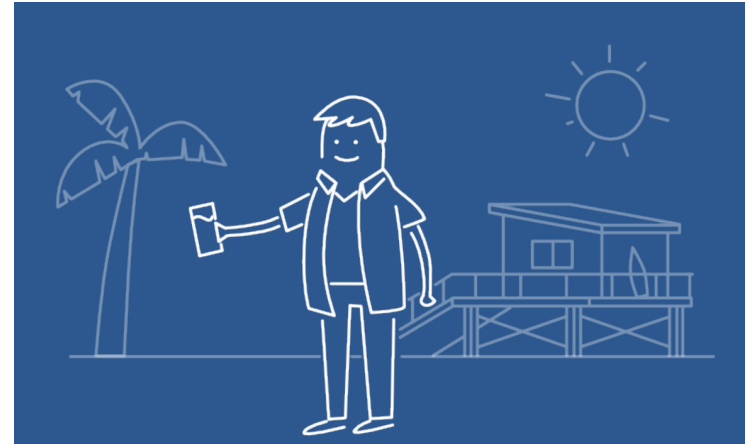


# Importance of Visual Scene in Emotion Perception



Presenter: **Ronak Kosti, PhD**

# Presentation Outline

**(1) What is Emotion Recognition?**

**(2) EMOTIons in Context (EMOTIC) Dataset**

**(3) Modeling and Analysis**

**(4) Conclusions**

# Next Section

**(1) What is Emotion Recognition?**

**(2) EMOTIONS in Context (EMOTIC) Dataset**

**(3) Modeling and Analysis**

**(4) Conclusions**

# What is Emotion Recognition<sup>[1]</sup>



[1] Kostj, Ronak, Jose M. Alvarez, Adria Recasens, and Agata Lapedriza. "Emotic: Emotions in context dataset." In 2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), pp.2309-2317. IEEE, 2017

# What is Emotion Recognition<sup>[1]</sup>



**“Relaxing”**



[1] Kostj, Ronak, Jose M. Alvarez, Adria Recasens, and Agata Lapedriza. "Emotic: Emotions in context dataset." In 2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), pp.2309-2317. IEEE, 2017

# What is Emotion Recognition<sup>[1]</sup>



**“Relaxing”**



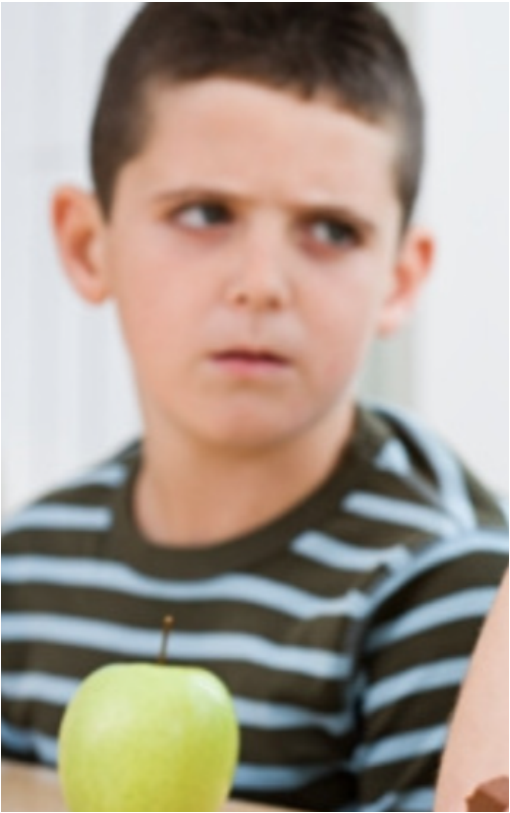
**“Working”**

[1] Kostj, Ronak, Jose M. Alvarez, Adria Recasens, and Agata Lapedriza. "Emotic: Emotions in context dataset." In 2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), pp.2309-2317. IEEE, 2017

# Role of Context in Emotion Recognition



# Role of Context in Emotion Recognition





# Role of Context in Emotion Recognition



# Role of Context in Emotion Recognition



Perceived Emotion changes: **Face** → **Visible Body** → **Scene Context**

# Sources of Context for Emotion Recognition

**Body Posture,  
Scene Context,  
Surroundings<sup>[1]</sup>**



# Sources of Context for Emotion Recognition

**Body Posture,  
Scene Context,  
Surroundings<sup>[1]</sup>**



**“Disgust”**

# Sources of Context for Emotion Recognition

Body Posture,  
Scene Context,  
Surroundings<sup>[1]</sup>



“Disgust”



“Anger”

# Sources of Context for Emotion Recognition

Body Posture,  
Scene Context,  
Surroundings<sup>[1]</sup>



**“Disgust”**



**“Anger”**



**“Sadness”**

# Sources of Context for Emotion Recognition

Body Posture,  
Scene Context,  
Surroundings<sup>[1]</sup>



“Disgust”



“Anger”



“Sadness”



“Fear”

[1] Aviezer, H., Ensenberg, N., and Hassin, R. R. (2017). The inherently contextualized nature of facial emotion perception. *Current Opinion in Psychology*.

# Approach for Emotion Recognition

(1) Find the Visual Features responsible for the emotions





# Approach for Emotion Recognition

(1) Find the Visual Features responsible for the emotions



(2) Label them



# Approach for Emotion Recognition

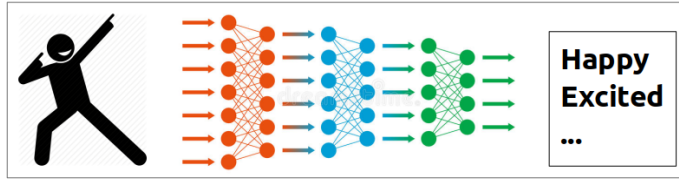
(1) Find the Visual Features responsible for the emotions



(2) Label them



(3) Model using Features & Labels



# Next Section

**(1) What is Emotion Recognition?**

**(2) EMOTIons in Context (EMOTIC) Dataset**

**(3) Modeling and Analysis**

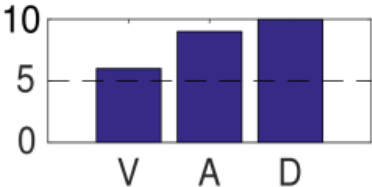
**(4) Conclusions**

# EMOTIC - Characteristics

## (1) Appearance of Subjects



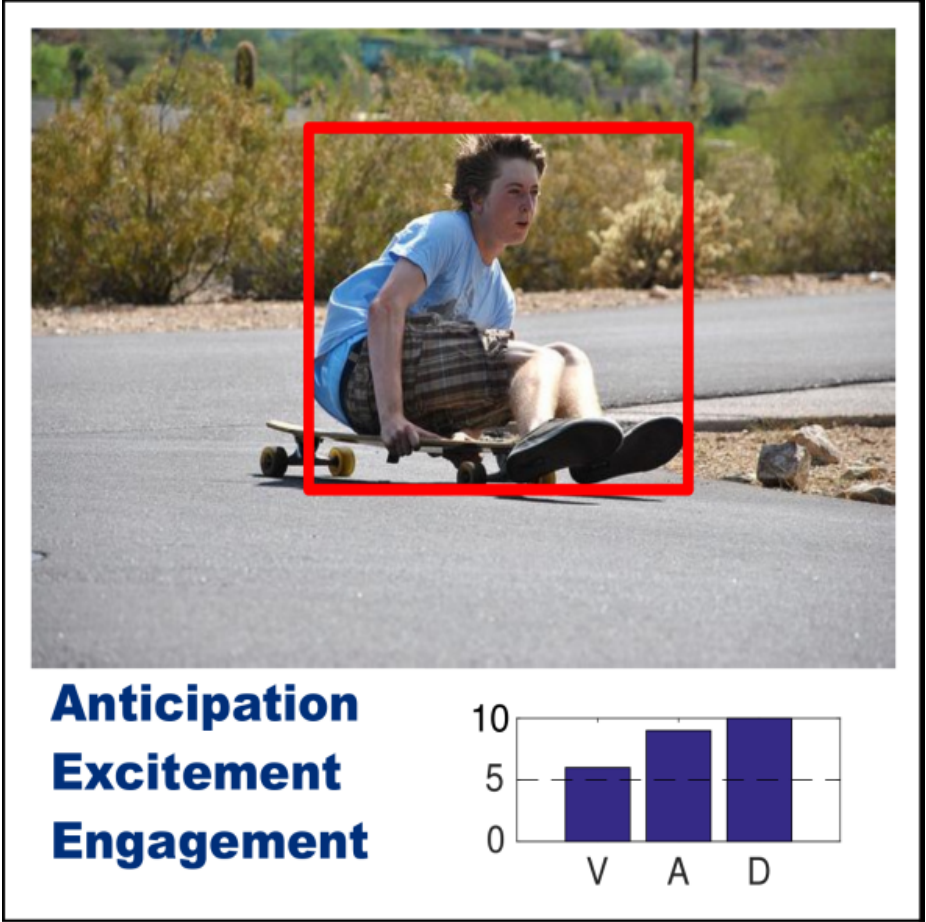
**Anticipation**  
**Excitement**  
**Engagement**



# EMOTIC - Characteristics

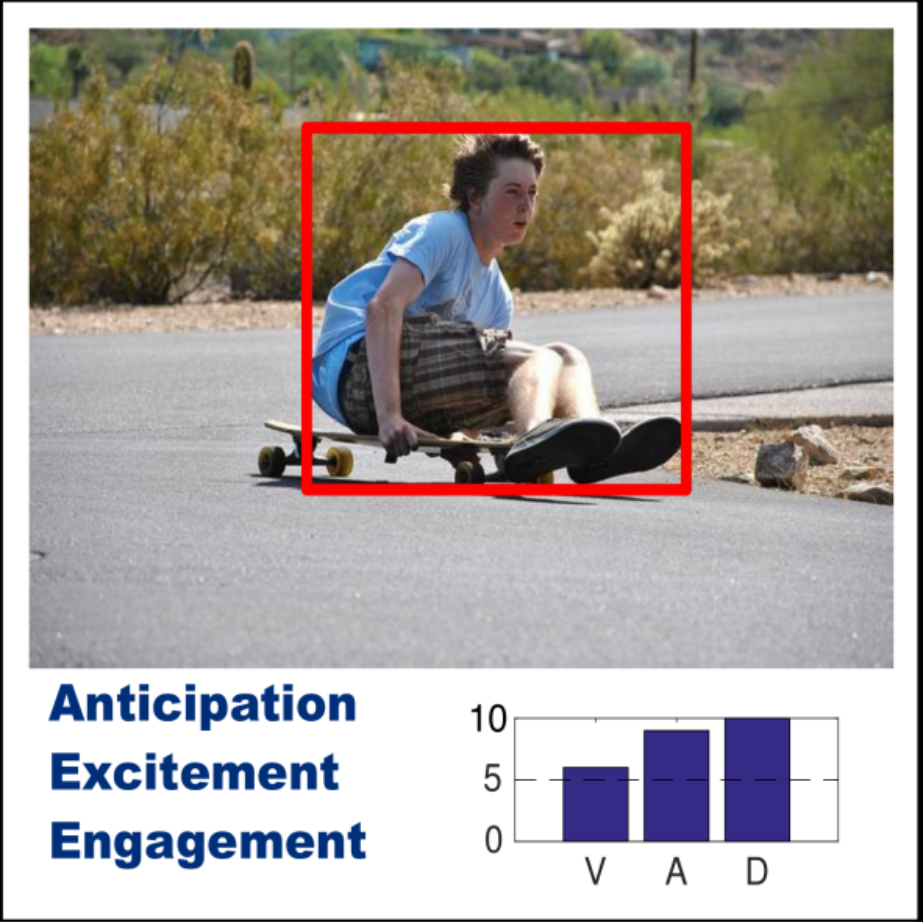
(1) Appearance of Subjects

(2) Presence of Scene Context



# EMOTIC - Characteristics

- (1) Appearance of Subjects
- (2) Presence of Scene Context
- (3) Extensive Emotion Labels



# EMOTIC - Construction

## Combined Emotion Labels<sup>[C]</sup>

### (1) 26 Emotion Categories

#### 6 “Basic” Emotions<sup>[1]</sup>

*Anger*

*Aversion*

*Fear*

*Sadness*

*Surprise*

*Happiness*

# EMOTIC - Construction

## Combined Emotion Labels<sup>[C]</sup>

### (1) 26 Emotion Categories

#### 6 “Basic” Emotions<sup>[1]</sup>

*Anger*  
*Aversion*  
*Fear*  
*Sadness*  
*Surprise*  
*Happiness*

#### + 20 more Affective Categories

<i>Peace</i>	<i>Suffering</i>
<i>Affection</i>	<i>Disconnection</i>
<i>Esteem</i>	<i>Embarrassment</i>
<i>Anticipation</i>	<i>Yearning</i>
<i>Engagement</i>	<i>Disapproval</i>
<i>Confidence</i>	<i>Annoyance</i>
<i>Pleasure</i>	<i>Sensitivity</i>
<i>Excitement</i>	<i>Disquietment</i>
<i>Sympathy</i>	<i>Pain</i>
<i>Doubt/Confusion</i>	<i>Suffering</i>



