95978813	1.386294361	3.496507561
0.500614239	2.499385761	2.704348613	3.83413648	1.386294361	3.496507561	0.499784976	2.500215024	2.757090478	3.85849726	1.386294361	3.496507561
0.616061259	2.383938741	2.494548802	3.796130947	1.386294361	3.496507561	0.560311662	2.439688338	2.619719375	3.776520579	1.386294361	3.496507561
0.200130182	2.799869818	2.76126297	3.392163776	1.386294361	3.496507561	0.239005764	2.760994236	2.897667178	3.596092551	1.386294361	3.496507561
0.350707554	2.649292446	2.780017787	3.691444304	1.386294361	3.496507561	0.415841697	2.584158303	2.809746174	3.752661303	1.386294361	3.496507561

Surprise (Nose)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.468098136	2.531901864	2.341308216	3.438681094	1.386294361	3.496507561	0.341851962	2.658148038	2.717785609	3.534401237	1.386294361	3.496507561
0.580061109	2.419938891	2.114182578	3.450734212	1.386294361	3.496507561	0.408052098	2.591947902	2.722157298	3.693440982	1.386294361	3.496507561
0.379161256	2.620838744	2.302709797	3.226556847	1.386294361	3.496507561	0.349427905	2.650572095	2.619929889	3.456269822	1.386294361	3.496507561
0.477100355	2.522899645	2.223496322	3.347186999	1.386294361	3.496507561	0.345431423	2.654568577	2.653985009	3.504360487	1.386294361	3.496507561
0.559970617	2.440029383	2.267611122	3.558467605	1.386294361	3.496507561	0.483528406	2.516471594	2.583026625	3.696756765	1.386294361	3.496507561
0.495557314	2.504442686	2.295603368	3.432895144	1.386294361	3.496507561	0.405909567	2.594090433	2.525798178	3.452904639	1.386294361	3.496507561
0.479572321	2.520427679	2.826180578	3.985119077	1.386294361	3.496507561	0.362215919	2.637784081	2.778680537	3.65222009	1.386294361	3.496507561
0.487709806	2.512290194	2.297675286	3.446711782	1.386294361	3.496507561	0.254628311	2.745371689	2.526389021	3.210908939	1.386294361	3.496507561
0.619558004	2.380441996	2.295586243	3.726453879	1.386294361	3.496507561	0.522409862	2.477590138	2.449216223	3.656811699	1.386294361	3.496507561
0.671923464	2.328076536	2.195442593	3.67788187	1.386294361	3.496507561	0.434987217	2.565012783	2.686722887	3.711902192	1.386294361	3.496507561
0.515683903	2.484316097	2.611928183	3.803349855	1.386294361	3.496507561	0.449480933	2.550519067	2.778307196	3.800685425	1.386294361	3.496507561
0.394370004	2.605629996	2.47992943	3.470719095	1.386294361	3.496507561	0.343113239	2.656886761	2.643106305	3.457821735	1.386294361	3.496507561
0.332171136	2.667828864	2.586884784	3.450481118	1.386294361	3.496507561	0.329315173	2.670684827	2.811200499	3.60494793	1.386294361	3.496507561
0.543030606	2.456969394	2.654883481	3.921223051	1.386294361	3.496507561	0.471042846	2.528957154	2.603225621	3.688791903	1.386294361	3.496507561
0.522951058	2.477048942	2.575692534	3.806887197	1.386294361	3.496507561	0.493850187	2.506149813	2.602098844	3.737202925	1.386294361	3.496507561
0.388995348	2.611004652	2.525512454	3.497239847	1.386294361	3.496507561	0.35745438	2.64254562	2.594380327	3.442842362	1.386294361	3.496507561
0.477580989	2.522419011	2.691948061	3.817883619	1.386294361	3.496507561	0.36198941	2.63801059	2.839609613	3.714466439	1.386294361	3.496507561
0.470348219	2.529651781	2.232089557	3.331065962	1.386294361	3.496507561	0.420942894	2.579057106	2.840770796	3.797146795	1.386294361	3.496507561
0.543030606	2.456969394	2.654883481	3.921223051	1.386294361	3.496507561	0.471042846	2.528957154	2.603225621	3.688791903	1.386294361	3.496507561

Disgust (Eyes)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.544312283	2.455687717	2.447211925	3.659972504	1.386294361	3.496507561	0.483671847	2.516328153	2.658211152	3.794429583	1.386294361	3.496507561
0.472324545	2.527675455	2.372430428	3.429383276	1.386294361	3.496507561	0.40443725	2.59556275	2.591532379	3.567246258	1.386294361	3.496507561
0.613806753	2.386193247	2.442044658	3.7518583	1.386294361	3.496507561	0.44164653	2.55835347	2.512493032	3.555105198	1.386294361	3.496507561
0.447312036	2.552687964	2.426171979	3.530459318	1.386294361	3.496507561	0.465281519	2.534718481	2.494916784	3.60276415	1.386294361	3.496507561
0.313126183	2.686873817	2.583955482	3.426809888	1.386294361	3.496507561	0.350613599	2.649386401	2.648634647	3.542597994	1.386294361	3.496507561
0.413969042	2.586030958	2.629634037	3.643204933	1.386294361	3.496507561	0.461299774	2.538700226	2.642345175	3.750059639	1.386294361	3.496507561
0.451668531	2.548331469	2.742969924	3.785573678	1.386294361	3.496507561	0.491083861	2.508916139	2.539404402	3.627705962	1.386294361	3.496507561
0.404903568	2.595096432	2.549522522	3.560981991	1.386294361	3.496507561	0.345973789	2.654026211	2.523181281	3.396265485	1.386294361	3.496507561
0.249514166	2.750485834	2.624990863	3.356086875	1.386294361	3.496507561	0.261533776	2.738466224	2.587221737	3.337626368	1.386294361	3.496507561
0.520238041	2.479761959	2.55401016	3.73987799	1.386294361	3.496507561	0.562905169	2.437094831	2.644852294	3.89756271	1.386294361	3.496507561
0.624720859	2.375279141	2.673970101	4.050630693	1.386294361	3.496507561	0.401547802	2.598452198	2.92096055	3.961255062	1.386294361	3.496507561
0.354093182	2.645906818	2.877926327	3.800228594	1.386294361	3.496507561	0.289387548	2.710612452	2.755885525	3.652769184	1.386294361	3.496507561
0.531244777	2.468755223	2.673954461	3.815268537	1.386294361	3.496507561	0.503828481	2.496171519	2.711677892	3.826838004	1.386294361	3.496507561
0.371953822	2.628046178	2.575094153	3.488018126	1.386294361	3.496507561	0.403230384	2.596769616	2.6090311	3.568031247	1.386294361	3.496507561
0.361456876	2.638543124	2.836240966	3.734981425	1.386294361	3.496507561	0.49157403	2.50842597	2.860930281	3.999430105	1.386294361	3.496507561
0.408267859	2.591732141	2.864168419	3.892389053	1.386294361	3.496507561	0.395271424	2.604728576	2.829504021	3.834646709	1.386294361	3.496507561
0.345348019	2.654651981	2.844007695	3.764421213	1.386294361	3.496507561	0.326623737	2.673376263	2.768804787	3.655562816	1.386294361	3.496507561
0.434124257	2.565875743	2.718780628	3.738657629	1.386294361	3.496507561	0.42470583	2.57529417	2.68219574	3.664540464	1.386294361	3.496507561
0.306475171	2.693524829	2.692412653	3.524794477	1.386294361	3.496507561	0.317427904	2.682572096	2.737710632	3.543628629	1.386294361	3.496507561

Disgust (Lips)											
+45						−45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.483025156	2.516974844	2.393104915	3.448445842	1.386294361	3.496507561	0.488959634	2.511040366	2.622090248	3.681905752	1.386294361	3.496507561
0.315273538	2.684726462	2.214655305	3.089973079	1.386294361	3.496507561	0.323656249	2.676343751	2.370585572	3.182915665	1.386294361	3.496507561
0.366370403	2.633629597	2.427747124	3.33087534	1.386294361	3.496507561	0.356830839	2.643169161	2.582279775	3.467031459	1.386294361	3.496507561
0.298749287	2.701250713	2.218125847	3.003529659	1.386294361	3.496507561	0.374542175	2.625457825	2.381556857	3.218736062	1.386294361	3.496507561
0.297770391	2.702229608	2.368592269	3.268508812	1.386294361	3.496507561	0.267038287	2.732961713	2.434433823	3.288215176	1.386294361	3.496507561
0.276665151	2.723334849	2.615600645	3.399646242	1.386294361	3.496507561	0.249680612	2.750319388	2.348619886	3.161023374	1.386294361	3.496507561
0.296498287	2.703501713	2.821409704	3.587168656	1.386294361	3.496507561	0.31820895	2.68179105	2.691029762	3.478329576	1.386294361	3.496507561
0.332861314	2.667138686	2.360304448	3.211480283	1.386294361	3.496507561	0.31435762	2.68564238	2.478464544	3.273676324	1.386294361	3.496507561
0.341098524	2.658901476	2.512137591	3.431815976	1.386294361	3.496507561	0.303694243	2.696305757	2.560872662	3.410308342	1.386294361	3.496507561
0.332208916	2.667791084	2.230896624	3.027849466	1.386294361	3.496507561	0.294827375	2.705172625	2.535608254	3.263163952	1.386294361	3.496507561
0.647536608	2.352463392	2.538282446	3.880346466	1.386294361	3.496507561	0.513326709	2.486673291	2.725533747	3.812531195	1.386294361	3.496507561
0.559251218	2.440748782	2.567676795	3.809904852	1.386294361	3.496507561	0.499007861	2.500992139	2.554699121	3.659176935	1.386294361	3.496507561
0.326766975	2.673233025	2.434294696	3.378326319	1.386294361	3.496507561	0.264629175	2.735370825	2.719242887	3.479288167	1.386294361	3.496507561
0.446082719	2.553917281	1.965887216	3.022354749	1.386294361	3.496507561	0.267891766	2.732108234	2.283633734	2.975633299	1.386294361	3.496507561
0.501063345	2.498936655	2.749253968	3.9062388	1.386294361	3.496507561	0.536077273	2.463922727	2.807911325	4.064176826	1.386294361	3.496507561
0.488734387	2.511265613	2.181041357	3.295758366	1.386294361	3.496507561	0.3993036	2.6006964	2.481392173	3.431534738	1.386294361	3.496507561
0.558825604	2.441174396	2.604997898	3.764576323	1.386294361	3.496507561	0.608164937	2.391835063	2.482414033	3.799590744	1.386294361	3.496507561
0.285320615	2.714679385	2.80644764	3.561167872	1.386294361	3.496507561	0.338393614	2.661606386	2.884597167	3.738418461	1.386294361	3.496507561
0.495627215	2.504372785	2.507291322	3.655940647	1.386294361	3.496507561	0.393867373	2.606132627	2.557535162	3.522109499	1.386294361	3.496507561