# **EMOTIC - Construction**

## **Combined Emotion Labels<sup>[C]</sup>**

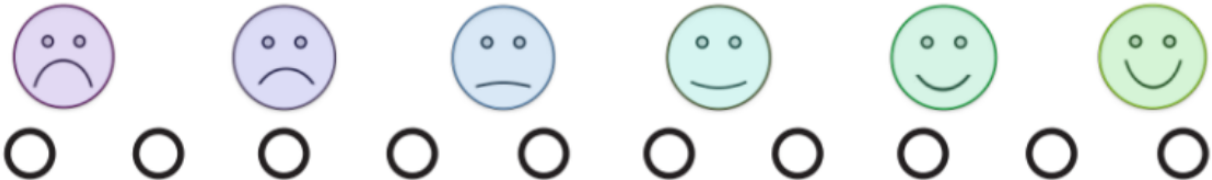
### **(1) 3 Continuous Dimensions**

# EMOTIC - Construction

## Combined Emotion Labels<sup>[C]</sup>

### **Valence: *Negative vs. Positive***

*Negative  
(unpleasant)*



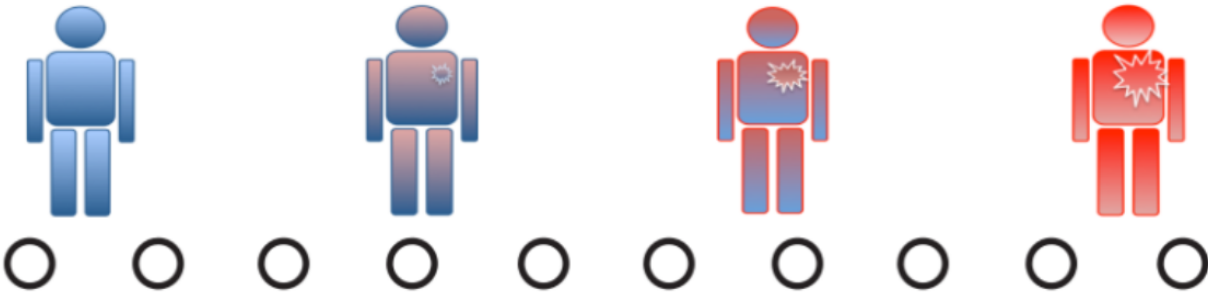
*Positive  
(pleasant)*

# EMOTIC - Construction

## Combined Emotion Labels<sup>[C]</sup>

**Arousal** (awakeness): *Calm* vs. *Ready to act*

*Calm*



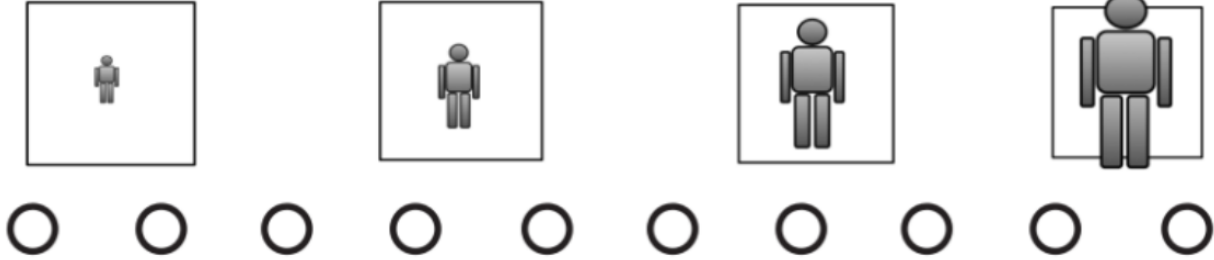
*Ready to act*  
*(active)*

# EMOTIC - Construction

## Combined Emotion Labels<sup>[C]</sup>

### **Dominance: *Dominated vs. In control***

*Dominated  
(no  
control)*

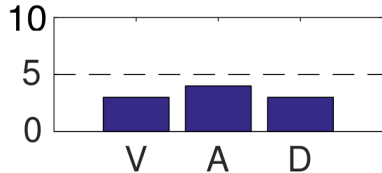


*In  
control*

# EMOTIC - Examples<sup>[C]</sup>



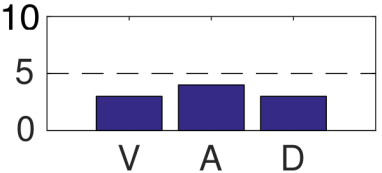
**Yearning**  
**Disquitement**  
**Annoyance**



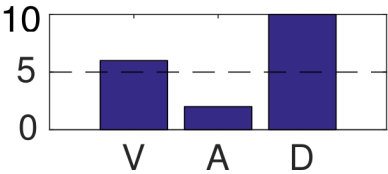
# EMOTIC - Examples<sup>[C]</sup>



**Yearning**  
**Disquitement**  
**Annoyance**



**Peace**  
**Esteem**  
**Happiness**



# Cooccurrence of Categories

1. Affection	100.00	0.05	0.00	12.35	0.26	17.11	0.16	1.00	0.42	0.90	0.58	33.74	17.48	27.19	0.37	0.32	65.42	0.21	14.52	42.61	0.95	3.01	0.48	2.69	22.97	1.69
2. Anger	0.28	100.00	46.05	5.65	20.34	5.65	31.36	5.65	21.47	12.99	4.52	15.82	0.56	3.11	3.95	6.50	0.56	6.78	0.00	0.28	9.60	4.24	11.58	3.95	0.85	3.39
3. Annoyance	0.00	24.18	100.00	9.20	16.32	5.64	37.54	13.35	24.48	18.69	4.45	19.14	0.30	3.26	12.61	5.64	0.89	5.93	0.59	0.30	10.24	5.64	12.17	4.30	0.89	4.45
4. Anticipation	2.85	0.24	0.75	100.00	0.34	23.04	0.77	1.84	1.49	3.96	0.45	62.34	5.40	25.16	1.11	0.82	19.29	0.30	3.81	6.82	0.29	0.79	0.26	1.50	2.88	1.80
5. Aversion	1.57	22.64	34.59	8.81	100.00	4.09	35.22	15.41	22.01	17.30	5.66	13.21	1.26	3.46	7.55	7.55	0.63	4.40	1.26	6.29	13.84	6.29	14.15	5.66	4.40	3.77
6. Confidence	4.93	0.30	0.58	28.80	0.20	100.00	0.53	1.52	0.91	0.70	0.26	57.58	9.36	43.13	0.87	0.41	28.97	0.18	8.40	14.39	0.06	0.35	0.08	1.28	3.19	0.85
7. Disapproval	0.48	17.70	40.35	10.05	17.86	5.58	100.00	12.60	21.05	30.46	6.06	23.29	0.32	2.23	15.31	4.94	1.59	11.80	1.28	1.28	14.04	5.58	17.86	13.56	2.23	9.73
8. Disconnection	0.85	0.90	4.04	6.77	2.20	4.48	3.54	100.00	6.77	7.35	1.17	17.04	1.75	2.15	9.28	0.81	4.75	0.81	8.43	1.93	2.96	1.30	1.66	0.99	0.76	1.43
9. Disquietment	0.95	9.06	19.67	14.54	8.34	7.15	15.73	18.00	100.00	19.55	5.84	21.33	1.19	6.44	16.33	7.27	1.19	4.77	1.19	0.72	18.95	7.39	15.02	4.41	4.17	3.58
10. Doubt/Confusion	1.51	4.09	11.20	28.89	4.89	4.09	16.98	14.58	14.58	100.00	3.91	32.89	1.51	5.69	12.09	7.91	3.20	6.84	3.29	3.02	8.18	4.62	9.51	12.09	2.13	8.00
11. Embarrassment	4.45	6.48	12.15	14.98	7.29	6.88	15.38	10.53	19.84	17.81	100.00	11.74	3.24	7.69	9.72	9.72	7.29	8.91	1.62	4.05	14.98	6.88	14.98	7.29	2.83	1.21
12. Engagement	3.36	0.29	0.68	26.96	0.22	19.93	0.77	2.00	0.94	1.95	0.15	100.00	3.61	20.37	1.09	0.31	18.66	0.21	6.13	8.02	0.55	0.45	0.22	1.17	1.72	0.84
13. Esteem	21.07	0.13	0.13	28.26	0.25	39.15	0.13	2.48	0.64	1.08	0.51	43.67	100.00	29.66	0.38	0.57	45.77	0.19	9.61	22.28	0.70	1.21	0.25	1.65	20.88	2.04
14. Excitement	7.10	0.15	0.30	28.51	0.15	39.11	0.19	0.66	0.74	0.88	0.26	53.37	6.43	100.00	0.39	0.65	45.33	0.06	4.66	18.43	0.03	0.36	0.06	2.66	2.94	0.79
15. Fatigue	0.80	1.60	9.70	10.39	2.74	6.51	10.96	23.63	15.64	15.53	2.74	23.63	0.68	3.20	100.00	3.08	3.77	11.07	8.90	2.85	8.33	2.74	14.04	6.96	1.48	7.88
16. Fear	1.82	6.99	11.55	20.36	7.29	8.21	9.42	5.47	18.54	27.05	7.29	17.63	2.74	14.29	8.21	100.00	1.22	11.85	3.65	2.13	21.88	9.73	20.36	12.77	2.74	4.86
17. Happiness	13.59	0.02	0.07	17.38	0.02	20.88	0.11	1.16	0.11	0.39	0.20	38.87	7.88	36.03	0.36	0.04	100.00	0.08	10.75	24.86	0.01	0.67	0.10	2.19	6.47	0.84
18. Pain	1.26	7.55	12.58	7.86	4.40	3.77	23.27	5.66	12.58	24.21	6.92	12.58	0.94	1.26	30.50	12.26	2.20	100.00	1.57	2.20	31.45	10.69	53.14	16.67	6.29	15.09
19. Peace	10.21	0.00	0.15	11.62	0.15	20.50	0.30	6.98	0.37	1.37	0.15	43.26	5.61	12.55	2.90	0.45	36.39	0.19	100.00	20.16	0.82	5.05	0.33	1.49	4.94	4.23
20. Pleasure	22.12	0.03	0.05	15.35	0.55	25.92	0.22	1.18	0.16	0.93	0.27	41.76	9.59	36.61	0.69	0.19	62.13	0.19	14.88	100.00	0.00	1.07	0.14	3.51	6.69	1.64
21. Sadness	2.47	4.67	9.48	3.30	6.04	0.55	12.09	9.07	21.84	12.64	5.08	14.42	1.51	0.27	10.03	9.89	0.14	13.74	3.02	0.00	100.00	14.84	34.89	1.92	12.36	4.53
22. Sensitivity	9.47	2.49	6.31	10.80	3.32	3.82	5.81	4.82	10.30	8.64	2.82	14.12	3.16	4.32	3.99	5.32	10.13	5.65	22.59	6.48	17.94	100.00	13.46	2.16	8.64	14.29
23. Suffering	1.80	8.22	16.43	4.21	9.02	1.00	22.44	7.41	25.25	21.44	7.41	8.42	0.80	0.80	24.65	13.43	1.80	33.87	1.80	1.00	50.90	16.23	100.00	10.22	7.82	10.62
24. Surprise	7.30	2.00	4.15	17.60	2.58	12.02	12.16	3.15	5.29	19.46	2.58	31.76	3.72	27.61	8.73	6.01	28.61	7.58	5.72	18.31	2.00	1.86	7.30	100.00	3.29	7.87
25. Sympathy	32.85	0.23	0.45	17.90	1.06	15.86	1.06	1.28	2.64	1.81	0.53	24.62	24.77	16.09	0.98	0.68	44.56	1.51	10.05	18.43	6.80	3.93	2.95	1.74	100.00	1.74
26. Yearning	3.26	1.22	3.05	15.06	1.22	5.70	6.21	3.26	3.05	9.16	0.31	16.17	3.26	5.80	7.02	1.63	7.83	4.88	11.60	6.10	3.36	8.75	5.39	5.60	2.34	100.00

# Cooccurrence of Categories

1. Affection	100.00	0.05	0.00	12.35	0.26	17.11	0.16	1.00	0.42	0.90	0.58	33.74	17.48	27.19	0.37	0.32	65.42	0.21	14.52	42.61	0.95	3.01	0.48	2.69	22.97	1.69
2. Anger	0.28	100.00	46.05	5.65	20.34	5.65	31.36	5.65	21.47	12.99	4.52	15.82	0.56	3.11	3.95	6.50	0.56	6.78	0.00	0.28	9.60	4.24	11.58	3.95	0.85	3.39
3. Annoyance	0.00	24.18	100.00	9.20	16.32	5.64	37.54	13.35	24.48	18.69	4.45	19.14	0.30	3.26	12.61	5.64	0.89	5.93	0.59	0.30	10.24	5.64	12.17	4.30	0.89	4.45
4. Anticipation	2.85	0.24	0.75	100.00	0.34	23.04	0.77	1.84	1.49	3.96	0.45	62.34	5.40	25.16	1.11	0.82	19.29	0.30	3.81	6.82	0.29	0.79	0.26	1.50	2.88	1.80
5. Aversion	1.57	22.64	34.59	8.81	100.00	4.09	35.22	15.41	22.01	17.30	5.66	13.21	1.26	3.46	7.55	7.55	0.63	4.40	1.26	6.29	13.84	6.29	14.15	5.66	4.40	3.77
6. Confidence	4.93	0.30	0.58	28.80	0.20	100.00	0.53	1.52	0.91	0.70	0.26	57.58	9.36	43.13	0.87	0.41	28.97	0.18	8.40	14.39	0.06	0.35	0.08	1.28	3.19	0.85
7. Disapproval	0.48	17.70	40.35	10.05	17.86	5.58	100.00	12.60	21.05	30.46	6.06	23.29	0.32	2.23	15.31	4.94	1.59	11.80	1.28	1.28	14.04	5.58	17.86	13.56	2.23	9.73
8. Disconnection	0.85	0.90	4.04	6.77	2.20	4.48	3.54	100.00	6.77	7.35	1.17	17.04	1.75	2.15	9.28	0.81	4.75	0.81	8.43	1.93	2.96	1.30	1.66	0.99	0.76	1.43
9. Disquietment	0.95	9.06	19.67	14.54	8.34	7.15	15.73	18.00	100.00	19.55	5.84	21.33	1.19	6.44	16.33	7.27	1.19	4.77	1.19	0.72	18.95	7.39	15.02	4.41	4.17	3.58
10. Doubt/Confusion	1.51	4.09	11.20	28.89	4.89	4.09	16.98	14.58	14.58	100.00	3.91	32.89	1.51	5.69	12.09	7.91	3.20	6.84	3.29	3.02	8.18	4.62	9.51	12.09	2.13	8.00
11. Embarrassment	4.45	6.48	12.15	14.98	7.29	6.88	15.38	10.53	19.84	17.81	100.00	11.74	3.24	7.69	9.72	9.72	7.29	8.91	1.62	4.05	14.98	6.88	14.98	7.29	2.83	1.21
12. Engagement	3.36	0.29	0.68	26.96	0.22	19.93	0.77	2.00	0.94	1.95	0.15	100.00	3.61	20.37	1.09	0.31	18.66	0.21	6.13	8.02	0.55	0.45	0.22	1.17	1.72	0.84
13. Esteem	21.07	0.13	0.13	28.26	0.25	39.15	0.13	2.48	0.64	1.08	0.51	43.67	100.00	29.66	0.38	0.57	45.77	0.19	9.61	22.28	0.70	1.21	0.25	1.65	20.88	2.04
14. Excitement	7.10	0.15	0.30	28.51	0.15	39.11	0.19	0.66	0.74	0.88	0.26	53.37	6.43	100.00	0.39	0.65	45.33	0.06	4.66	18.43	0.03	0.36	0.06	2.66	2.94	0.79
15. Fatigue	0.80	1.60	9.70	10.39	2.74	6.51	10.96	23.63	15.64	15.53	2.74	23.63	0.68	3.20	100.00	3.08	3.77	11.07	8.90	2.85	8.33	2.74	14.04	6.96	1.48	7.88
16. Fear	1.82	6.99	11.55	20.36	7.29	8.21	9.42	5.47	18.54	27.05	7.29	17.63	2.74	14.29	8.21	100.00	1.22	11.85	3.65	2.13	21.88	9.73	20.36	12.77	2.74	4.86
17. Happiness	13.59	0.02	0.07	17.38	0.02	20.88	0.11	1.16	0.11	0.39	0.20	38.87	7.88	36.03	0.36	0.04	100.00	0.08	10.75	24.86	0.01	0.67	0.10	2.19	6.47	0.84
18. Pain	1.26	7.55	12.58	7.86	4.40	3.77	23.27	5.66	12.58	24.21	6.92	12.58	0.94	1.26	30.50	12.26	2.20	100.00	1.57	2.20	31.45	10.69	53.14	16.67	6.29	15.09
19. Peace	10.21	0.00	0.15	11.62	0.15	20.50	0.30	6.98	0.37	1.37	0.15	43.26	5.61	12.55	2.90	0.45	36.39	0.19	100.00	20.16	0.82	5.05	0.33	1.49	4.94	4.23
20. Pleasure	22.11	0.03	0.03	13.35	0.33	25.92	0.22	1.16	0.16	0.33	0.27	41.76	9.59	33.61	0.69	0.13	62.13	0.19	14.88	100.00	0.00	1.07	0.14	3.51	6.69	1.64
21. Sadness	2.47	4.67	9.48	3.30	6.04	0.55	12.09	9.07	21.84	12.64	5.08	14.42	1.51	0.27	10.03	9.89	0.14	13.74	3.02	0.00	100.00	14.84	34.89	1.92	12.36	4.53
22. Sensitivity	9.47	2.49	6.31	10.80	3.32	3.82	5.81	4.82	10.30	8.64	2.82	14.12	3.16	4.32	3.99	5.32	10.3	5.65	22.59	6.48	17.94	100.00	13.46	2.16	8.64	14.29
23. Suffering	1.80	8.22	16.43	4.21	9.02	1.00	22.44	7.41	25.25	21.44	7.41	8.42	0.80	0.80	24.65	13.43	1.80	33.87	1.80	1.00	50.90	16.23	100.00	10.22	7.82	10.62
24. Surprise	7.30	2.00	4.15	17.60	2.58	12.02	12.16	3.15	5.29	19.46	2.58	31.76	3.72	27.61	8.73	6.01	28.11	7.58	5.72	18.31	2.00	1.86	7.30	100.00	3.29	7.87
25. Sympathy	32.85	0.23	0.45	17.90	1.06	15.86	1.06	1.28	2.64	1.81	0.53	24.62	24.77	16.09	0.98	0.68	44.11	1.51	10.05	18.43	6.80	3.93	2.95	1.74	100.00	1.74
26. Yearning	3.26	1.22	3.05	15.06	1.22	5.70	6.21	3.26	3.05	9.16	0.31	16.17	3.26	5.80	7.02	1.63	7.87	4.88	11.60	6.10	3.36	8.75	5.39	5.60	2.34	100.00



# Cooccurrence of Categories

1. Affection	100.00	0.05	0.00	12.35	0.26	17.11	0.16	1.00	0.42	0.90	0.58	33.74	17.48	27.19	0.37	0.32	65.42	0.21	14.52	42.61	0.95	3.01	0.48	2.69	22.97	1.69
2. Anger	0.28	100.00	46.05	5.65	20.34	5.65	31.36	5.65	21.47	12.99	4.52	15.82	0.56	3.11	3.95	6.50	0.56	6.78	0.00	0.28	9.60	4.24	11.58	3.95	0.85	3.39
3. Annoyance	0.00	24.18	100.00	9.20	16.32	5.64	37.54	13.35	24.48	18.69	4.45	19.14	0.30	3.26	12.61	5.64	0.89	5.93	0.59	0.30	10.24	5.64	12.17	4.30	0.89	4.45
4. Anticipation	2.85	0.24	0.75	100.00	0.34	23.04	0.77	1.84	1.49	3.96	0.45	62.34	5.40	25.16	1.11	0.82	19.29	0.30	3.81	6.82	0.29	0.79	0.26	1.50	2.88	1.80
5. Aversion	1.57	22.64	34.59	8.81	100.00	4.09	35.22	15.41	22.01	17.30	5.66	13.21	1.26	3.46	7.55	7.55	0.63	4.40	1.26	6.29	13.84	6.29	14.15	5.66	4.40	3.77
6. Confidence	4.93	0.30	0.58	28.80	0.20	100.00	0.53	1.52	0.91	0.70	0.26	57.58	9.36	43.13	0.87	0.41	28.97	0.18	8.40	14.39	0.06	0.35	0.08	1.28	3.19	0.85
7. Disapproval	0.48	17.70	40.35	10.05	17.86	5.58	100.00	12.60	21.05	30.46	6.06	23.29	0.32	2.23	15.31	4.94	1.59	11.80	1.28	1.28	14.04	5.58	17.86	13.56	2.23	9.73
8. Disconnection	0.85	0.90	4.04	6.77	2.20	4.48	3.54	100.00	6.77	7.35	1.17	17.04	1.75	2.15	9.28	0.81	4.75	0.81	8.43	1.93	2.96	1.30	1.66	0.99	0.76	1.43
9. Disquietment	0.95	9.06	19.67	14.54	8.34	7.15	15.73	18.00	100.00	19.55	5.84	21.33	1.19	6.44	16.33	7.27	1.19	4.77	1.19	0.72	18.95	7.39	15.02	4.41	4.17	3.58
10. Doubt/Confusion	1.51	4.09	11.20	28.89	4.89	4.09	16.98	14.58	14.58	100.00	3.91	32.89	1.51	5.69	12.09	7.91	3.20	6.84	3.29	3.02	8.18	4.62	9.51	12.09	2.13	8.00
11. Embarrassment	4.45	6.48	12.15	14.98	7.29	6.88	15.38	10.53	19.84	17.81	100.00	11.74	3.24	7.69	9.72	9.72	7.29	8.91	1.62	4.05	14.98	6.88	14.98	7.29	2.83	1.21
12. Engagement	3.36	0.29	0.68	26.96	0.22	19.93	0.77	2.00	0.94	1.95	0.15	100.00	3.61	20.37	1.09	0.31	18.66	0.21	6.13	8.02	0.55	0.45	0.22	1.17	1.72	0.84
13. Esteem	21.07	0.13	0.13	28.26	0.25	39.15	0.13	2.48	0.64	1.08	0.51	43.67	100.00	29.66	0.38	0.57	45.77	0.19	9.61	22.28	0.70	1.21	0.25	1.65	20.88	2.04
14. Excitement	7.10	0.15	0.30	28.51	0.15	39.11	0.19	0.66	0.74	0.88	0.26	53.37	6.43	100.00	0.39	0.65	45.33	0.06	4.66	18.43	0.03	0.36	0.06	2.66	2.94	0.79
15. Fatigue	0.80	1.60	9.70	10.39	2.74	6.51	10.96	23.63	15.64	15.53	2.74	23.63	0.68	3.20	100.00	3.08	3.77	11.07	8.90	2.85	8.33	2.74	14.04	6.96	1.48	7.88
16. Fear	1.82	6.99	11.55	20.36	7.29	8.21	9.42	5.47	18.54	27.05	7.29	17.63	2.74	14.29	8.21	100.00	1.22	11.85	3.65	2.13	21.88	9.73	20.36	12.77	2.74	4.86
17. Happiness	13.59	0.02	0.07	17.38	0.02	20.88	0.11	1.16	0.11	0.39	0.20	38.87	7.88	36.03	0.36	0.04	100.00	0.08	10.75	24.86	0.01	0.67	0.10	2.19	6.47	0.84
18. Pain	1.26	7.55	12.58	7.86	4.40	3.77	23.27	5.66	12.58	24.21	6.92	12.58	0.94	1.26	30.50	12.26	2.20	100.00	1.57	2.20	31.45	10.69	53.14	16.67	6.29	15.09
19. Peace	10.21	0.00	0.15	11.62	0.15	20.50	0.30	6.98	0.37	1.37	0.15	43.26	5.61	12.55	2.90	0.45	36.39	0.19	100.00	20.16	0.82	5.05	0.33	1.49	4.94	4.23
20. Pleasure	22.12	0.03	0.05	15.35	0.55	25.92	0.22	1.18	0.16	0.93	0.27	41.76	9.59	36.61	0.69	0.19	62.13	0.19	14.88	100.00	0.00	1.07	0.14	3.51	6.69	1.64
21. Sadness	2.47	4.67	9.48	3.30	6.04	0.55	12.09	9.07	21.84	12.64	5.08	14.42	1.51	0.27	10.03	9.89	0.14	13.74	3.02	0.00	100.00	14.84	34.89	1.92	12.36	4.53
22. Sensitivity	9.47	2.49	6.31	10.80	3.32	3.82	5.81	4.82	10.30	8.64	2.82	14.12	3.16	4.32	3.99	5.32	10.13	5.65	22.59	6.48	17.94	100.00	13.46	2.16	8.64	14.29
23. Suffering	0.22	13.16	1.21	0.02	1.00	22.13	7.41	23.23	21.47	7.41	8.42	0.80	0.80	24.89	13.43	1.80	33.87	1.80	1.00	50.90	6.23	100.00	10.22	7.82	10.62	
24. Surprise	7.30	2.00	4.15	17.60	2.58	12.02	12.16	3.15	5.29	19.46	2.58	31.76	3.72	27.61	8.73	6.01	28.61	7.58	5.72	18.31	2.00	1.86	7.30	100.00	3.29	7.87
25. Sympathy	32.85	0.23	0.45	17.90	1.06	15.86	1.06	1.28	2.64	1.81	0.53	24.62	24.77	16.09	0.98	0.68	44.56	1.51	10.05	18.43	6.80	3.93	2.95	1.74	100.00	1.74
26. Yearning	3.26	1.22	3.05	15.06	1.22	5.70	6.21	3.26	3.05	9.16	0.31	16.17	3.26	5.80	7.02	1.63	7.83	4.88	11.60	6.10	3.00	8.75	5.39	5.60	2.34	100.00

# EMOTIC – Analysis<sup>[J]</sup> – Co-occurrence

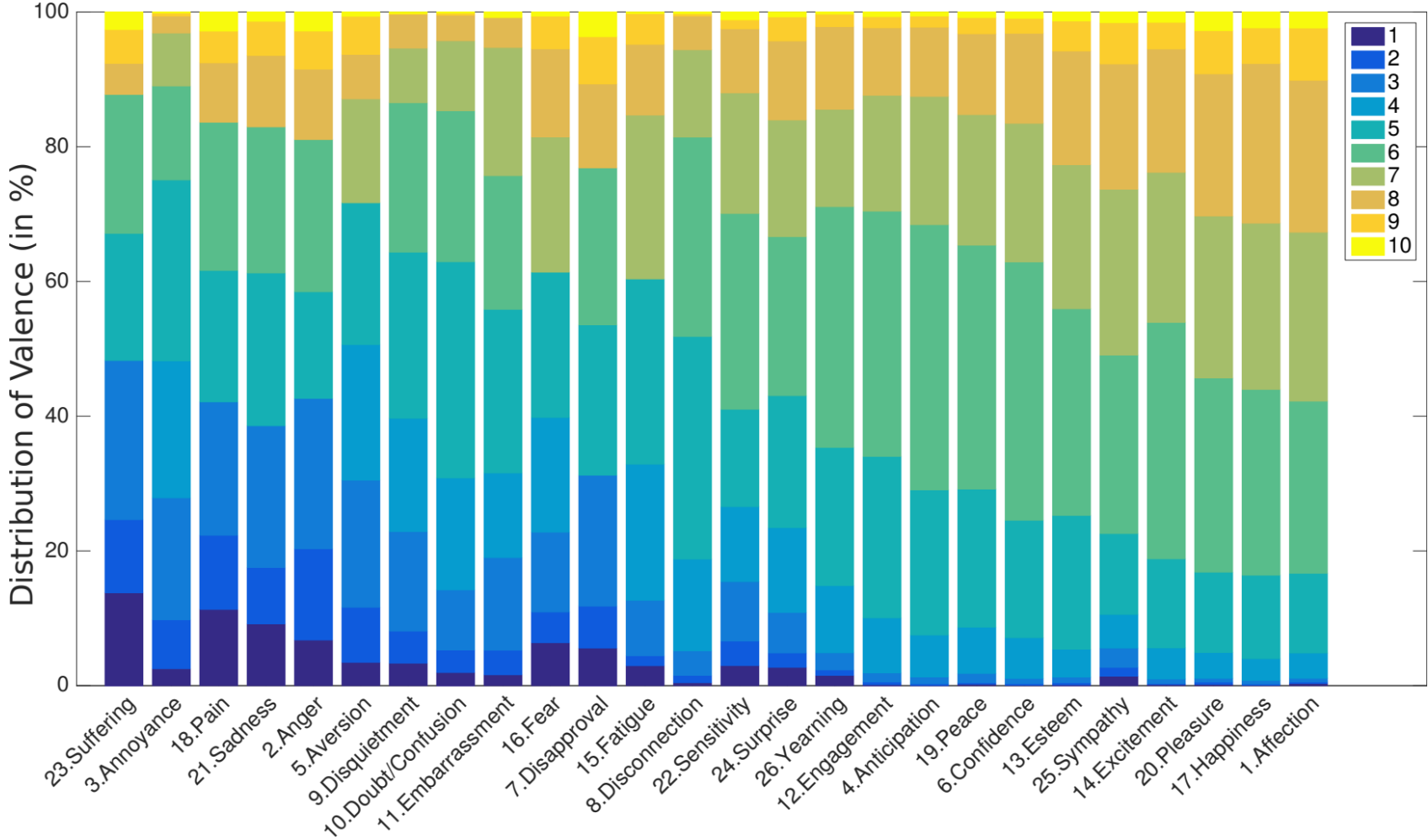
*Anticipation  
Engagement  
Confidence*