Disgust (Nose)												
+ 45						− 45						
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.623759334	2.376240666	2.150653772	3.56441526	1.386294361	3.496507561	0.531486327	2.468513673	2.535054285	3.70507876	1.386294361	3.496507561
0.57073681	2.42926319	2.147858557	3.468903621	1.386294361	3.496507561	0.420803811	2.579196189	2.593407424	3.590120138	1.386294361	3.496507561
0.441903721	2.558096279	2.276463651	3.313443003	1.386294361	3.496507561	0.322623617	2.677376383	2.60858315	3.387891324	1.386294361	3.496507561
0.572541919	2.427458081	2.117935141	3.438544643	1.386294361	3.496507561	0.401889865	2.598110135	2.573724873	3.570291847	1.386294361	3.496507561
0.561275924	2.438724076	2.232186877	3.519873052	1.386294361	3.496507561	0.516932552	2.483067448	2.522618867	3.6949297	1.386294361	3.496507561
0.608361912	2.391638088	2.182589283	3.52379609	1.386294361	3.496507561	0.456215128	2.543784872	2.527928709	3.591588319	1.386294361	3.496507561
0.493203048	2.506796952	2.822239397	4.016689348	1.386294361	3.496507561	0.339454829	2.660545171	2.846296598	3.678697617	1.386294361	3.496507561
0.498492094	2.501507906	2.34387529	3.53051604	1.386294361	3.496507561	0.281396538	2.718603462	2.632493864	3.357242496	1.386294361	3.496507561
0.624636096	2.375363904	2.325919055	3.761431396	1.386294361	3.496507561	0.527226933	2.472773067	2.409666473	3.640130555	1.386294361	3.496507561
0.602787955	2.397212045	2.339891145	3.733315137	1.386294361	3.496507561	0.507077046	2.492922954	2.633888157	3.794531105	1.386294361	3.496507561
0.5178281	2.4821719	2.570187176	3.788442644	1.386294361	3.496507561	0.464213527	2.535786473	2.800535778	3.85669531	1.386294361	3.496507561
0.482959454	2.517040546	2.459626956	3.599774685	1.386294361	3.496507561	0.390852124	2.609147876	2.647489665	3.571544627	1.386294361	3.496507561
0.419777085	2.580222915	2.535798329	3.583768743	1.386294361	3.496507561	0.427956576	2.572043424	2.759677894	3.723860085	1.386294361	3.496507561
0.527800177	2.472199823	2.675318198	3.928517527	1.386294361	3.496507561	0.438929221	2.561070779	2.642295399	3.68971571	1.386294361	3.496507561
0.49018657	2.50981343	2.637975639	3.762522533	1.386294361	3.496507561	0.517882595	2.482117405	2.582655412	3.788630344	1.386294361	3.496507561
0.358881841	2.641118159	2.622947875	3.558129865	1.386294361	3.496507561	0.359608921	2.640391079	2.619177065	3.496625572	1.386294361	3.496507561
0.504911251	2.495088749	2.648067671	3.816900855	1.386294361	3.496507561	0.427358101	2.572641899	2.737064732	3.747938823	1.386294361	3.496507561
0.524749788	2.475250212	2.307831877	3.52445874	1.386294361	3.496507561	0.540479179	2.459520821	2.703908509	3.887902367	1.386294361	3.496507561
0.527800177	2.472199823	2.675318198	3.928517527	1.386294361	3.496507561	0.438929221	2.561070779	2.642295399	3.68971571	1.386294361	3.496507561

Neutral (Eyes)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.342685493	2.657314507	2.618305173	3.514203901	1.386294361	3.496507561	0.343776782	2.656223218	2.755752219	3.675091315	1.386294361	3.496507561
0.48969403	2.51030597	2.435738027	3.578949162	1.386294361	3.496507561	0.397716608	2.602283392	2.626502261	3.607029899	1.386294361	3.496507561
0.599452014	2.400547986	2.44857633	3.727002515	1.386294361	3.496507561	0.411213716	2.588786284	2.579450113	3.556575618	1.386294361	3.496507561
0.272023371	2.727976629	2.481430097	3.328568432	1.386294361	3.496507561	0.361344853	2.638655147	2.564001214	3.500357985	1.386294361	3.496507561
0.363171354	2.636828646	2.620233886	3.492027551	1.386294361	3.496507561	0.404638475	2.595361525	2.695388338	3.620360062	1.386294361	3.496507561
0.311665571	2.688334429	2.668710161	3.470314727	1.386294361	3.496507561	0.242788315	2.757211685	2.678326942	3.498961993	1.386294361	3.496507561
0.40392215	2.59607785	2.815099325	3.735620031	1.386294361	3.496507561	0.403536442	2.596463558	2.606828373	3.525531795	1.386294361	3.496507561
0.383727225	2.616272775	2.649052988	3.576517621	1.386294361	3.496507561	0.348340757	2.651659243	2.576103714	3.446474019	1.386294361	3.496507561
0.311739293	2.688260707	2.759499625	3.579537861	1.386294361	3.496507561	0.356871519	2.643128481	2.648055632	3.526911969	1.386294361	3.496507561
0.474508934	2.525491066	2.60355991	3.710540084	1.386294361	3.496507561	0.449800095	2.550199905	2.737216458	3.762436302	1.386294361	3.496507561
0.397626103	2.602373897	2.892243831	3.907963351	1.386294361	3.496507561	0.305412592	2.694587408	2.949373489	3.836594821	1.386294361	3.496507561
0.347317293	2.652682707	3.054775072	3.977384648	1.386294361	3.496507561	0.352698264	2.647301736	2.816160419	3.762789355	1.386294361	3.496507561
0.366274294	2.633725706	2.812068219	3.701995528	1.386294361	3.496507561	0.383206426	2.616793574	2.801942769	3.712311273	1.386294361	3.496507561
0.448450921	2.551549079	2.663011353	3.70714386	1.386294361	3.496507561	0.449411529	2.550588471	2.708412933	3.760237223	1.386294361	3.496507561
0.415009245	2.584990755	2.871010563	3.885855305	1.386294361	3.496507561	0.277572033	2.722427967	2.863533492	3.64821565	1.386294361	3.496507561
0.468349848	2.531650152	2.97851545	4.097341626	1.386294361	3.496507561	0.355653557	2.644346443	2.931405866	3.867162346	1.386294361	3.496507561
0.365390686	2.634609314	2.900122552	3.851860851	1.386294361	3.496507561	0.27420868	2.72579132	2.894534838	3.707417557	1.386294361	3.496507561
0.494966967	2.505033033	2.7595427	3.863279839	1.386294361	3.496507561	0.505211645	2.494788355	2.699520928	3.812246109	1.386294361	3.496507561
0.327078641	2.672921359	2.825024732	3.641820301	1.386294361	3.496507561	0.271787946	2.728212054	2.854894538	3.587678425	1.386294361	3.496507561

Neutral (Lips)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.30157827	2.69842173	2.533593032	3.32635097	1.386294361	3.496507561	0.3539301	2.6460699	2.715977579	3.569593232	1.386294361	3.496507561
0.262810169	2.737189831	2.456599174	3.334985447	1.386294361	3.496507561	0.267542596	2.732457404	2.778317764	3.56158952	1.386294361	3.496507561
0.296240416	2.703759584	2.479633458	3.304816609	1.386294361	3.496507561	0.247607037	2.752392963	2.74804074	3.452627057	1.386294361	3.496507561
0.36557365	2.63442635	2.278368445	3.201129349	1.386294361	3.496507561	0.349263464	2.650736536	2.591206787	3.46243928	1.386294361	3.496507561
0.348736507	2.651263493	2.403790508	3.355879112	1.386294361	3.496507561	0.324021826	2.675978174	2.551776959	3.426906883	1.386294361	3.496507561
0.360016851	2.639983149	2.340397082	3.262443732	1.386294361	3.496507561	0.39047431	2.60952569	2.394762267	3.337696395	1.386294361	3.496507561
0.446451303	2.553548697	2.716496099	3.720045626	1.386294361	3.496507561	0.420534486	2.579465514	2.69479876	3.638074789	1.386294361	3.496507561
0.371213574	2.628786426	2.46283074	3.433115041	1.386294361	3.496507561	0.3404022	2.6595978	2.531047605	3.413694898	1.386294361	3.496507561
0.415250651	2.584749349	2.567795652	3.6421068	1.386294361	3.496507561	0.351795317	2.648204683	2.592505692	3.550458389	1.386294361	3.496507561
0.401613885	2.598386115	2.277324455	3.305637861	1.386294361	3.496507561	0.309199594	2.690800406	2.662702953	3.501524055	1.386294361	3.496507561
0.50251925	2.49748075	2.71910336	3.803143183	1.386294361	3.496507561	0.641208888	2.358791112	2.650979371	3.983938966	1.386294361	3.496507561
0.505785515	2.494214485	2.789747967	3.914778538	1.386294361	3.496507561	0.458478483	2.541521517	2.589050958	3.638493565	1.386294361	3.496507561
0.413447691	2.586552309	2.33051607	3.394787966	1.386294361	3.496507561	0.315339105	2.684660895	2.57310657	3.369422446	1.386294361	3.496507561
0.468594986	2.531405014	2.098290777	3.227468389	1.386294361	3.496507561	0.468720883	2.531279117	2.32100404	3.379524917	1.386294361	3.496507561
0.567402562	2.432597438	2.771916517	4.057523206	1.386294361	3.496507561	0.516085113	2.483914887	2.779390441	3.952905452	1.386294361	3.496507561
0.504928362	2.495071638	2.558566985	3.732779868	1.386294361	3.496507561	0.469694691	2.530305309	2.664291386	3.720911211	1.386294361	3.496507561
0.576023604	2.423976396	2.511895451	3.783970895	1.386294361	3.496507561	0.531850114	2.468149886	2.599376751	3.736034147	1.386294361	3.496507561
0.200901502	2.799098498	2.728605164	3.40431315	1.386294361	3.496507561	0.210932264	2.789067736	2.756843365	3.335335917	1.386294361	3.496507561
0.350707554	2.649292446	2.780017787	3.691444304	1.386294361	3.496507561	0.415841697	2.584158303	2.809746174	3.752661303	1.386294361	3.496507561