*Doubt/Confusion  
Disapproval  
Annoyance*

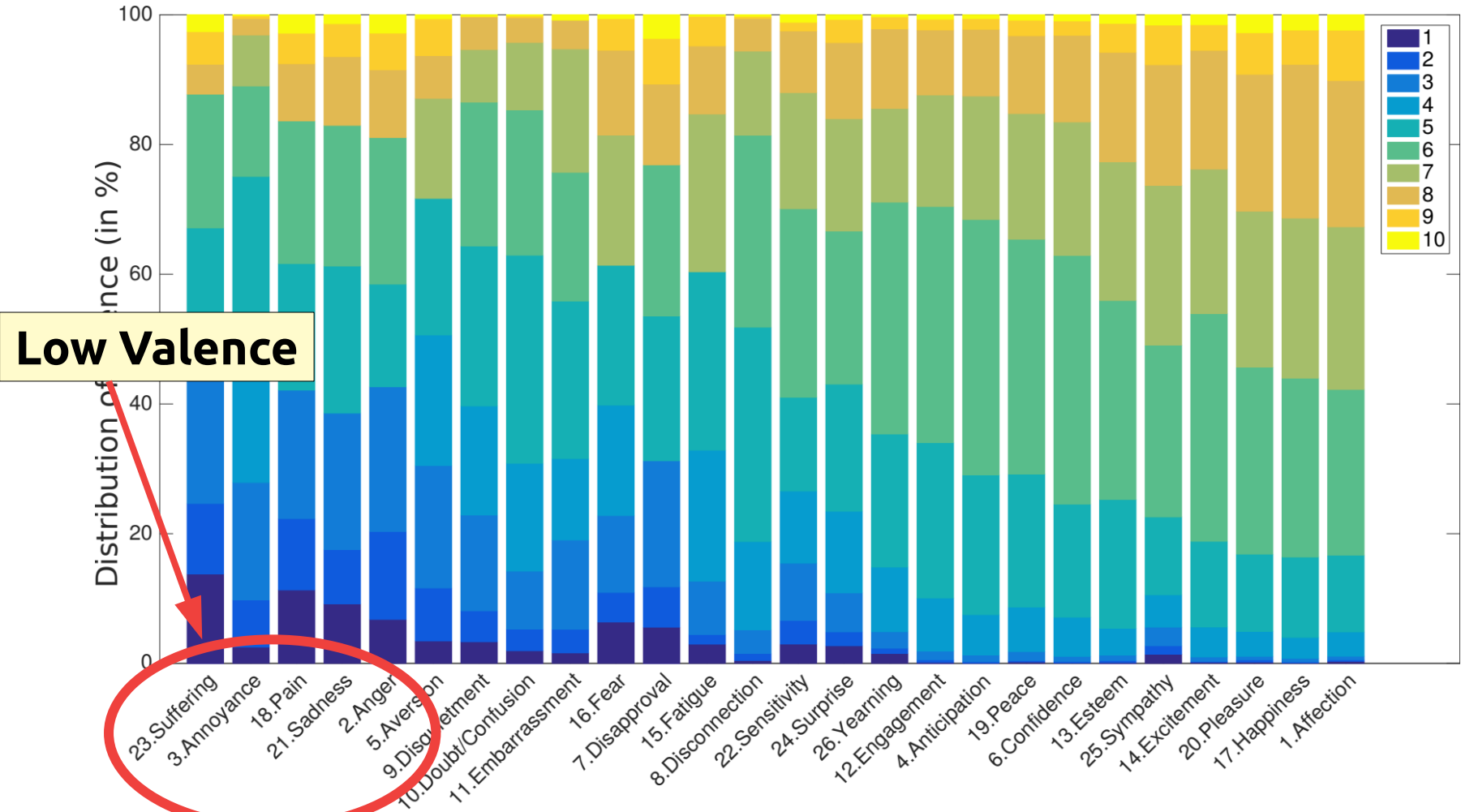
*Affection  
Happiness  
Pleasure*

*Yearning  
Annoyance  
Disquietment*

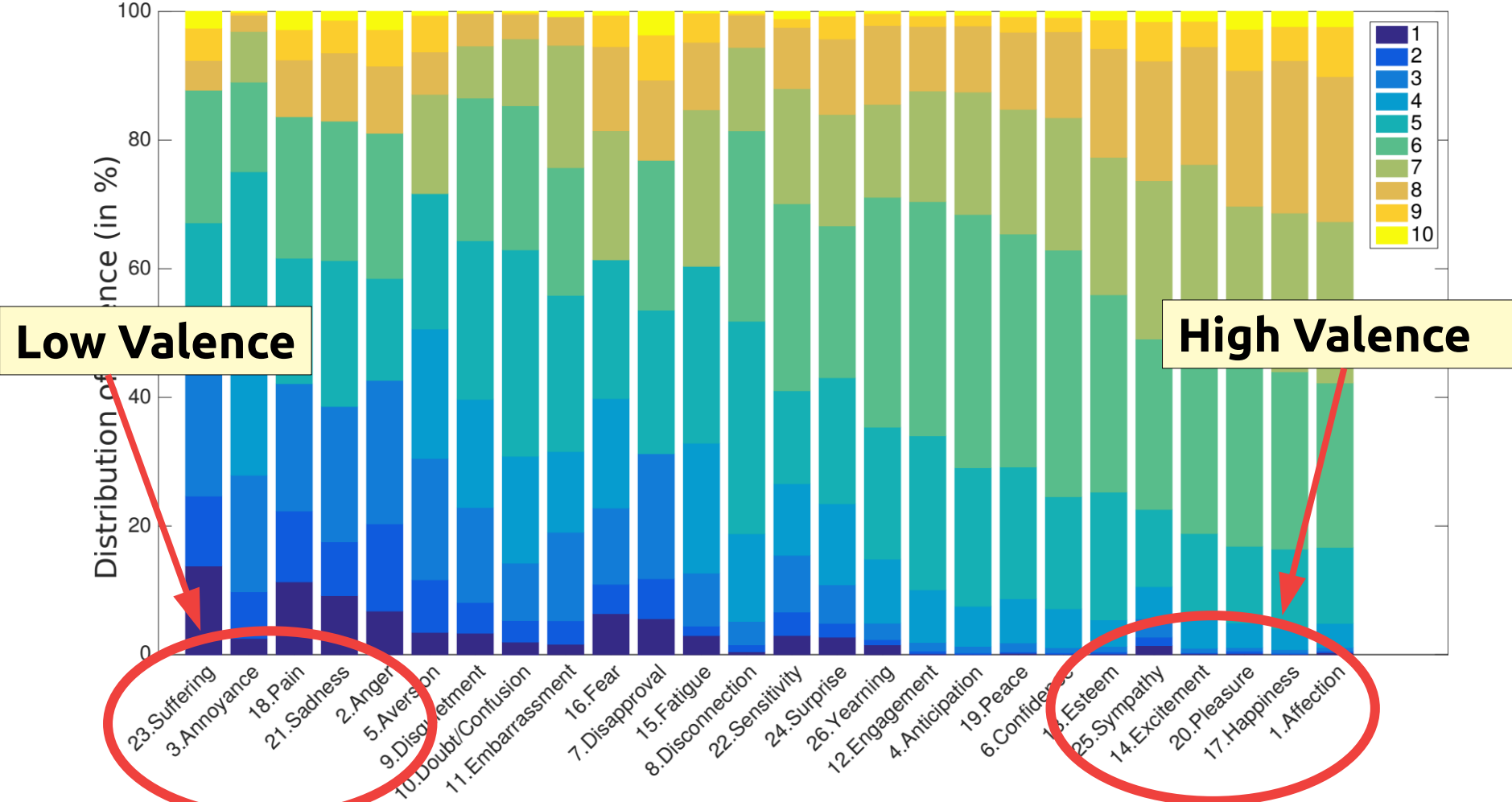
# EMOTIC – Analysis<sup>[J]</sup> – Cross Relationship



# EMOTIC – Analysis<sup>[J]</sup> – Cross Relationship



# EMOTIC – Analysis<sup>[J]</sup> – Cross Relationship



# Next Section

**(1) What is Emotion Recognition?**

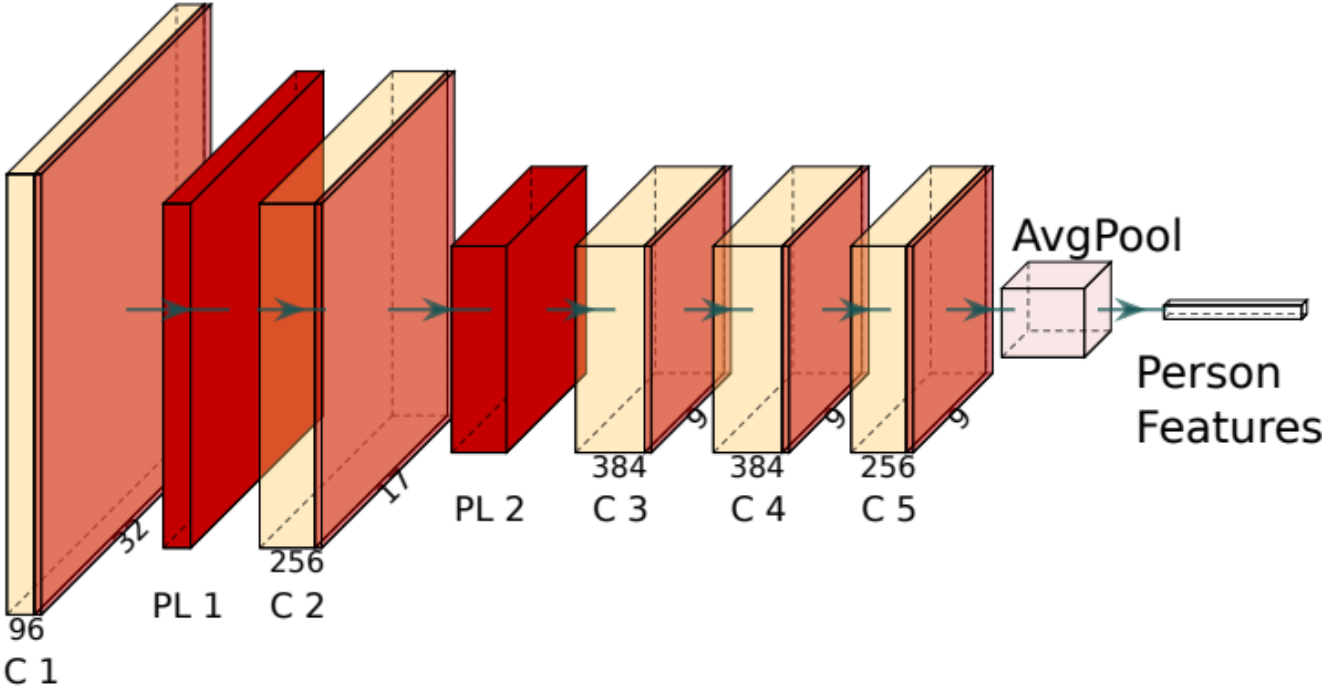
**(2) EMOTIONS in Context (EMOTIC) Dataset**

**(3) Modeling and Analysis**

**(4) Conclusions**

# EMOTIC Modeling

## Person Features<sup>[C]</sup>

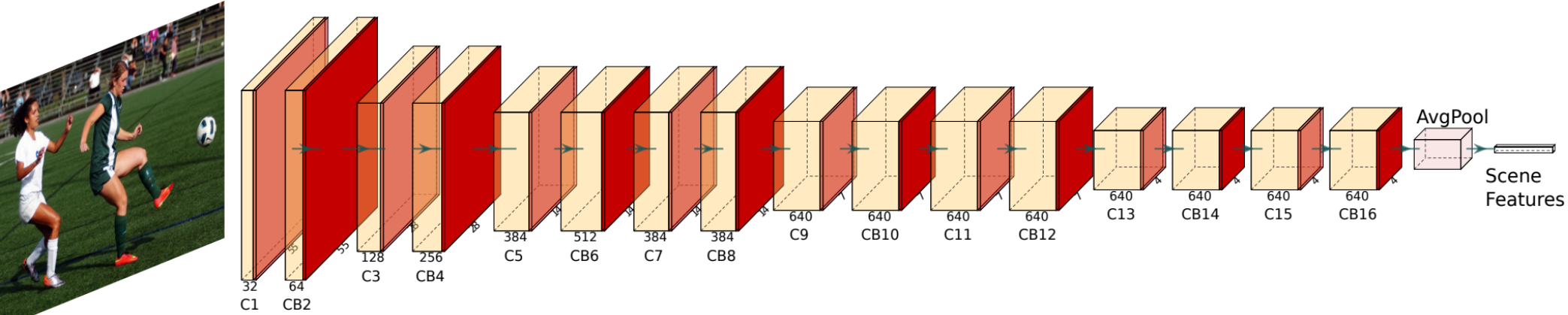


Based on Alexnet<sup>[1]</sup>

[1] Krizhevsky, Alex, Ilya Sutskever, and Geoffrey E. Hinton. "Imagenet classification with deep convolutional neural networks." In *Advances in neural information processing systems*, pp. 1097-1105. 2012.

# EMOTIC Modeling

## Visual Scene Features<sup>[C]</sup>



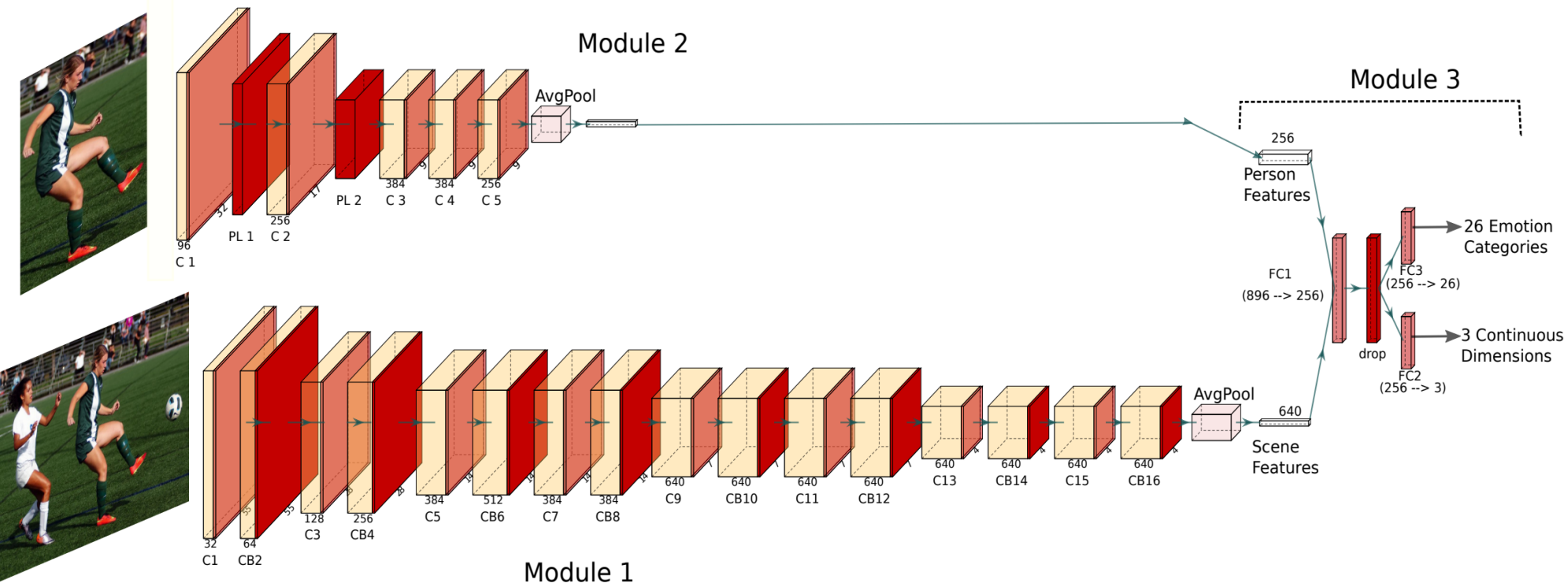
**Based on PlacesCNN<sup>[1]</sup>**

[1] Zhou, B., Lapedriza, A., Khosla, A., Oliva, A., and Torralba, A. (2017a). Places: A 10 million image database for scene recognition. *IEEE transactions on pattern analysis and machine intelligence*