Neutral (Nose)											
+ 45						− 45					
Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]	Hurst Coefficient	Fractal Dimension	Range of log(NMSID) [min value]	Range of log(NMSID) [max value]	Range of log(NSR) [min value]	Range of log(NSR) [max value]
0.477671627	2.522328373	2.240744264	3.340895025	1.386294361	3.496507561	0.313500439	2.686499561	2.6981542	3.459023335	1.386294361	3.496507561
0.584782244	2.415217756	2.103958086	3.413414894	1.386294361	3.496507561	0.366941376	2.633058624	2.672184171	3.550226848	1.386294361	3.496507561
0.364923511	2.635076489	2.292258345	3.186276387	1.386294361	3.496507561	0.284746646	2.715253354	2.653979691	3.387314525	1.386294361	3.496507561
0.474974952	2.525025048	2.18416885	3.300847304	1.386294361	3.496507561	0.324999352	2.675000648	2.679811729	3.488143501	1.386294361	3.496507561
0.565812664	2.434187336	2.257215436	3.552148913	1.386294361	3.496507561	0.495588318	2.504411682	2.54444362	3.661986911	1.386294361	3.496507561
0.585622503	2.414377497	2.122841368	3.414845439	1.386294361	3.496507561	0.46155676	2.53844324	2.47195355	3.499166257	1.386294361	3.496507561
0.400661283	2.599338717	2.823202011	3.78901233	1.386294361	3.496507561	0.372867478	2.627132522	2.690167049	3.594437536	1.386294361	3.496507561
0.480875429	2.519124571	2.379863462	3.507545091	1.386294361	3.496507561	0.277804211	2.722195789	2.579107665	3.293792062	1.386294361	3.496507561
0.620336198	2.379663802	2.240177251	3.649609089	1.386294361	3.496507561	0.526708564	2.473291436	2.357119228	3.554773548	1.386294361	3.496507561
0.653497377	2.346502623	2.228113675	3.67976217	1.386294361	3.496507561	0.44823818	2.55176182	2.622027098	3.687341289	1.386294361	3.496507561
0.515228988	2.484771012	2.502580811	3.702381754	1.386294361	3.496507561	0.464234198	2.535765802	2.817837998	3.872393929	1.386294361	3.496507561
0.387233392	2.612766608	2.642575189	3.626522235	1.386294361	3.496507561	0.336492455	2.663507545	2.688684726	3.483934649	1.386294361	3.496507561
0.342610629	2.657389371	2.531019036	3.411450005	1.386294361	3.496507561	0.315720548	2.684279452	2.821233109	3.584160953	1.386294361	3.496507561
0.495198822	2.504801178	2.655428019	3.817308388	1.386294361	3.496507561	0.446072057	2.553927943	2.597847672	3.63967127	1.386294361	3.496507561
0.547191626	2.452808374	2.515919916	3.786823089	1.386294361	3.496507561	0.461114801	2.538885199	2.700742408	3.764938195	1.386294361	3.496507561
0.364044639	2.635955361	2.574763163	3.503009436	1.386294361	3.496507561	0.35824025	2.64175975	2.622700954	3.487551903	1.386294361	3.496507561
0.568605718	2.431394282	2.67250141	3.961237885	1.386294361	3.496507561	0.408492614	2.591507386	2.743221705	3.705919697	1.386294361	3.496507561
0.482317729	2.517682271	2.319030135	3.440808186	1.386294361	3.496507561	0.564142237	2.435857763	2.671318106	3.936337583	1.386294361	3.496507561
0.543030606	2.456969394	2.654883481	3.921223051	1.386294361	3.496507561	0.471042846	2.528957154	2.603225621	3.688791903	1.386294361	3.496507561

Fractal Dimension and Hurst Coefficient Analysis of the Indian Affective Picture Database (IAPD) 2.0

Braj Bhushan & Prabhat Munshi

Abstract

This study conducted a fractal analysis of the Indian Affective Picture Database-II with three primary objectives: (i) to compute the fractal dimension and Hurst coefficient for full face and segmented facial zones (eyes, nose, lips) to examine emotional differences, (ii) to evaluate whether the baseline condition (neutral expression) exhibits commonality across expressers in terms of fractal metrics, and (iii) to investigate fractal dimension changes across facial regions and compare them at -45 and +45 degree angles for six basic emotions. Findings revealed that fractal changes in the eye region significantly exceeded those in the nose and lip zones, as well as in the full face, highlighting the eyes as the most unpredictable in expressing basic emotions. Notably, individual differences were evident even in neutral expressions. The analysis indicated that although the intensity of anger expression varied among individuals, the Hurst coefficient consistently remained higher during anger than in neutral expressions. Similarly, this trend was observed for surprise, with one exception. Conversely, emotions such as happiness, sadness, fear, and disgust displayed greater individual variation. In summary, the results suggest that while the expressions of basic emotions manifest distinctly at +45 degrees—particularly for happiness, anger, and disgust—they do not exhibit distinctive characteristics at -45 degrees.

Background

Development and validation of databases of facial expressions has been an integral part of basic research in psychological science. The behavioural scientists have mostly focused on range of emotions (basic-complex), context (posed vs spontaneous), type (static photographs vs dynamic videos), and so forth. A good number of databases such as Pictures of Facial Affect (POFA: Ekman & Friesen, 1976), Japanese and Caucasian Facial Expressions of Emotion (JACFEE: Matsumoto & Ekman, 1988), Karolinska Directed Emotional Faces (KDEF:

Lundqvist, Flykt, & Ohman, 1998), Montreal Set of Facial Displays of Emotion (MSFDE: Beaupré, Cheung, & Hess, 2000), the International Affective Picture System (IAPS: Lang, Bradley, & Cuthbert, 2005), the Tool for Recognition of Emotions in Neuropsychiatric Disorders (TRENDS: Behere et al., 2008), NimStim set of facial Expressions (Tottenham, Tanaka, Leon, McCarry, Nurse, Hare, et al., 2009), University of California, Davis, Set of Emotion Expressions (UCDSEE: Tracy, Robins, & Schriber, 2009), the Indian Spontaneous Facial Expression Database (ISED: Happy, Patnaik, Routray, & Guha, 2015), and the Indian Affective Picture Database (IAPD: Sharma & Bhushan, 2019) comprise of the basic emotions.

A close examination of the nature of these databases suggest that psychologists have largely focused on physical property of the images (grey or coloured), non-facial features (facial hairs, etc.), labelling (correct-incorrect recognition of emotion), emotion tagging (valence-arousal scale), or rating of emotion (intensity of expression) of facial expressions. In terms of physical properties of the images, three distinct aspects emerge from the literature. Firstly, earlier databases preferred only facial features and the non-facial features were erased. Secondly, the databases have a mix of achromatic and chromatic images. For instance, POFA (Ekman & Friesen, 1976) contains 110 black and white images, MSFDE (Beaupré, Cheung, & Hess, 2000) consists of 144 black and white photos, and so forth whereas ISED (Happy, Patnaik, Routray, & Guha, 2015) and many others comprise of coloured images. Thirdly, most of the databases have the frontal view of the expressors. Only select databases, such as KDEF (Lundqvist, Flykt, & Ohman, 1998) and IAPD (Sharma & Bhushan, 2019) consists of colour pictures of the emotional expressions taken from five different angles. Further, the behavioural studies seem to assume that all expressers are equally expressive and the baseline condition (neutral expression) is the same for all expressers.

Although not so commonly adopted by psychologists, the facial expressions of these databases can be further validated using other techniques such as fractal analysis for a robust validation in the context of affective computing. Analysis of facial expressions using fractal dimension changes (Takehara, Ochial, & Suzuki, 2002; Takehara, Ochiai, Watanabe, & Suzuki, 2013; Bhushan & Munshi, 2021) have yielded promising results. Takehara et al. (2002, 2007, 2013) conducted pioneering studies using limited images on small sample. Later, Bhushan and Munshi (2021) performed fractal analysis of Indian Database of Basic Emotions (IDBE: Bhushan, 2007) comprising of frontal view of six basic emotions and IAPD (Sharma & Bhushan, 2019) comprising of images of six basic emotions from five different viewing angles.

However, two things are important here. Firstly, the number of expressers in both the databases were limited, and secondly, the studies by Takehara et al. and Bhushan and Munshi performed fractal analysis of images which were largely devoid of occlusions such as facial hairs. Image and perception can be subjective, often influenced by factors like facial hair, makeup, lighting, etc. Removing facial hair might be essential in image-based applications to maintain consistency in visual data and to ensure accurate recognition. On the other hand, mathematical analysis of facial features focuses more on underlying structures, dimensions, and geometry of the face, which remain constant regardless of superficial elements. This type of analysis can extract features like distances between key points on the face, angles, and other quantitative metrics that are unaffected by facial hair or other external factors.

Discrete model of emotion adopts a categorical approach that identifies distinct emotions such as happiness, sadness, etc. with unique characteristics such as subjective experiences and action tendencies. On the other hand, the dimensional models of emotion view emotion as a continuous space defined by dimensions such as arousal (low to high) and valence (pleasant to unpleasant). The key difference between the two models is specificity vs generality. Unlike discrete model that focuses on unique characteristics, dimensional model characterizes emotions more broadly, suggesting that emotions can be mapped onto these dimensions. Further, different emotions can overlap within this space. For example, both anger and fear might be high in arousal but differ in valence. The two models further differ with respect to behaviour prediction. Discrete models predict specific actions linked to emotions, whereas dimensional models predict emotional responses based on arousal and valence levels.

It merits mention that KDEF (Lundqvist, Flykt, & Ohman, 1998) and IAPD (Sharma & Bhushan, 2019) are the only two databases comprising of expressions of the six basic emotional along with a neutral expression taken from front as well as four different angles, i.e., −90° (full left profile), −45° (half left profile), +45° (half right profile) and +90° (full right profile). The fractal analysis by Bhushan and Munshi (2021) endorsed that visual angle did not affect recognition of happy expression. Recently, Nara et al. (2025) investigated facial angles and emotion recognition using MEG and endorsed comparing front profile with −45° (left) and +45° (right) profiles. Looking at the significance of fractal dimension analysis for facial expressions, relatively large number of expressers in the database, and images of basic emotions with and without facial hairs at front, −45°, and +45° profiles, we performed fractal

analysis of the Indian Affective Picture Database- 2.0 (Bhushan, 2023) with the following objectives—

i) to compute the fractal dimension and Hurst coefficient of full face and eye, nose and lip zones to see difference among emotions,

ii) to see whether the baseline condition (neutral expression) is common for all the expressers in terms of fractal dimension and Hurst coefficient, and

iii) to compute the fractal dimension changes of the full face and the three facial regions (eye, nose, and lips) and compare them with -45 and +45 degree profiles for the six basic emotion.

METHOD

IAPD- 2.0 DATABASE

The Indian Affective Picture Database- 2.0 (IAPD- 2.0, Bhushan, 2023) comprise of 399 achromatic pictures of 19 amateur actors (7 males, 12 females) with mean age of 21.1 years (SD 2.58). The mean age of male expressers was 22.14 years (SD 2.41) and female expressers was 20.5 years (SD 2.58). Of the seven male expressers, five had facial hairs and two were clean shaved. All the expressers were associated with a performing art centre. These expressers were instructed to express six basic emotions, happy, sad, fear, anger, surprise, and disgust along with neutral expression and the expressions were captured from three camera angles, 0° (straight front profile), -45° (half left profile), and +45° (half right profile).

Figure 29 illustrates sample from IAPD- 2.0 (Bhushan, 2023) of the facial expression of happiness captured at 90° (referred as 0° straight front profile), -45°, and +45° from the camera position.

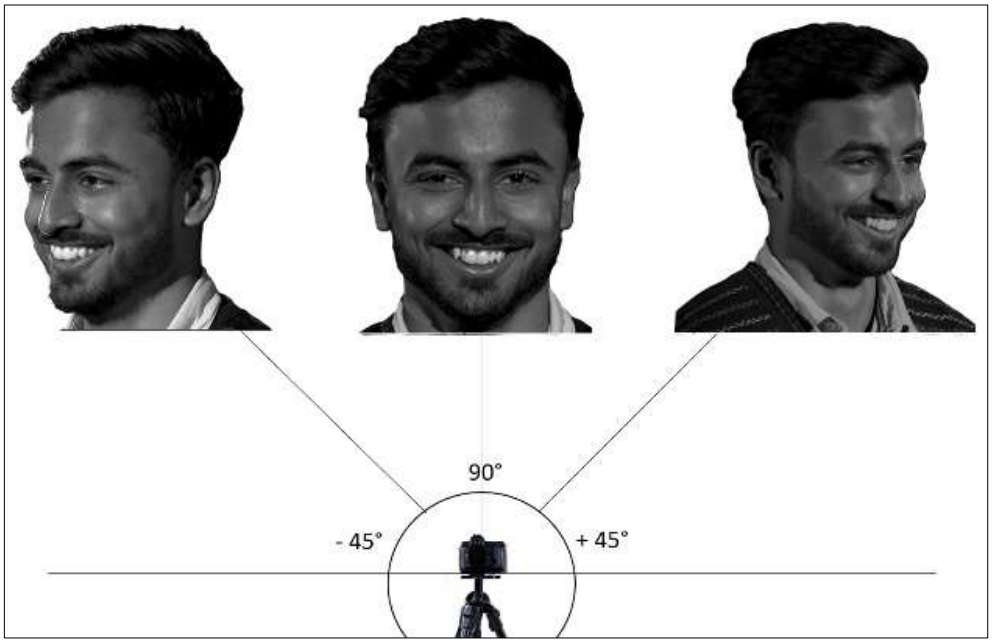


Figure 30. IAPD- 2.0 facial expression of happiness captured at 90° (referred as 0° straight front profile), -45°, and +45° from the camera position.

Equation

Hurst coefficient was calculated using the following formula—

H= fraclog (R/S) log (T) (1)

Where H= Hurst coefficient, R= Range of cumulative deviations, S= SD, and T= time period

RESULT

0 degree (Front view)

A repeated-measures ANOVA was performed to evaluate the effect of fractal changes on facial expressions of emotions. The emotion specific means and standard deviations for the full face as well as the three AOIs, i.e., eyes, nose, and lips, are presented in Table 18.

Table 18. Mean and SD of fractal dimensions and Hurst Coefficient for full face and the three AOIs.

Face Area	Emotion	Fractal Dimension		Hurst Coefficient	
		Mean	SD	Mean	SD
Full Face	Anger	2.446	0.037	0.554	0.037
	Surprise	2.468	0.137	0.559	0.039
	Neutral	2.401	0.044	0.599	0.044
	Happy	2.433	0.039	0.566	0.041
	Sad	2.433	0.043	0.567	0.043
	Fear	2.447	0.044	0.553	0.044
	Disgust	2.423	0.036	0.575	0.034
Eyes	Anger	2.563	0.085	0.437	0.085
	Surprise	2.613	0.038	0.387	0.038
	Neutral	2.595	0.053	0.405	0.053
	Happy	2.588	0.045	0.412	0.045
	Sad	2.583	0.046	0.417	0.046
	Fear	2.606	0.039	0.522	0.533
	Disgust	2.579	0.071	0.421	0.071
Nose	Anger	2.451	0.040	0.548	0.040
	Surprise	2.435	0.069	0.565	0.069
	Neutral	2.450	0.039	0.550	0.039
	Happy	2.411	0.046	0.589	0.046
	Sad	2.456	0.043	0.544	0.043

	Fear	2.450	0.049	0.550	0.049
	Disgust	2.425	0.053	0.575	0.053
Lips	Anger	2.425	0.083	0.575	0.083
	Surprise	2.417	0.059	0.583	0.059
	Neutral	2.408	0.063	0.592	0.063
	Happy	2.447	0.066	0.553	0.066
	Sad	2.423	0.071	0.577	0.071
	Fear	2.404	0.065	0.596	0.065
	Disgust	2.458	0.062	0.542	0.062

Mauchly's test of sphericity indicated that the assumption of sphericity was violated for fractal dimension (approx. $\chi^2 = 12.24$, df= 5, $p < .05$) as well as emotions (approx. $\chi^2 = 45.95$, df= 20, $p < .001$). Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity (Fractals: $\varepsilon = 0.68$, Emotion: $\varepsilon = 0.47$). The within subject effect of fractal dimensions (F= 61.35, df= 3, p<.001) and the fractal dimension x emotion interaction (F= 3.421, df= 18, p<.001) were significant.

Post-hoc pairwise comparisons with a Bonferroni adjustment indicated significant difference between fractal dimension of the full face and eye region (Mean Difference= -0.154, SE= 0.014, t= -10.908, p<.001), eye-nose regions (Mean Difference= 0.15, SE= 0.014, t= 10.633, p<.001), and eye-lip regions (Mean Difference= 0.164, SE= 0.014, t= 11.602, p<.001) suggesting that the fractal changes in the eye region were significantly higher than the nose and lip regions as well as the full face. Further, the fractal changes between nose and lip regions were not significantly different.

Hurst coefficient (H) is directly related to fractal dimension in a self-similar time series and range between 0-1 wherein higher values (0.5 – 1) indicate 'a smoother trend, less volatility, and less roughness' [18]. The value of H ranges between 0.553 – 0.599 for the full face, 0.544 – 0.589 for nose, and 0.542 – 0.596 for lips. On the contrary, H for eyes range between 0.387 – 0.437 for all emotions and exceeds the threshold only for fear (0.522). Table 1 summarizes the H for the full face as well as the three ROIs for different emotions. Figure 30

illustrates the comparative views of fractal dimensions and H for the three ROIs as well as the full face.

Put together, fractal dimension and H suggest eyes to be most unpredictable in terms of expression of basic emotions, thus significantly contributing to expressions of these emotions.

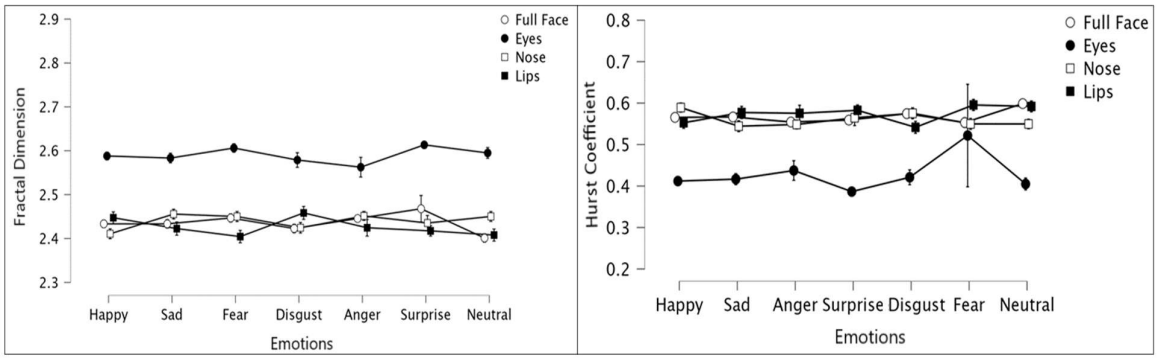


Figure 31. Fractal dimensions and Hurst coefficients of eye, nose, and lip regions and the full face.

It seems that facial expression databases assume that everyone is equally expressive as individual differences among the expressors are not reported. Based on the fractal dimension analysis, Bhushan and Munshi (2021) reported individual difference in the variation of expressiveness among expressors for different types of emotions. We examined the individual difference in H among the 19 expressors (Figure 31). At the first stage, the range of H for neutral expression of all the expressors was compared. The H ranged between .51–.61 with mean of .59 (SD .043). The value of H varies between 0-1, where higher values indicate smoother trend and less volatility. *H* in the range 0.5–1 indicates a time series with long-term positive autocorrelation. It merits mention that the H of neutral expressions for all the participants were above 0.5 and ranged between .51–.61 suggesting individual difference in face even for neutral expression.

***Individual differences in Hurst coefficients*:**

The H of the six basic emotions ranged between .49–.66. The H for happiness ranged between .51–.64 (M= .56, SD= .039), sadness between .49–.63 (M= .56, SD= .04), fear between .49–.65 (M= .55, SD= .04), anger between .49–.62 (M= .55, SD= .03), surprise between .49–.63 (M= .55, SD= .03), and disgust between .53–.61 (M= .57, SD= .03).

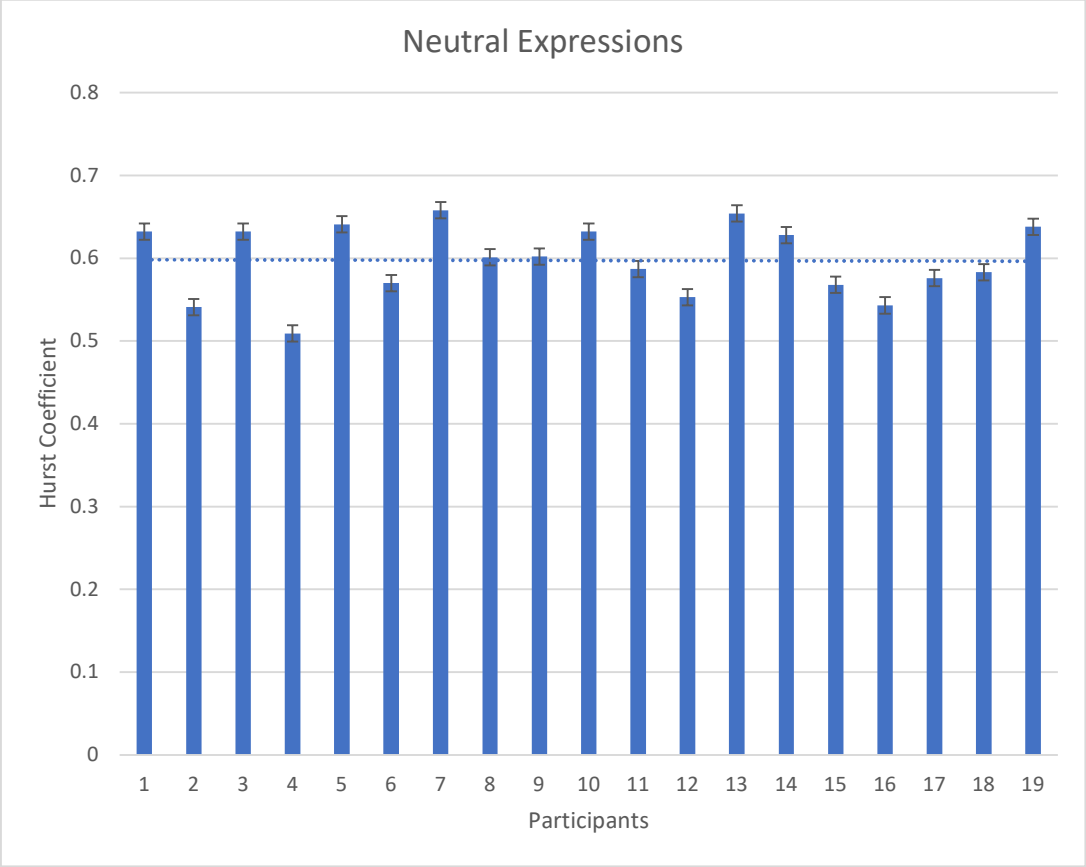


Figure 32: Hurst coefficient (H) of neutral expression of all the 19 expressors.