# EMOTIC Modeling

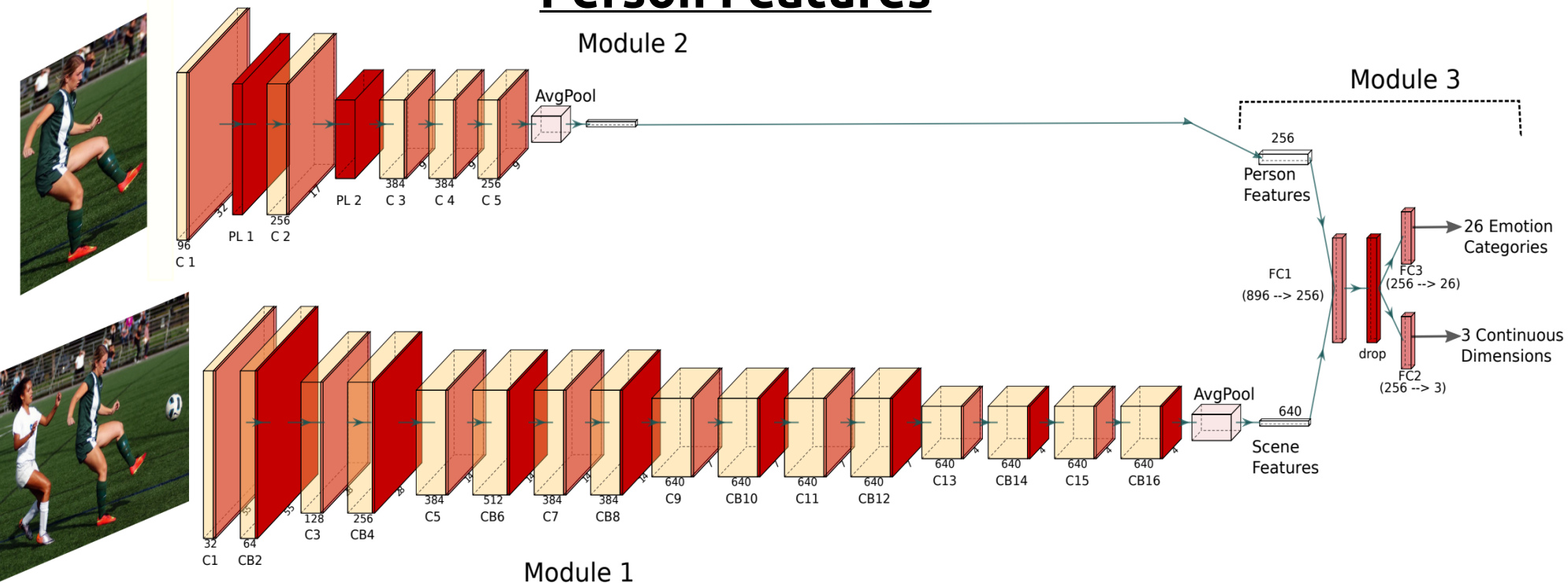
## Fusion CNN Model<sup>[C]</sup>



# EMOTIC Modeling

## Fusion CNN Model<sup>[C]</sup>

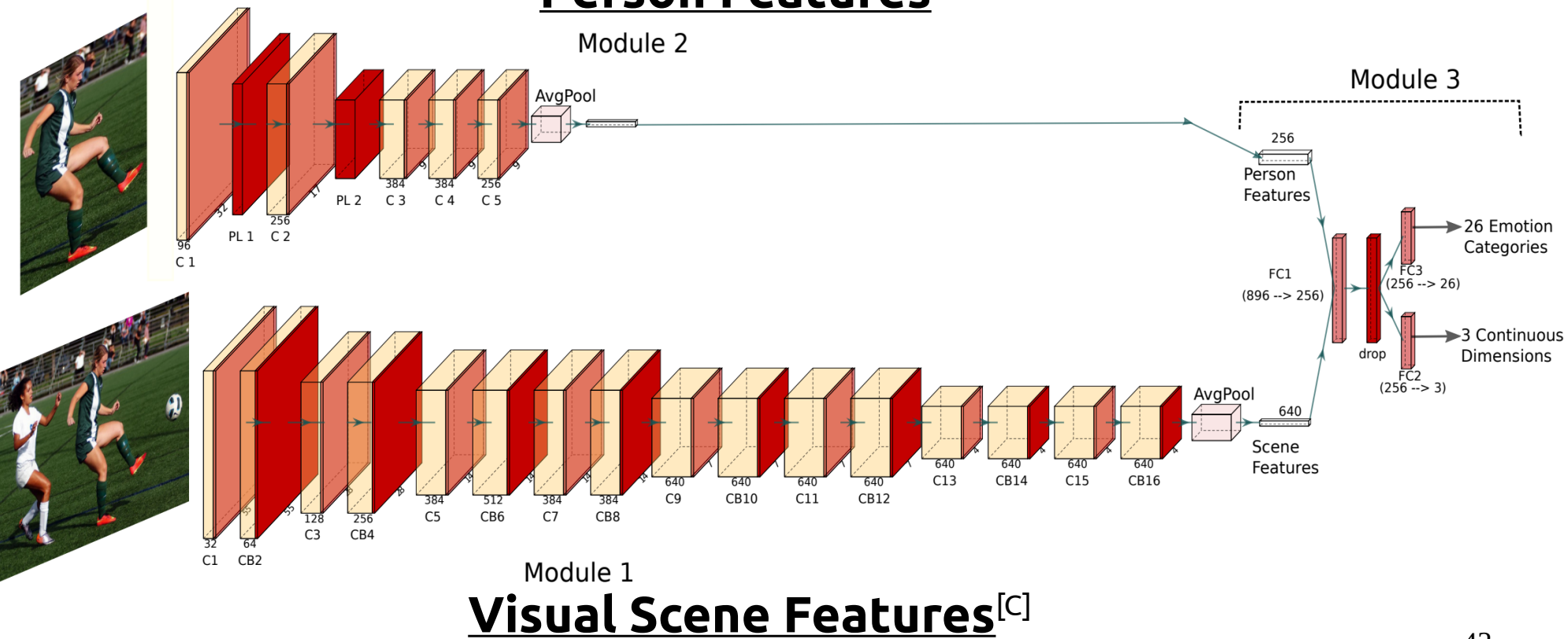
### Person Features<sup>[C]</sup>



# EMOTIC Modeling

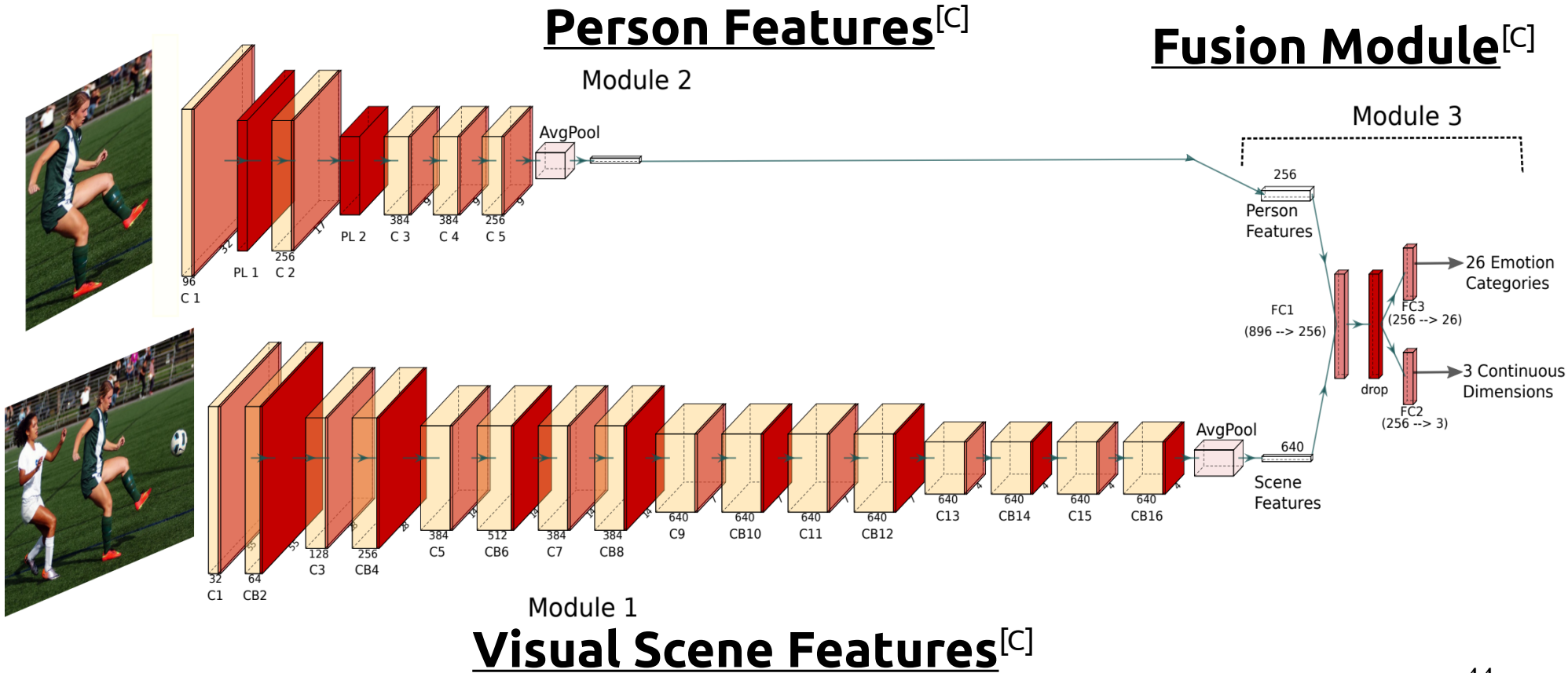
## Fusion CNN Model<sup>[C]</sup>

### Person Features<sup>[C]</sup>



# EMOTIC Modeling

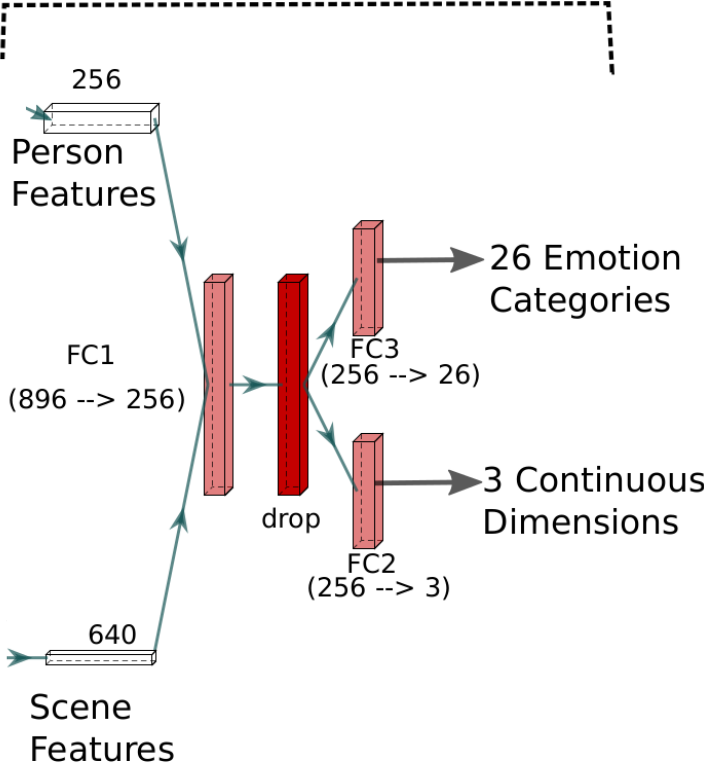
## Fusion CNN Model<sup>[C]</sup>



# EMOTIC Modeling

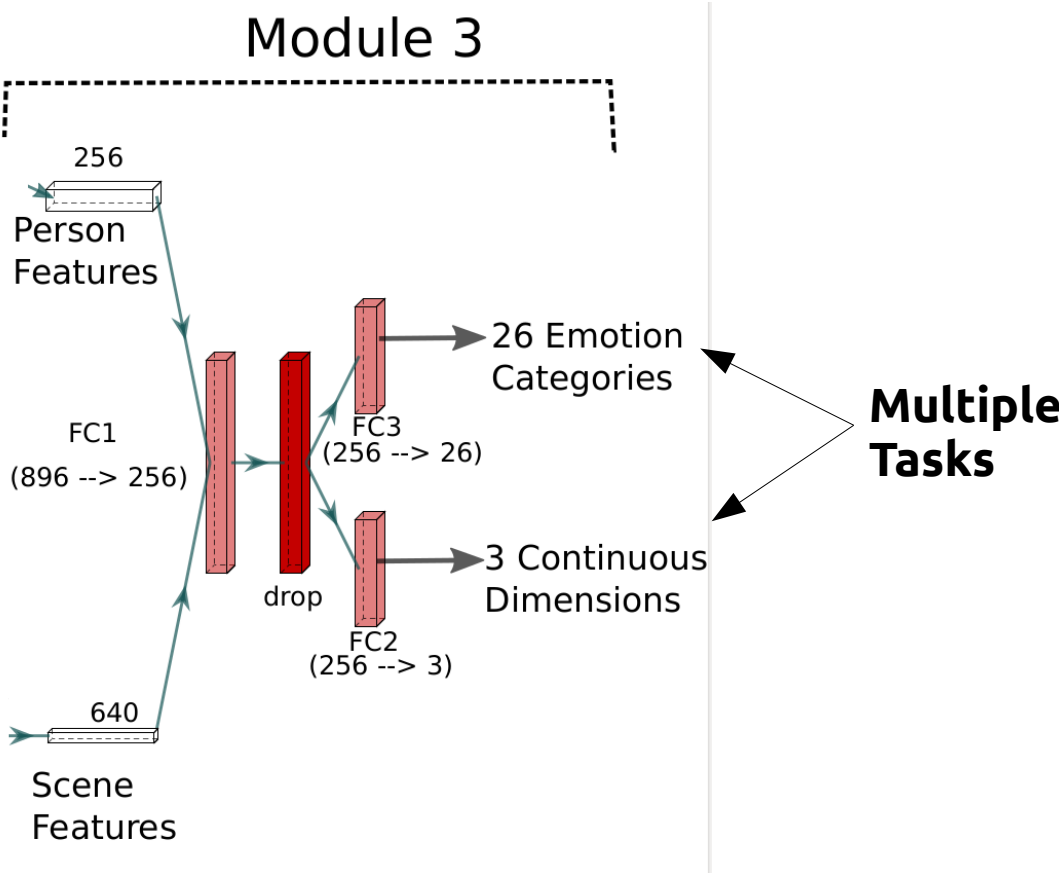
## Fusion Module[C]

### Module 3



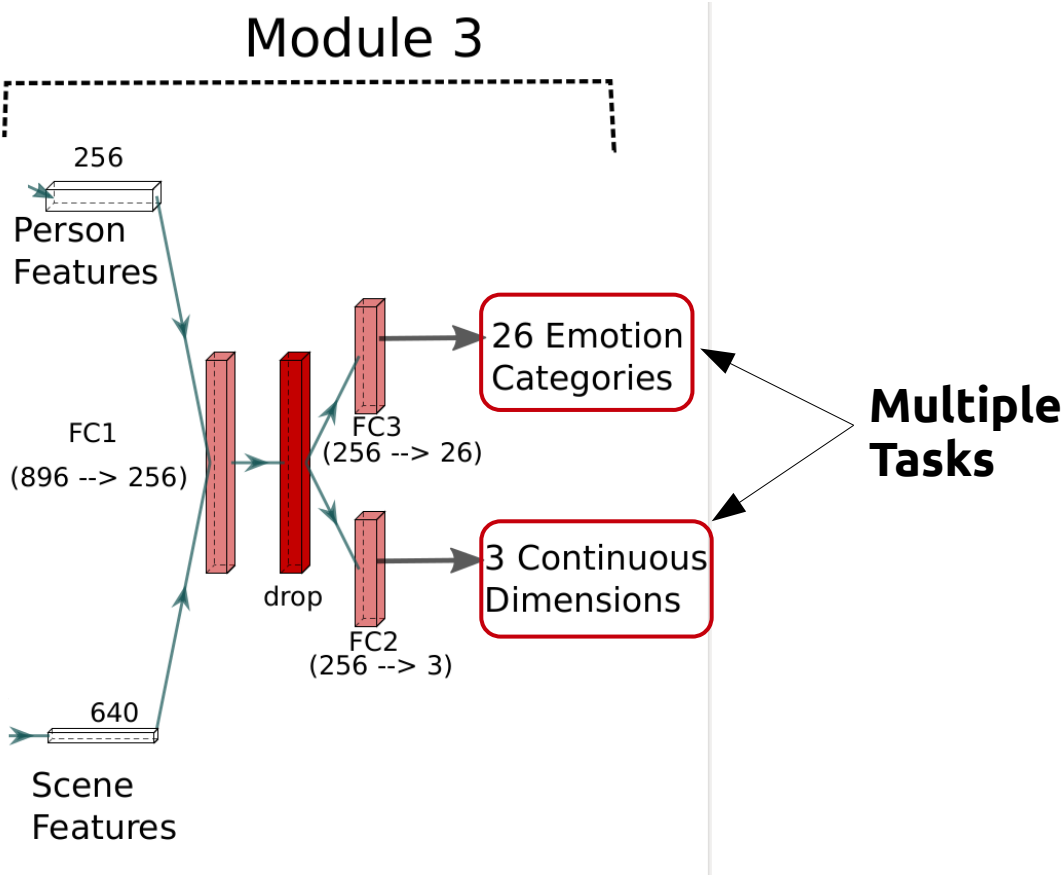
# EMOTIC Modeling

## Fusion Module[C]



# EMOTIC Modeling

## Fusion Module[C]



# EMOTIC Modeling

## Combined Criteria<sup>[C, J]</sup>

$$L_{comb1} = \lambda_{disc} L_{disc} + \lambda_{cont} L_{2cont}$$

Emotion Category



Continuous Dimensions





# EMOTIC Modeling

## Combined Criteria<sup>[C, J]</sup>

$$L_{comb1} = \lambda_{disc}L_{disc} + \lambda_{cont}L_{2cont}$$

$$L_{comb2} = \lambda_{disc}L_{disc} + \lambda_{cont}SL_{1cont}$$

Emotion Category



Continuous Dimensions  
(Generic)



# EMOTIC Modeling

## Combined Criteria<sup>[C, J]</sup>

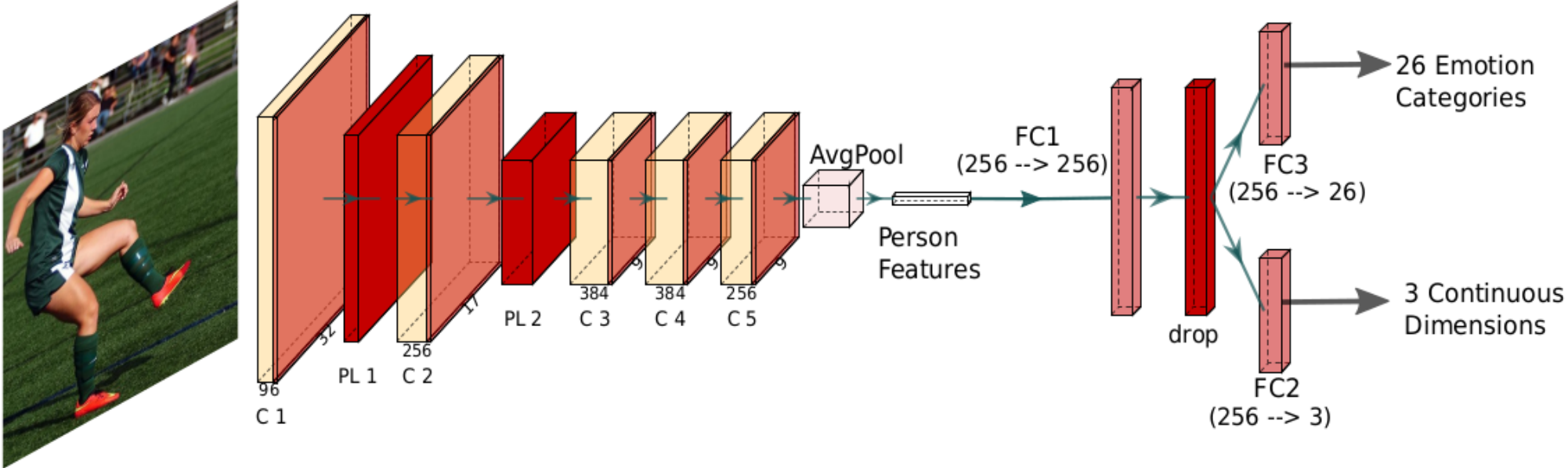
$$L_{comb1} = \lambda_{disc}L_{disc} + \lambda_{cont}L_{2cont}$$