Thereafter, percentage change in H for all the six basic emotions were computed considering H of neutral expression as the baseline. Figure 32 illustrates the respective changes for all the six basic emotions. The variation in the extent of expression of the basic emotions with respect to respective neutral expression of the participants was obvious inasmuch as select emotion expressions were even lower in magnitude than the neutral expression for nine participants.

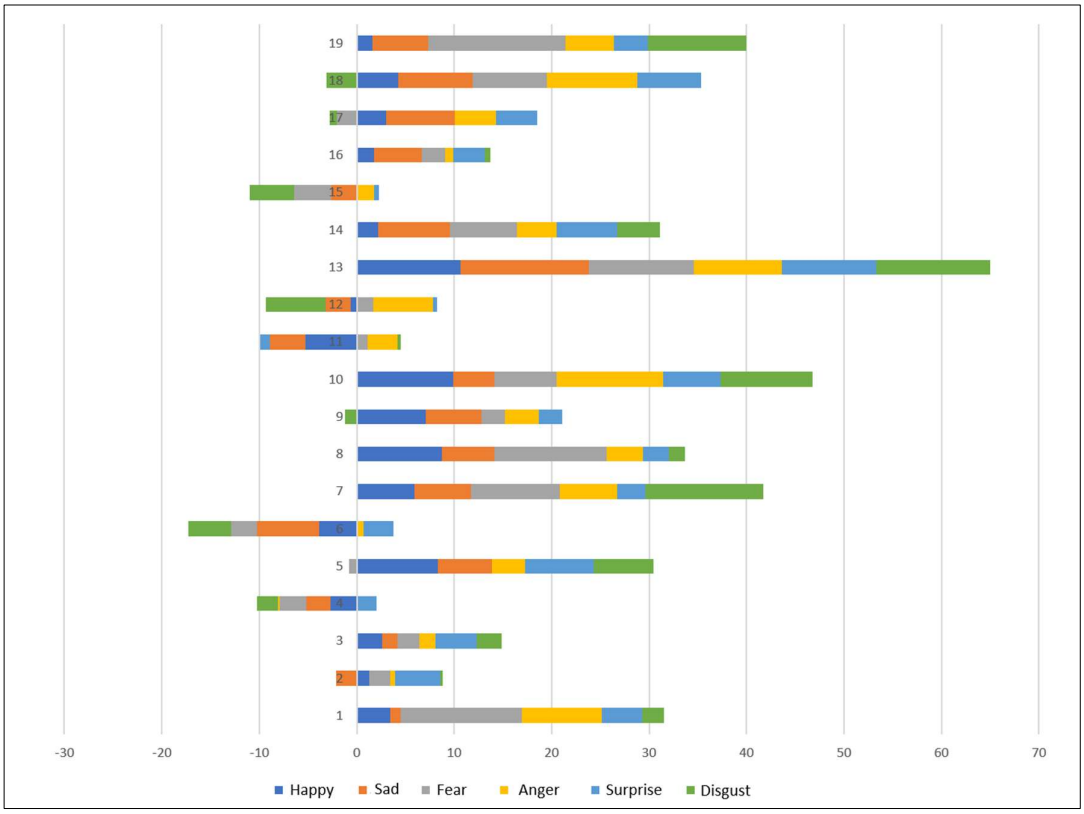
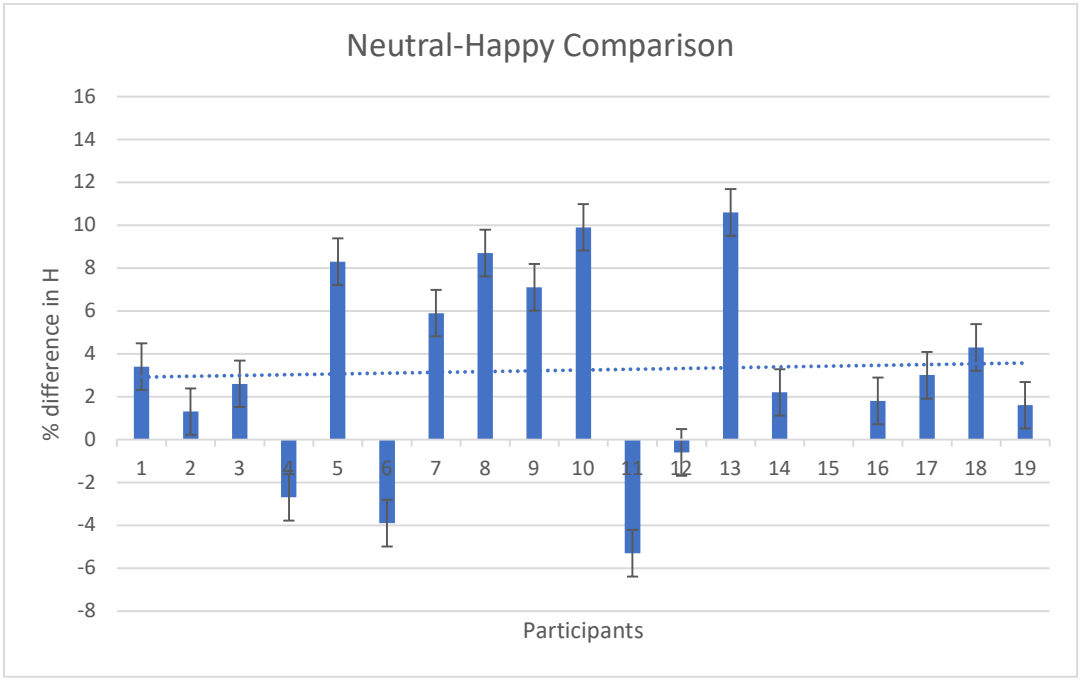
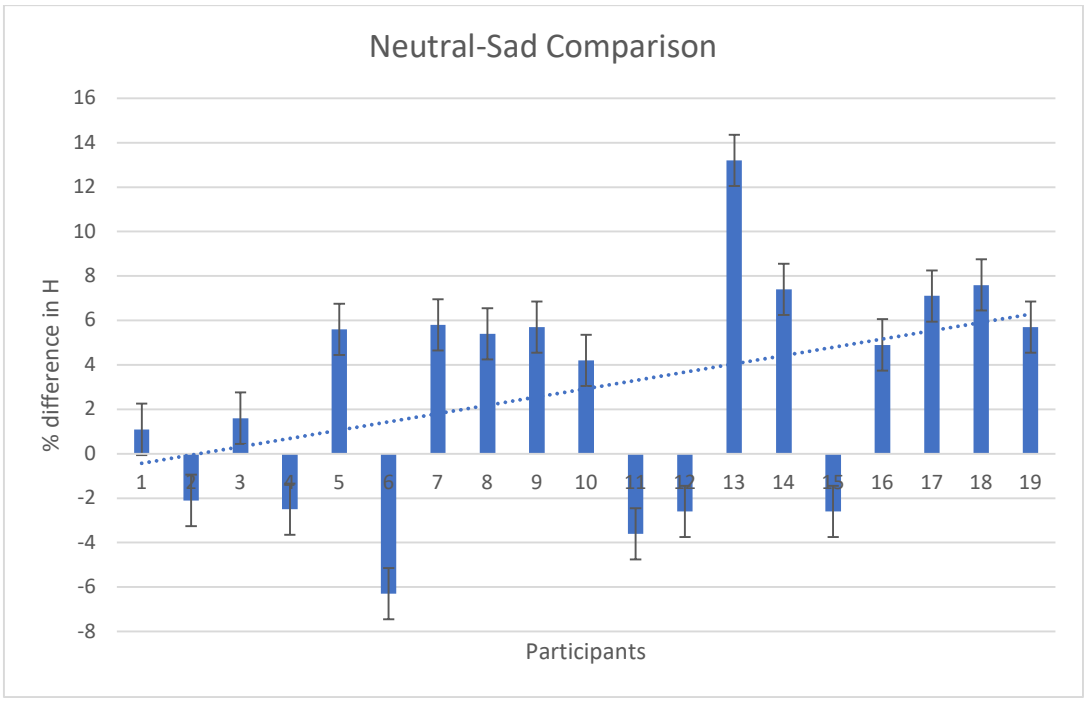


Figure 33. The cluster column chart representing variation in the extent of expression of the basic emotions with respect to respective neutral expression for all the 19 participants.

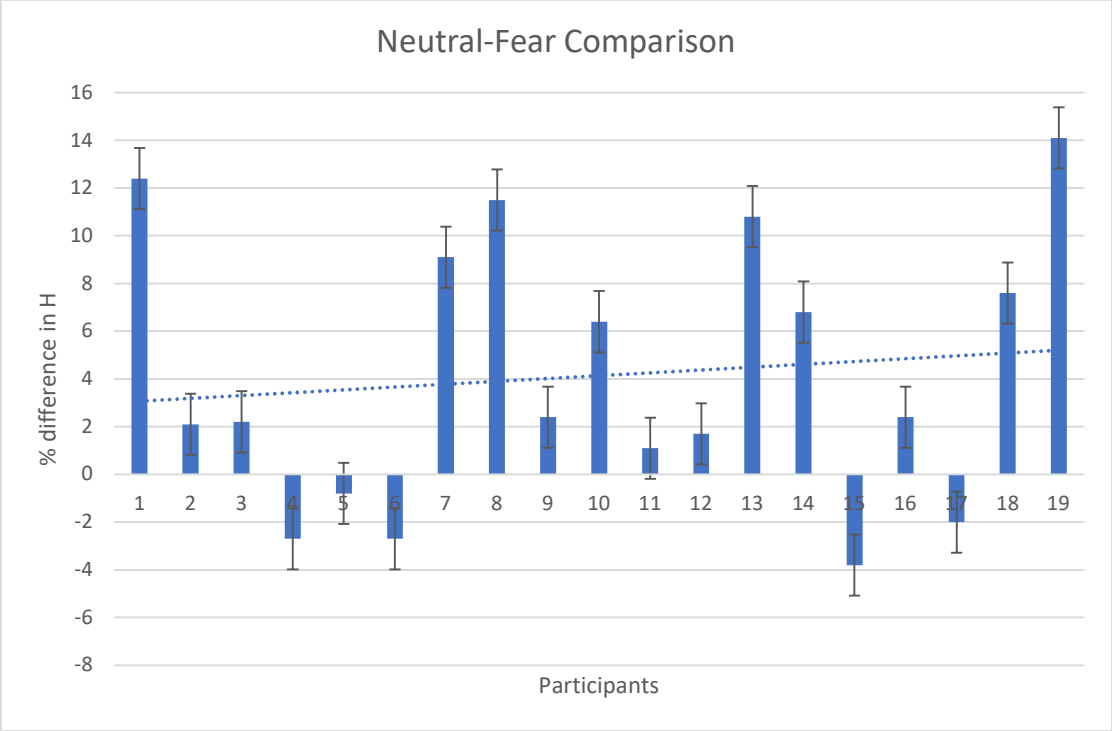
Figure 33 illustrates explicit percentage difference in H between the neutral expression and the six basic emotions.


Neutral-Happy Comparison
% difference in H
Participants
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

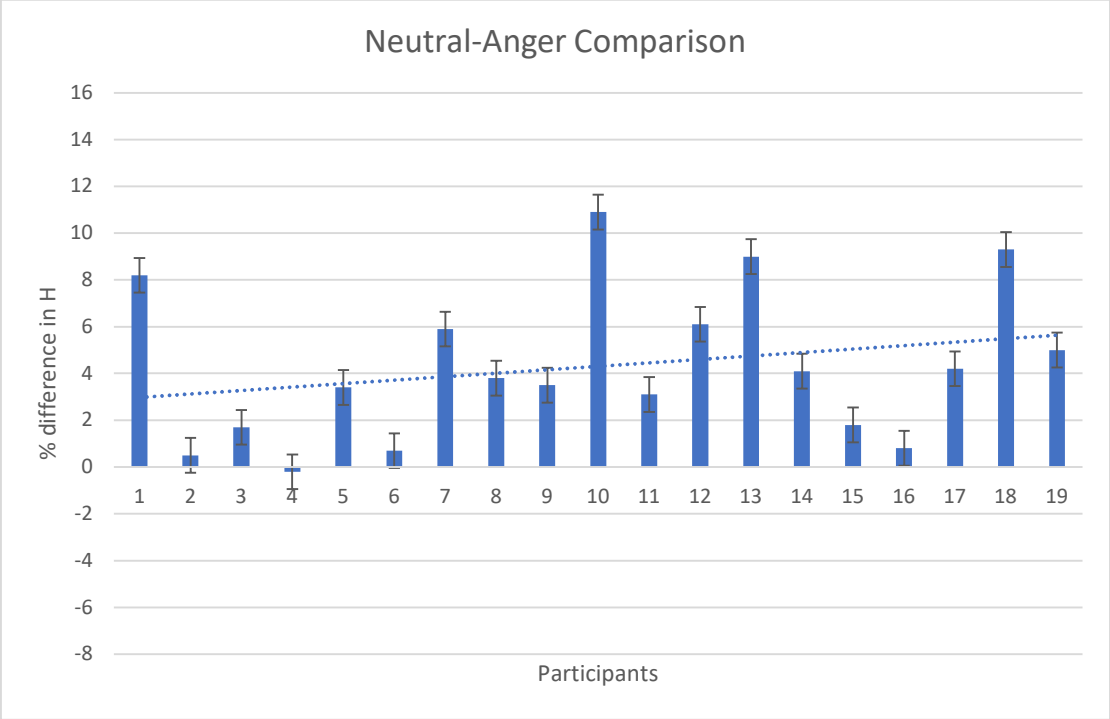
34 (A)


Neutral-Sad Comparison
% difference in H
Participants
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

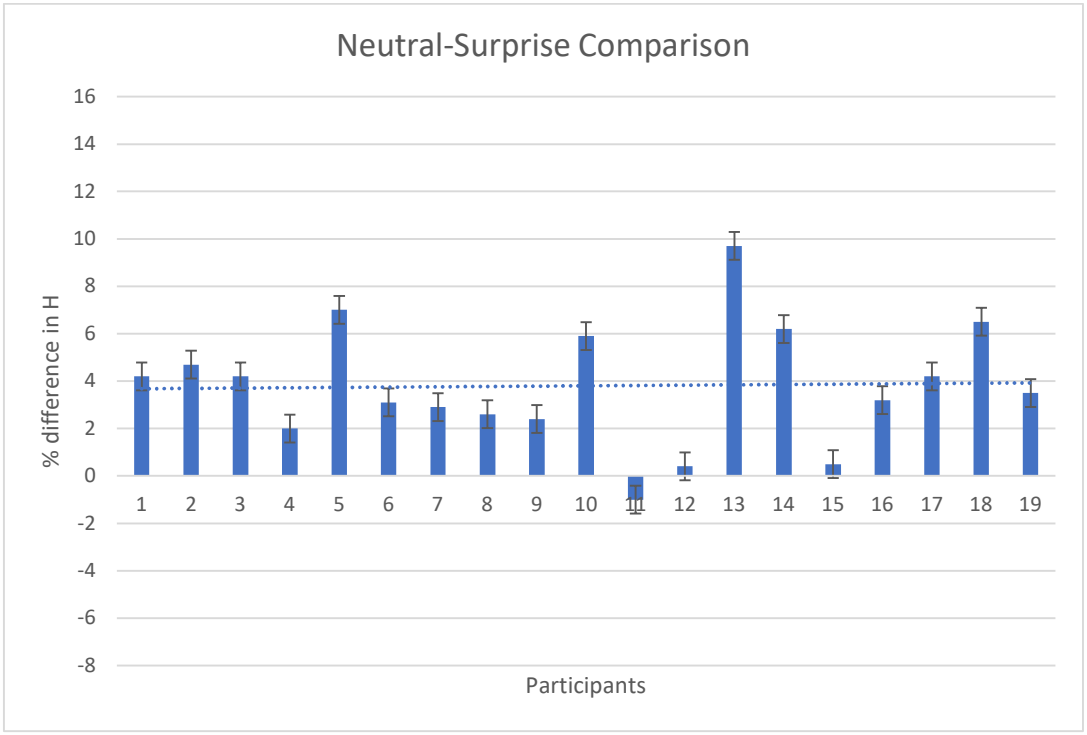
34 (B)


Neutral-Fear Comparison
% difference in H
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Participants

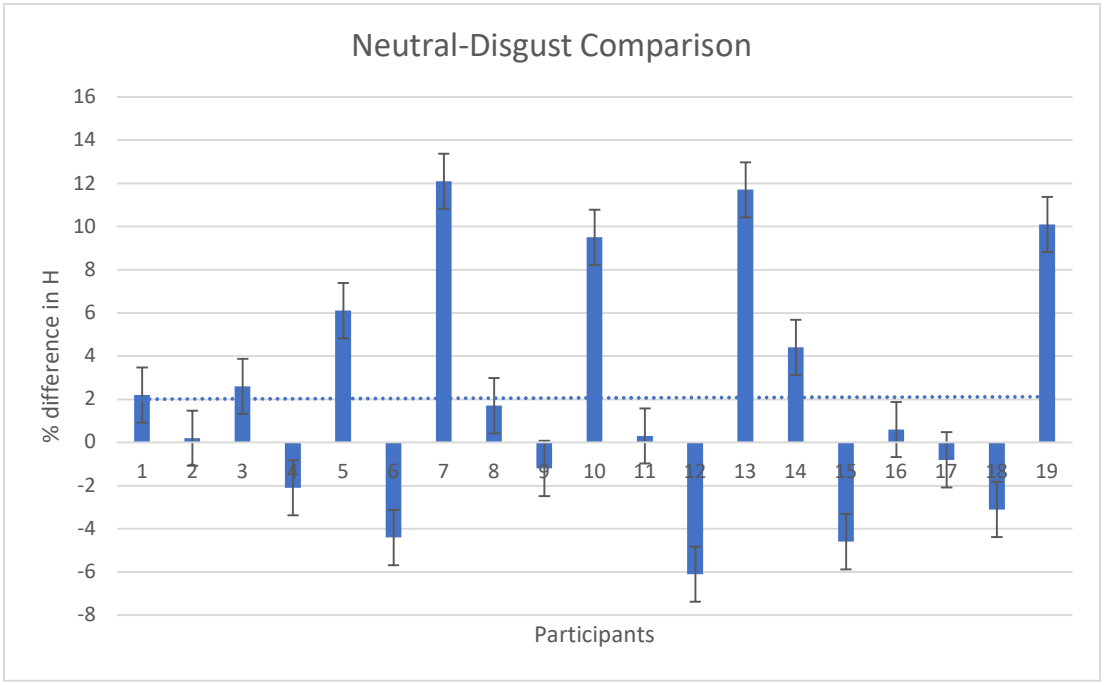
34 (C)


Neutral-Anger Comparison
% difference in H
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Participants

34 (D)


Neutral-Surprise Comparison
% difference in H
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Participants

34 (E)


Neutral-Disgust Comparison
% difference in H
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Participants

34 (F)

Figure 34 (A-F). Percentage difference in H between expressions of neutral and the six basic emotions.

The findings suggest that although the magnitude of expression of anger varies from individual to individual, the H is always higher that the neutral expression. The same was found for surprise, except one aberration. Happiness, sadness, fear, and disgust have larger individual differences.

±45 degree views (left and right profile view)

A repeated-measures ANOVA was performed to evaluate the effect of fractal changes on facial expressions of emotions at -45 degree angle. The emotion specific means and standard deviations for the full face as well as the three AOIs, i.e., eyes, nose, and lips, are presented in Table 19.

Table 19. Mean and SD of fractal dimensions and Hurst Coefficient for full face and the three AOIs at -45 and +45 degree views.