$$L_{comb2} = \lambda_{disc}L_{disc} + \lambda_{cont}SL_{1cont}$$

$$\lambda_{disc} = \lambda_{cont} = 0.5$$

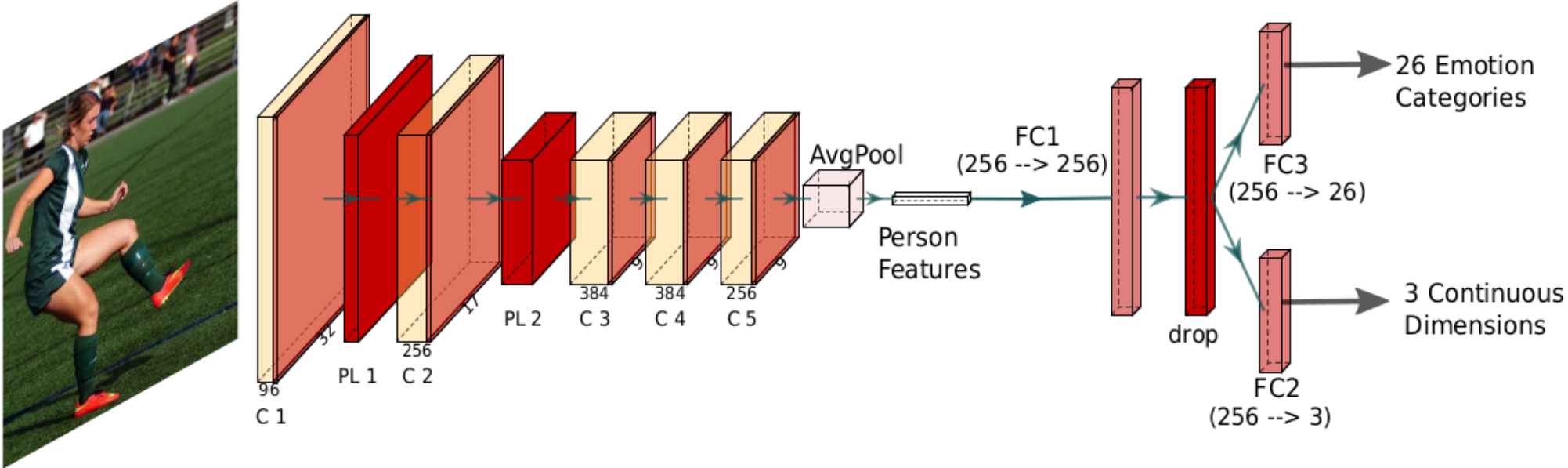
# Experiments<sup>[C, J]</sup>

## B Model



# Experiments<sup>[C, J]</sup>

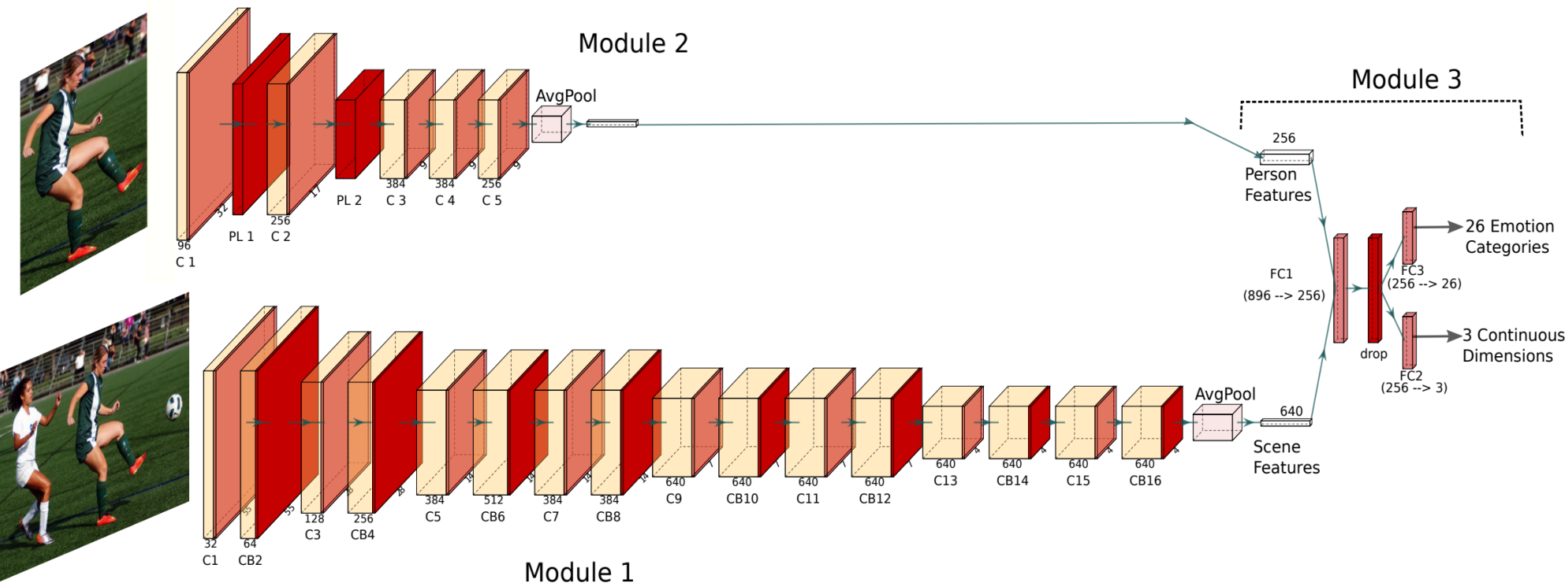
## B Model



Trained with  $L_{comb1}$  &  $L_{comb2}$

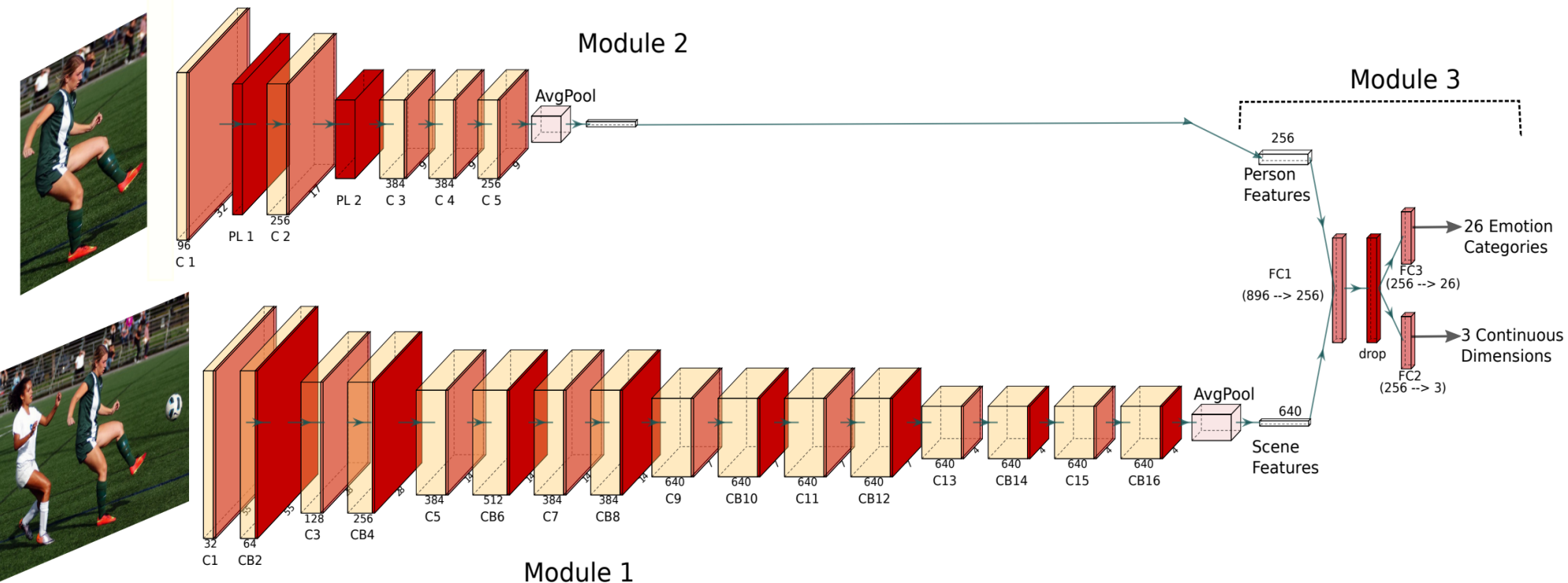
# Experiments<sup>[C, J]</sup>

## B+I Model (Fusion CNN Model)



# Experiments<sup>[C, J]</sup>

## B+I Model (Fusion CNN Model)



Trained with  $L_{comb1}$  &  $L_{comb2}$

# Results – Emotion Categories

	<b>B Model</b>	<b>Fusion Model</b>
$L_{comb1}$	23.86	<b>24.88</b>
$L_{comb2}$	22.36	<b>27.38</b>

**Average Precision (AP)**

# Results – Emotion Categories

	B Model	Fusion Model
$L_{comb1}$	23.86	<b>24.88</b>
$L_{comb2}$	22.36	<b>27.38</b>

← 4.3% higher

**Average Precision (AP)**



# Results – Emotion Categories

	B Model	Fusion Model
$L_{comb1}$	23.86	24.88
$L_{comb2}$	22.36	27.38

← 4.3% higher

← 22.5% higher

**Average Precision (AP)**

# Results – Emotion Categories

	B Model	Fusion Model
$L_{comb1}$	23.86	24.88
$L_{comb2}$	22.36	27.38

← 4.3% higher

← 22.5% higher

**Average Precision (AP)**

# Results – Continuous Dimensions

	B Model	Fusion Model
$L_{comb1}$	<b>0.0569</b>	0.0589
$L_{comb2}$	0.0581	<b>0.0573</b>

**Average Absolute Error (AE)**

# Results – Continuous Dimensions

	B Model	Fusion Model
$L_{comb1}$	<b>0.0569</b>	0.0589
$L_{comb2}$	0.0581	<b>0.0573</b>

← 3.5% lower

**Average Absolute Error (AE)**

# Results – Continuous Dimensions

	B Model	Fusion Model	
$L_{comb1}$	<b>0.0569</b>	0.0589	← 3.5% lower
$L_{comb2}$	0.0581	<b>0.0573</b>	← 1.4% higher

**Average Absolute Error (AE)**

# Results – Continuous Dimensions

	B Model	Fusion Model	
$L_{comb1}$	0.0569	0.0589	← 3.5% lower
$L_{comb2}$	0.0581	0.0573	← 1.4% higher

**Average Absolute Error (AE)**

# Quantitative Analysis – Emotion Categories

## Jaccard Coefficient (JC)<sup>[C,J]</sup>

**P** = Predicted Categories

**G** = Ground Truth Categories

# Quantitative Analysis – Emotion Categories

## Jaccard Coefficient (JC)<sup>[C,J]</sup>

**P** = Predicted Categories

**G** = Ground Truth Categories

$$JC = \frac{\text{Intersection (P, G)}}{\text{Union (P, G)}}$$



# Quantitative Analysis – Emotion Categories

## Jaccard Coefficient (JC)<sup>[C,J]</sup>

**P** = Predicted Categories

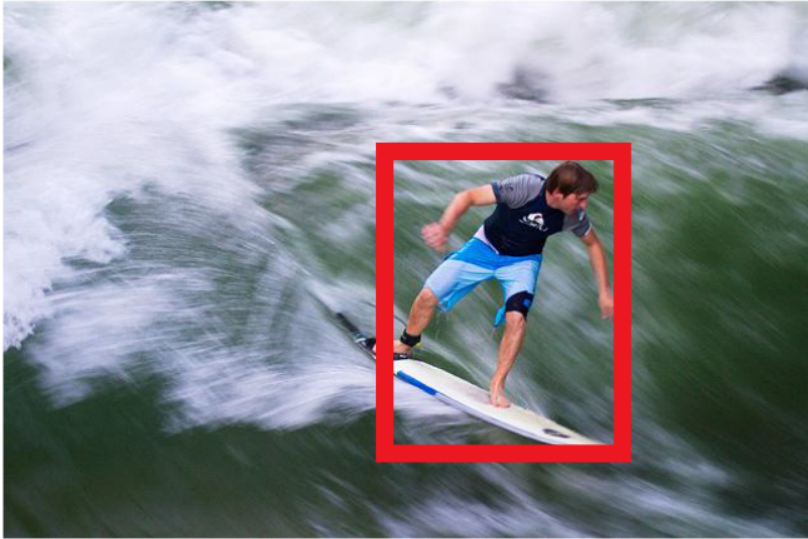
**G** = Ground Truth Categories

$$JC = \frac{\text{Intersection (P, G)}}{\text{Union (P, G)}}$$

*Higher values are better*

# Qualitative Analysis ( $L_{comb2}$ )

## High JC values

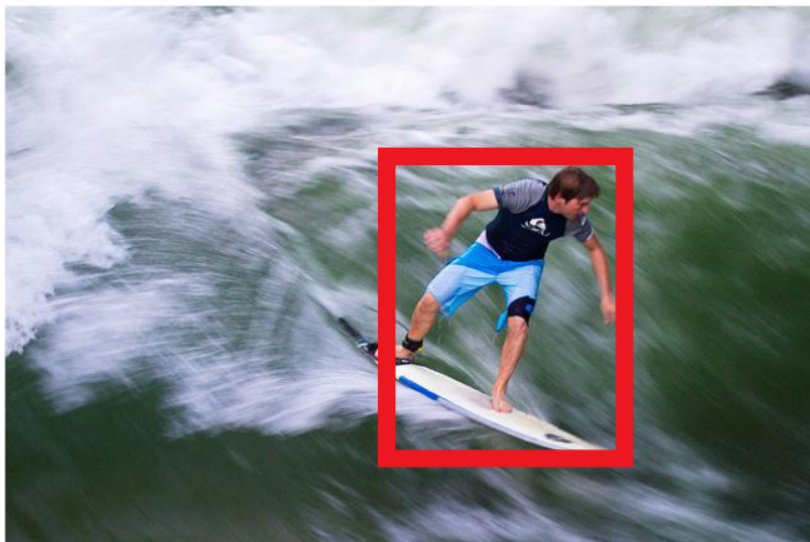


Anticipation      V: 0,57  
Confidence        A: 0,83  
Engagement       D: 0,67  
Excitement

Ground Truth

# Qualitative Analysis ( $L_{comb2}$ )

## High JC values



Anticipation V: 0,57  
Confidence A: 0,83  
Engagement D: 0,67  
Excitement

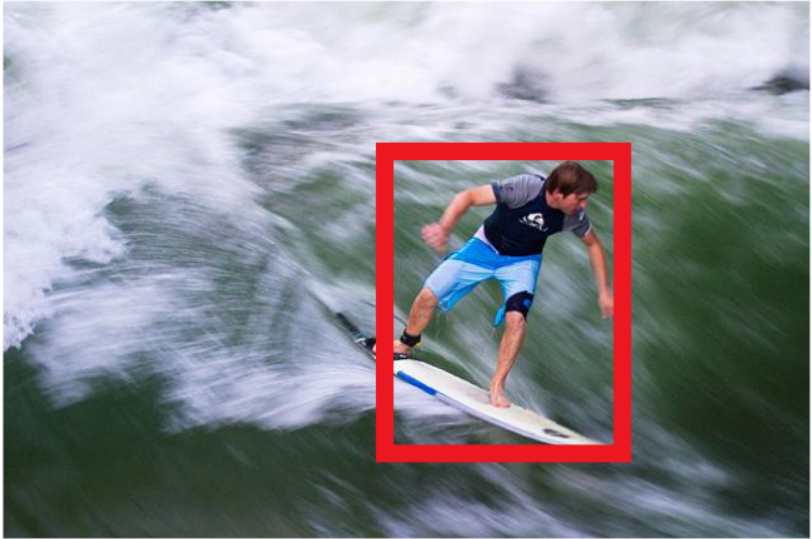
Ground Truth

## B Model

Anticipation V: 0,61  
Confidence A: 0,61  
Engagement D: 0,67  
Excitement  
Happiness  
Surprise  
Sympathy  
JC: 0,57