Face Area	Emotion	Fractal Dimension				Hurst Coefficient			
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
		-45	-45	+45	+45	-45	-45	+45	+45
Full Face	Anger	2.597	0.035	2.630	0.049	0.403	0.035	0.370	0.049
	Surprise	2.606	0.042	2.631	0.046	0.394	0.042	0.369	0.046
	Neutral	2.606	0.034	2.622	0.051	0.394	0.034	0.378	0.051
	Happy	2.645	0.042	2.657	0.049	0.355	0.042	0.343	0.049
	Sad	2.605	0.039	2.630	0.044	0.395	0.039	0.370	0.044
	Fear	2.579	0.067	2.629	0.039	0.421	0.067	0.371	0.039
	Disgust	2.614	0.040	2.651	0.047	0.386	0.040	0.349	0.047
Eyes	Anger	2.547	0.084	2.533	0.074	0.453	0.084	0.467	0.074

	Surprise	2.673	0.062	2.659	0.075	0.327	0.062	0.341	0.075
	Neutral	2.632	0.067	2.602	0.083	0.368	0.067	0.398	0.083
	Happy	2.615	0.070	2.583	0.087	0.385	0.070	0.417	0.087
	Sad	2.622	0.057	2.604	0.087	0.378	0.057	0.396	0.087
	Fear	2.626	0.058	2.609	0.081	0.374	0.058	0.391	0.081
	Disgust	2.593	0.081	2.566	0.104	0.407	0.081	0.434	0.104
Nose	Anger	2.586	0.080	2.497	0.089	0.414	0.080	0.503	0.089
	Surprise	2.605	0.068	2.506	0.086	0.395	0.068	0.494	0.086
	Neutral	2.598	0.086	2.505	0.094	0.402	0.086	0.495	0.094
	Happy	0.418	0.076	2.488	0.074	0.418	0.076	0.512	0.074
	Sad	2.593	0.074	2.508	0.081	0.407	0.074	0.492	0.081
	Fear	2.601	0.073	2.518	0.067	0.399	0.073	0.482	0.067
	Disgust	2.567	0.075	2.474	0.072	0.433	0.075	0.526	0.072
Lips	Anger	2.628	0.108	2.586	0.123	0.372	0.108	0.414	0.123
	Surprise	2.626	0.086	2.619	0.107	0.374	0.086	0.381	0.107
	Neutral	2.619	0.106	2.606	0.096	0.381	0.106	0.394	0.096
	Happy	2.632	0.106	2.599	0.105	0.368	0.106	0.401	0.105
	Sad	2.630	0.105	2.597	0.113	0.370	0.105	0.403	0.113
	Fear	2.652	0.105	2.625	0.103	0.348	0.105	0.375	0.103
	Disgust	2.635	0.101	2.603	0.115	0.365	0.101	0.397	0.115

For -45 degree view, Mauchly's test of sphericity indicated that the assumption of sphericity was violated for fractal dimension (approx. χ^2 = 14.76, df= 5, p<.05) as well as emotions (approx. χ^2 = 38.92, df= 20, p<.008). Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity (Fractals: ε = 0.617, Emotion: ε = 0.593). For +45 degree view, Mauchly's test of sphericity indicated that the assumption of sphericity was violated for emotions (approx. χ^2 = 33.377, df= 20, p<.034) and not for fractal dimension (approx. χ^2 = 6.784, df= 5, p<.239). Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity only for emotion (ε = 0.585).

The within subject effects were significant for -45 as well as +45 degree views. For -45 degree view, the within subject effects of fractal dimensions (F= 115.253, df= 3, p<.001), emotion (F= 1153.028, df= 6, p<.001), and the fractal dimension x emotion interaction (F= 1307.682, df= 18, p<.001) were significant. For +45 degree view, the within subject effects of fractal dimensions (F= 9.993, df= 3, p<.001), emotion (F= 6.513, df= 6, p<.001), and the fractal dimension x emotion interaction (F= 4.612, df= 18, p<.001) were significant.

Post-hoc pairwise comparisons with a Bonferroni adjustment for both -45 and +45 degree views did not result into any significant difference between fractal dimension of the full face and the three face regions suggesting that the fractal changes in the three face regions did not significantly affect the expression.

Hurst coefficient (H) is directly related to fractal dimension in a self-similar time series and range between 0-1 wherein higher values (0.5 – 1) indicate 'a smoother trend, less volatility, and less roughness' (Mandelbrot, 1985). For -45 degree, the value of H ranges between 0.355 – 0.421 for the full face, 0.327 – 0.453 for eyes, 0.395 – 0.433 for nose, and 0.348 – 0.381 for lips. Contrary to the zero degree view, H for none of the face regions exceed the threshold of 0.5. For +45 degree, the value of H ranges between 0.343 – 0.378 for the full face, 0.391 – 0.467 for eyes, 0.482 – 0.526 for nose, and 0.375 – 0.414 for lips. The H for anger (0.503), happy (0.512), and disgust (0.526) exceeded the threshold of 0.5. Overall, the Hurst Coefficient indicates significant changes in the +45 degree view for happiness, anger, and disgust and non-significant changes on the -45 degree view.

Table 19 summarizes the H for the full face as well as the three AOIs for different emotions. Figure 34 illustrates the comparative views of fractal dimensions and H for the three AOIs as well as the full face for -45 degree and +45 degree views. Figure 35 illustrates the variation in fractal dimensions of full face as well as the three face regions between -45 and +45 degree views for all the expressors for happiness, anger, and disgust, respectively. Put together, fractal dimension and H suggest that the changes on the face during expression of

basic emotions are not distinctive at -45 degree view but are distinct for happiness, anger, and disgust at +45 degree view.

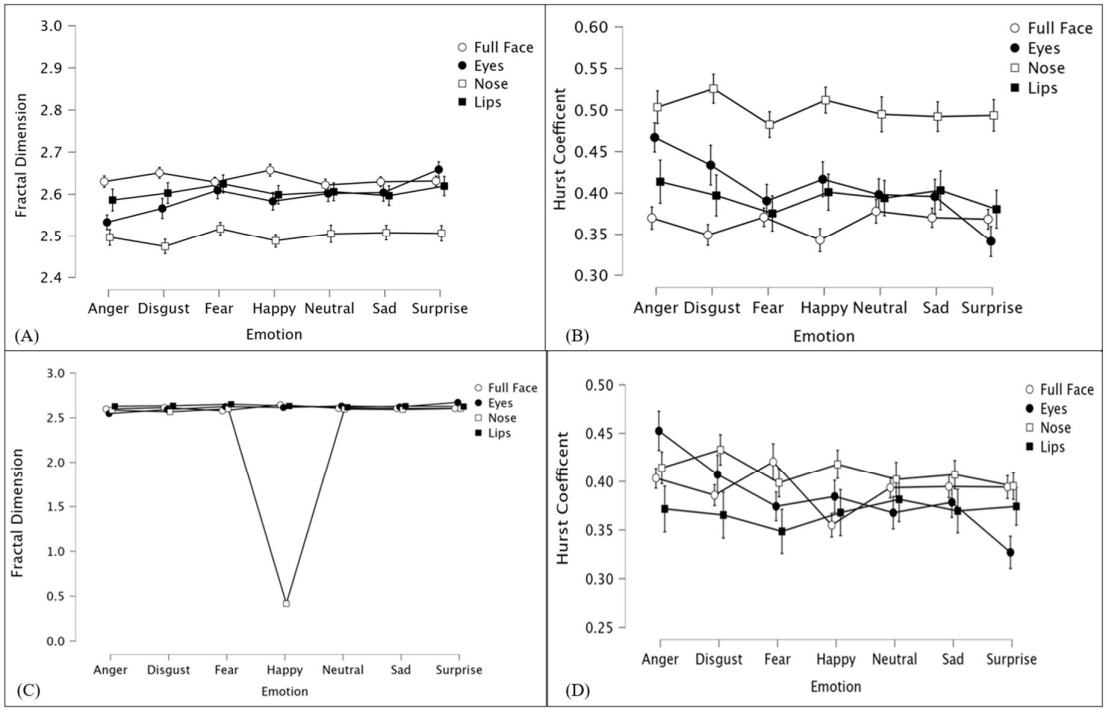


Figure 35. Fractal dimensions and Hurst coefficients of eye, nose, and lip regions and the full face. (A) Fractal dimensions +45 degree view, (B) Hurst coefficients +45 degree view, (C) Fractal dimensions -45 degree view, (D) Hurst coefficient +45 degree view.

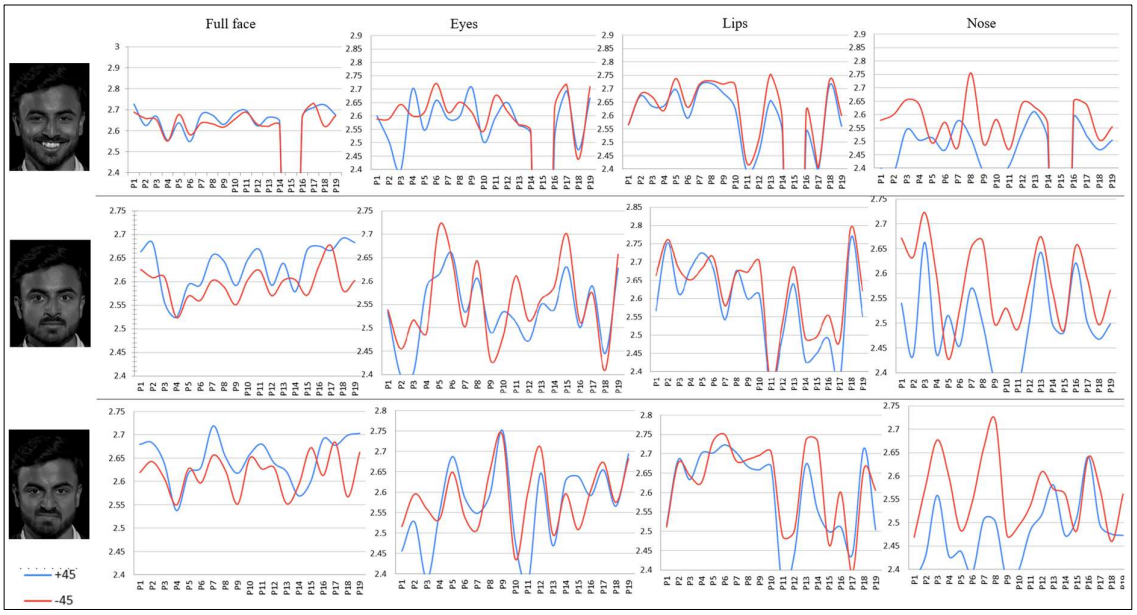


Figure 36. The plot of ±45 degree views in fractal dimensions.

CONCLUSION

The main effect of fractal dimension and its interaction with emotion suggests a significant role of fractal dimension in distinguishing expressions of basic emotions, particularly with the eye region's fractal changes contributing significantly to these expressions. The corresponding change in Hurst coefficient is ~ 30%.

We observed individual differences among expressers for the neutral expression. Although the intensity of anger expression varies from Expresser to Expresser, the H value is consistently higher (10 % to 14%) than that of the neutral expression. A similar pattern was found for surprise, with one exception. Happiness, sadness, fear, and disgust exhibit larger (14%) individual differences.

Overall, the fractal dimension and H values indicate that the changes in facial expressions of basic emotions are not distinct at a -45-degree view but are distinct for happiness, anger, and disgust at a +45-degree view (difference is upto 14%).

It can be concluded that emotion expression on the face is not affected by facial hairs and the earlier preference of the psychologists for databases without facial occlusions seem to be driven by visual appearance.

In the present study fractal dimension measured the complexity of a signal, capturing patterns of specific emotions that repeated at different scales while hurst coefficient measured the long-term memory of the time series, indicating how these signals regress to the mean or cluster in a direction. It can help distinguish between different emotional states based on signal persistence or predictability. Psychologists have been using Facial Action Coding System (FACS) which breaks down facial expressions into Action Units (AUs), which are contractions or relaxations of specific facial muscles. By integrating fractal dimension and Hurst coefficient analysis with FACS, researchers can create more comprehensive emotion recognition systems. Fractal analysis can capture the complexity and temporal structure of physiological signals, while FACS provides detailed information on facial muscle movements. As FACS has not been mapped with majority facial expression databases, this specific mathematical framework is the best suited for understanding emotional expressions in a computational or applied context such as real-time systems for mental health monitoring, empathetic human-computer interaction, and assistive technologies.

The finding of expressions being more distinguishable at +45° angles but not at -45° has been reported in magnetoencephalography (MEG) study as well (Nara et al., 2025) and could have some implications in the field of affective computing and human-computer interaction. For instance, by focusing on the +45° angle, emotion recognition systems can identify subtle emotional cues more accurately, leading to better user experiences in applications like virtual assistants, customer service bots, and mental health monitoring tools. This would result into enhanced emotion recognition. This might also be useful for improved user interfaces to capture facial expressions more effectively by guiding users to look at specific angles or placement of cameras. This could be particularly useful in applications that rely on facial expressions as input, such as gesture-based controls or emotion-sensitive interfaces. Facial recognition systems used for security purposes could benefit from this knowledge by focusing on the +45° angle to improve accuracy and reduce false positives or negatives.

Eyes are often described as the windows to the soul, and the findings of this study takes that notion to a new level with quantitative analysis. The idea of leveraging the fractal complexity in the eye region for more accurate emotion recognition is innovative. While one

can explore the gaze-based emotion recognition model using eye-tracking data to derive real-time insights into a Expresser's emotional state, fractal analysis can capture the intricate, multi-scale dynamics of emotional signals, providing a more nuanced understanding of emotional states. The Hurst coefficient can provide insights into the temporal structure of emotional signals, helping to identify patterns that are not immediately obvious. The findings indicate of a region-specific emotion recognition model that can prove as ae fascinating approach to understanding human emotions.

This study critically examines the Indian Affective Picture Database- 2.0, acknowledging inherent biases related to demographic representation, cultural variability, and differing recording conditions. We acknowledge the impact of ethnicity, gender, and contextual factors on facial expressivity, which limits the generalizability of emotional findings. While the research centers on six basic emotions in accordance with the discrete emotion model, this framework falls short of encapsulating the complexity inherent in emotional expressions. To address this gap, we employ fractal analysis to investigate the intricate, multi-scale dynamics of emotional signals. The Hurst coefficient emerges as a vital tool for revealing the temporal structures within these signals, allowing for the identification of subtle patterns that might be overlooked in traditional analyses. Our findings advocate for a region-specific emotion recognition model, underscoring the need for a more nuanced understanding of affective states.

ACKNOWLEDGMENT

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Research using IAPD and IAPD 2.0

This section summarizes the body of research projects and scholarly papers from our team that have employed the Indian Affective Picture Database (IAPD; Sharma & Bhushan, 2019) and IAPD 2.0 (Bhushan, 2023). By examining how these resources have been integrated into diverse studies, the respective details highlight their role in advancing affective science, emotion recognition, and computational modelling. They underscore the methodological contributions of IAPD and IAPD 2.0, while situating them within broader developments in cross-cultural emotion research and applied domains such as psychology, neuroscience, and artificial intelligence.

Emotion Recognition and Social Adaptive Behaviour of Children with Autism Spectrum Disorder

Ujjwal Sharma, Braj Bhushan, & Sheffali Gulati

Background

Recognizing emotions from facial expressions is fundamental to effective social interaction. Children with Autism Spectrum Disorder (ASD) often face challenges in this domain, which can impact their communication and adaptive behaviours. This study examined how children with ASD recognize emotions and how these abilities relate to their social functioning.

Method

Participants: 40 children with ASD and 40 typically developing (TD) children, aged 4–11 years ($M = 7.1$, $SD = 1.66$ for ASD; $M = 7.35$, $SD = 1.41$ for TD).

Task: Emotion-matching task.

Measures: Emotion recognition accuracy, ASD severity, and adaptive behaviour domains (communication, daily living, socialization).

Key Findings

(i) Recognition Accuracy: ASD group struggled most with fear (20%) and surprise (20%), while happiness (60%) was most easily recognized.

(ii) TD group recognized all emotions with significantly higher accuracy.

(iii) Recognition of happiness may partly reflect chance, while recognition of other emotions was reliably above chance.

(iv) Emotion recognition is strongly influenced by ASD status and emotion type.

(v) Positive vs Negative Emotions: Both groups recognized positive emotions significantly better than negative ones.

(vi) Adaptive Behaviour Links: Deficits in emotion recognition predicted difficulties in Receptive communication, Written communication, Domestic daily living skills, and Community living skills.

(vii) Autism severity and chronological age also significantly influenced these outcomes.

Conclusion

Children with ASD demonstrate marked difficulties in recognizing certain emotions, particularly fear, disgust, and surprise, which in turn affect their communication and adaptive functioning. These findings underscore the importance of incorporating emotion recognition training into interventions for ASD, targeting both socialization and daily living skills.

Reference

Sharma, U., Bhushan, B., & Gulati, S. (2025). Emotion recognition and social adaptive behaviour of children with Autism Spectrum Disorder. *Psychiatry, Psychotherapy and Clinical Psychology, 16:3*, 271-277. https://doi.org/10.34883/PI.2025.16.3.001

Visual angles and emotional valence affect temporal dynamics of neural representations of facial expression: an MEG study

Sanjeev Nara, Dheeraj Rathee, Nicola Molinaro, Naomi Du Bois, Braj Bhushan, & Girijesh Prasad

This study titled '*Visual Angles and Emotional Valence Affect Temporal Dynamics of Neural Representations of Facial Expression: An MEG Study'* (Nara et al., 2025) explored how visual angle (left vs. right side of the face) and emotional valence (happy vs. sad) influence the temporal dynamics of neural processing of facial expressions. Using magnetoencephalography (MEG), the authors examined how the brain decodes emotions when faces are viewed from different angles, addressing a gap in prior research that mostly used frontal facial views.

Objectives

The study aimed to—

1. Investigate hemispheric and hemifacial asymmetry in emotion processing.
2. Determine whether visual angle affects how happy and sad expressions are recognized.
3. Examine the time course of neural decoding for these emotions using high-resolution MEG data.

Participants

Thirteen healthy adults (aged 21–38 years) participated, all with normal or corrected vision.

Experimental Design

Stimuli: Images of happy and sad faces from *IAPD* were presented at four visual angles: −90°, −45° (left side = negative angles) and +45°, +90° (right side = positive angles).

Trials: Each participant viewed 256 trials (32 per emotion × 4 angles × 2 blocks).

- **Task:** After each image (displayed for 1 s), participants identified the emotion via button press.
- **Accuracy:** Mean recognition accuracy was 93.76 ± 4.23 %.

Analytical Techniques

Sensor-level ERF analysis: Examined amplitude differences between emotions and angles.

Source reconstruction: Used LCMV beamforming to localize neural activity (370–420 ms post-stimulus).

Multivariate Pattern Analysis (MVPA): Applied linear SVM classifiers to decode emotion and visual angle from MEG signals, using bootstrapped pseudo-trials and 5-fold cross-validation.

Key Findings

Evoked Responses

(i) **Temporal dynamics:** Decodable processing of happy emotions emerged earlier than for sad emotions.

(ii) **Amplitude:** Sad emotions evoked stronger neural responses than happy ones but only when faces were viewed from positive visual angles (right side of the face).

(iii) **Significance:** A cluster ($p = 0.006$) between 372–419 ms showed higher amplitude for sad vs. happy emotions at positive angles.

(iv) **No significant difference** was found at negative angles (left side).

Source Localization

(v) Neural activity localized to both ventral and dorsal visual streams, notably in Fusiform gyrus (face recognition), Lingual gyrus (visual processing), Putamen (emotion and motor integration), and Pre- and post-central gyrus (sensorimotor response).

(vi) These regions collectively support emotion decoding and facial-expression perception.

MVPA Decoding

(vii) Successful decoding of happy vs. sad emotions occurred only for positive visual angles, confirming hemifacial asymmetry.

(viii) Linear SVM weights indicated that fronto-temporal sensors contributed most to emotion discrimination.

Insights

The results highlight that—

(i) The right side of the face (positive visual angle) conveys emotionally richer cues, aligning with behavioural evidence of right-hemisphere dominance for emotion perception.

(ii) Sad emotions elicit stronger neural activation, possibly due to their negative valence and higher cognitive load.

(iii) Temporal decoding shows that emotional differentiation occurs around 370–420 ms, suggesting mid-level perceptual processing rather than early sensory stages.

(iv) Happy emotions are processed faster, but sad emotions evoke stronger neural responses.

(v) Emotion decoding is successful only when faces are viewed from the right side (positive visual angles).

(vi) Neural activation involves fusiform and lingual gyri, putamen, and sensorimotor cortices, confirming the distributed nature of emotion processing.

The work integrates neurophysiological, behavioural, and computational perspectives to understand hemispheric and hemifacial asymmetry in emotion recognition. The findings advance understanding of how emotional valence and facial orientation interact to shape the brain's temporal and spatial representation of human emotions.

Reference

Nara, S., Rathee, D., Molinaro, N., Bois. N.D., Bhushan, B., & Prasad, G. (2025). Visual angles and emotional valence affect temporal dynamics of neural representations of facial expression: An MEG study. *IEEE Transactions on Neural Systems & Rehabilitation Engineering, 33*, 1-9.
DOI: https://doi.org/10.1109/TNSRE.2024.3506737

The Indian Affective Picture Database (IAPD) is a pioneering resource for emotion research, offering culturally contexttialized facial expressions across multiple viewing angles, and the database supports *studies* in *psychology, neuroscience, and affective computing.*

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