# Qualitative Analysis ( $L_{comb2}$ )

## High JC values



Anticipation V: 0,57  
Confidence A: 0,83  
Engagement D: 0,67  
Excitement

Ground Truth

### B Model

Anticipation V: 0,61  
Confidence A: 0,61  
Engagement D: 0,67  
Excitement  
Happiness  
Surprise  
Sympathy  
JC: 0,57

### Fusion Model

Anticipation V: 0,62  
Confidence A: 0,70  
Engagement D: 0,66  
Excitement  
JC: 1.00

# Qualitative Analysis ( $L_{comb2}$ )

## High JC values



Anticipation V: 0,57  
Confidence A: 0,83  
Engagement D: 0,67  
Excitement

Ground Truth

### B Model

Anticipation V: 0,61  
Confidence A: 0,61  
Engagement D: 0,67  
Excitement  
Happiness  
Surprise  
Sympathy  
JC: 0,57

**AE = 0.087**

### Fusion Model

Anticipation V: 0,62  
Confidence A: 0,70  
Engagement D: 0,66  
Excitement  
JC: 1.00

**AE = 0.045**

# Qualitative Analysis ( $L_{comb2}$ )

## High JC values



Anticipation V: 0,57  
Confidence A: 0,83  
Engagement D: 0,67  
Excitement

Ground Truth

### B Model

Anticipation V: 0,61  
Confidence A: 0,61  
Engagement D: 0,67  
Excitement  
Happiness  
Surprise  
Sympathy  
JC: 0,57

**AE = 0.087**

### Fusion Model

Anticipation V: 0,62  
Confidence A: 0,70  
Engagement D: 0,66  
Excitement  
JC: 1.00

**AE = 0.045**

# Qualitative Analysis ( $L_{comb2}$ )

## Low JC values



Anger V: 0,50  
Annoyance A: 0,33  
Aversion D: 0,67  
Doubt/Confusion  
Sadness  
Surprise

Ground Truth

# Qualitative Analysis ( $L_{comb2}$ )

## Low JC values



### B Model

Anticipation V: 0,60  
Confidence A: 0,50  
Disconnection D: 0,63  
Engagement  
Happiness  
Pain

JC: 0,00

Anger V: 0,50  
Annoyance A: 0,33  
Aversion D: 0,67  
Doubt/Confusion  
Sadness  
Surprise

Ground Truth



# Qualitative Analysis ( $L_{comb2}$ )

## Low JC values



Anger V: 0,50  
 Annoyance A: 0,33  
 Aversion D: 0,67  
 Doubt/Confusion  
 Sadness  
 Surprise

Ground Truth

### B Model

Anticipation V: 0,60  
 Confidence A: 0,50  
 Disconnection D: 0,63  
 Engagement  
 Happiness  
 Pain

JC: 0,00

### Fusion Model

Affection V: 0,64  
 Anticipation A: 0,54  
 Disquietment D: 0,62  
 Doubt/Confusion  
 Engagement  
 Happiness  
 Pleasure

JC: 0,08

# Qualitative Analysis ( $L_{comb2}$ )

## Low JC values



Anger V: 0,50  
 Annoyance A: 0,33  
 Aversion D: 0,67  
 Doubt/Confusion  
 Sadness  
 Surprise

Ground Truth

### B Model

Anticipation V: 0,60  
 Confidence A: 0,50  
 Disconnection D: 0,63  
 Engagement  
 Happiness  
 Pain

JC: 0,00

**AE = 0.10**

### Fusion Model

Affection V: 0,64  
 Anticipation A: 0,54  
 Disquietment D: 0,62  
 Doubt/Confusion  
 Engagement  
 Happiness  
 Pleasure

JC: 0,08

**AE = 0.13**

# Qualitative Analysis ( $L_{comb2}$ )

## Low JC values



Anger V: 0,50  
 Annoyance A: 0,33  
 Aversion D: 0,67  
 Doubt/Confusion  
 Sadness  
 Surprise

Ground Truth

### B Model

Anticipation V: 0,60  
 Confidence A: 0,50  
 Disconnection D: 0,63  
 Engagement  
 Happiness  
 Pain

JC: 0,00

**AE = 0.10**

### Fusion Model

Affection V: 0,64  
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**AE = 0.13**

# Sentibanks as Visual Context Features

**Image Sentiment?**

# Sentibanks as Visual Context Features

**Image Sentiment?**



# Sentibanks as Visual Context Features

**Image Sentiment?**



**“Sunset at the beach”**

# Sentibanks as Visual Context Features

**Image Sentiment?**



**“Beautiful Sunset at the beach”**

# Sentibanks as Visual Context Features

**Image Sentiment?**



**Adjective – Noun Pair (ANP)  
(Sentibanks)**

→ **“Beautiful Sunset at the beach”**



# Sentibanks as Visual Context Features



# Sentibanks as Visual Context Features



**“A Dog”**

# Sentibanks as Visual Context Features

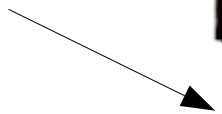


**“A Muddy Dog”**

# Sentibanks as Visual Context Features

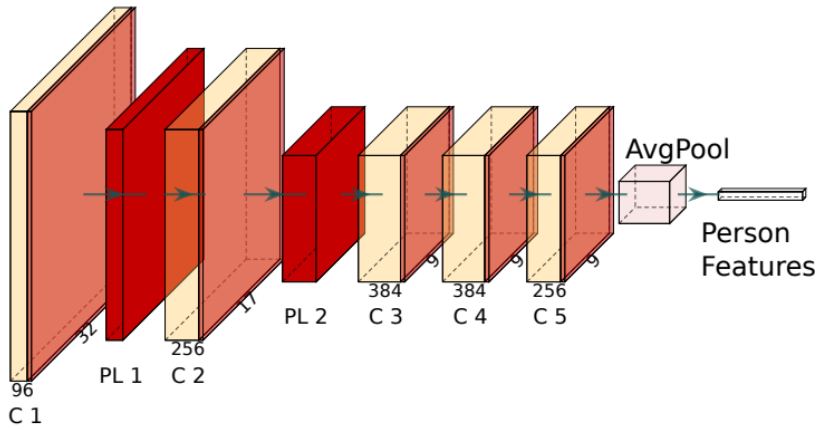


Adjective – Noun Pair (ANP)  
(Sentibanks)



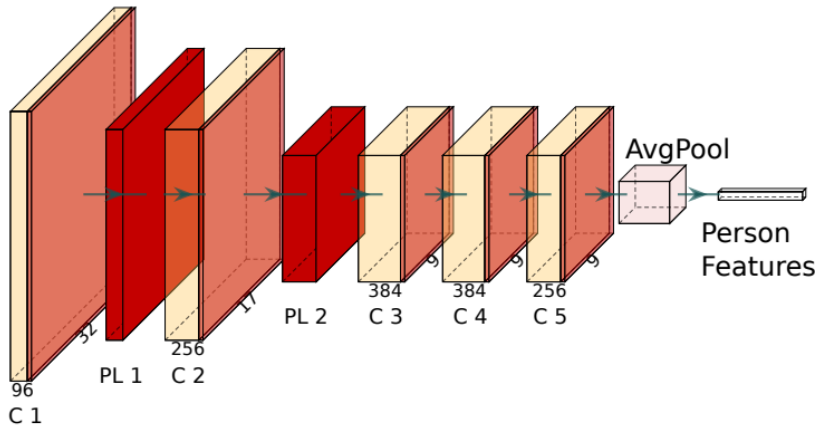
**“A Muddy Dog”**

# Sentibanks as Visual Context Features (Experiments)

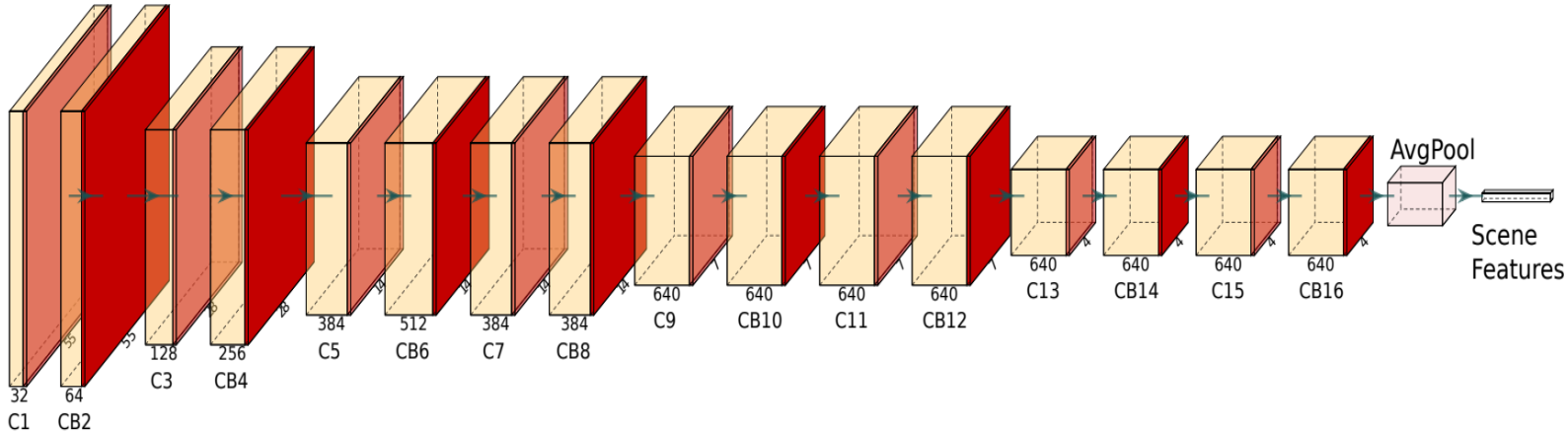


**B<sub>f</sub>**

# Sentibanks as Visual Context Features (Experiments)

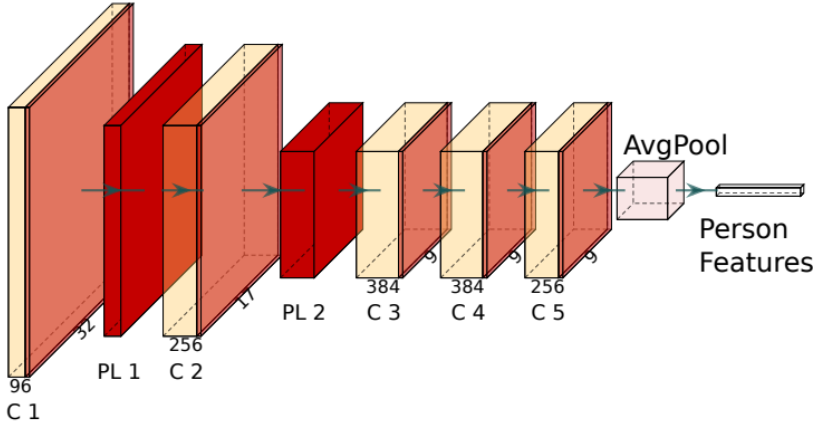


**B<sub>f</sub>**



**I<sub>f</sub>**

# Sentibanks as Visual Context Features (Experiments)



$B_f$



$I_s$

# Sentibanks as Visual Context Features (Results)

## Logistic Regression

Features	$B_f$	$B_f + I_f$	$B_f + I_s$
AP	23.00	27.70	<b>29.45</b>
AE	0.0704	<b>0.0643</b>	0.0713



# Sentibanks as Visual Context Features (Results)

## Logistic Regression

Emotion Categories →

Features	$B_f$	$B_f + I_f$	$B_f + I_s$
AP	23.00	27.70	29.45
AE	0.0704	0.0643	0.0713

# Sentibanks as Visual Context Features (Results)

## Logistic Regression

Sentibanks  
↓

Emotion Categories →

Continuous Dimensions →

Features	$B_f$	$B_f + I_f$	$B_f + I_s$
AP	23.00	27.70	29.45
AE	0.0704	0.0643	0.0713

# Sentibanks as Visual Context Features (Results)

## Logistic Regression

	Features	$B_f$	$B_f + I_f$	$B_f + I_s$
Emotion Categories →	AP	23.00	27.70	29.45
Continuous Dimensions →	AE	0.0704	0.0643	0.0713

$I_s$  (sentibanks) – a good source for Visual Scene Context

# Next Section

**(1) What is Emotion Recognition?**

**(2) EMOTIons in Context (EMOTIC) Dataset**

**(3) Modeling and Analysis**

**(4) Takeaways**

# Main Takeaways

**(1) EMOTIC – A Novel Emotion Recognition Dataset**

# **Main Takeaways**

**(1) EMOTIC – A Novel Emotion Recognition Dataset**

**(2) Fusion CNN model – models visual scene**

# Main Takeaways

- (1) EMOTIC – A Novel Emotion Recognition Dataset**
- (2) Fusion CNN model – models visual scene**
- (3) Sentibank features and Scene context features – both good sources of visual context information**

# Future Work

## (1) Data Augmentation



# Future Work

**(1) Data Augmentation**

**(2) Strategy of Emotion labels**

# **Future Work**

**(1) Data Augmentation**

**(2) Strategy of Emotion labels**

**(3) Emotion Captioning**

# Contributions - Publications

- [C] Kosti, Ronak, Jose M. Alvarez, Adria Recasens, and Agata Lapedriza. "*Emotion recognition in context.*" In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, pp. 1667-1675. 2017.
- [W] Kosti, Ronak, Jose M. Alvarez, Adria Recasens, and Agata Lapedriza. "*Emotic: Emotions in context dataset.*" In 2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), pp.2309-2317. IEEE, 2017.
- [J] Kosti, Ronak, Jose M. Alvarez, Adria Recasens, and Agata Lapedriza. "*Context Based Emotion Recognition using EMOTIC Dataset.*" IEEE transactions on pattern analysis and machine intelligence (2019).

# Thank You



Code / Data

