

# Predicting the Signal Value of Infants' Smiles and Negative Facial Expressions

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## Introduction

- Infants have a rich and varied repertoire of distinctive facial expressions that serve crucial communicative functions in infant-caregiver interactions (Darwin, 1872, 1998; Oster, 2005).
- Studies by Messinger and colleagues (e.g., Messinger, Mattson, Mahoor, & Cohn, 2012) have found that “eye constriction” (AU 6; “cheek raise” in Baby FACS) and “lip and mouth opening” (AUs 25/26/27) increase the perceived intensity of both smiles and cry faces.
- However, other facial muscle actions that influence the perceived emotional valence and intensity of infants' facial expressions have not been empirically investigated.

## The Present Study

**AIMS:** To examine similarities and differences in the facial muscle action components of positive and negative facial expressions and the AUs that contribute to their perceived intensity.

### Hypotheses

- Negative facial expressions will show greater variability and complexity in terms of their component facial muscle action units (AUs) than positive expressions.
- Certain muscle actions will predict the rated intensity of both positive and negative expressions, while certain others will be uniquely associated with increased intensity ratings of positive or negative expressions.

## Methods

**Source:** *City Infant Faces Database* (Webb, Ayers, and Endress, 2018)

- Close-up images of positive and negative affect in infants photographed at home by mothers in naturally occurring situations. Mothers were not given criteria for specific facial configurations. Negative images included cry faces and other negative expressions. All positive expressions were smiles.
- 71 untrained observers (63 females,  $M = 28$  years old,  $SD = 8.52$ ) identified each expression as positive, neutral, or negative, and rated their intensity, clarity, and genuineness on separate 5-point scales.

**Our study** included only the 46 infants (of 64 in the database) with photos of both positive and negative expressions (23 males,  $M = 6.76$  months,  $SD = 2.77$ ) and only the observers' intensity ratings.

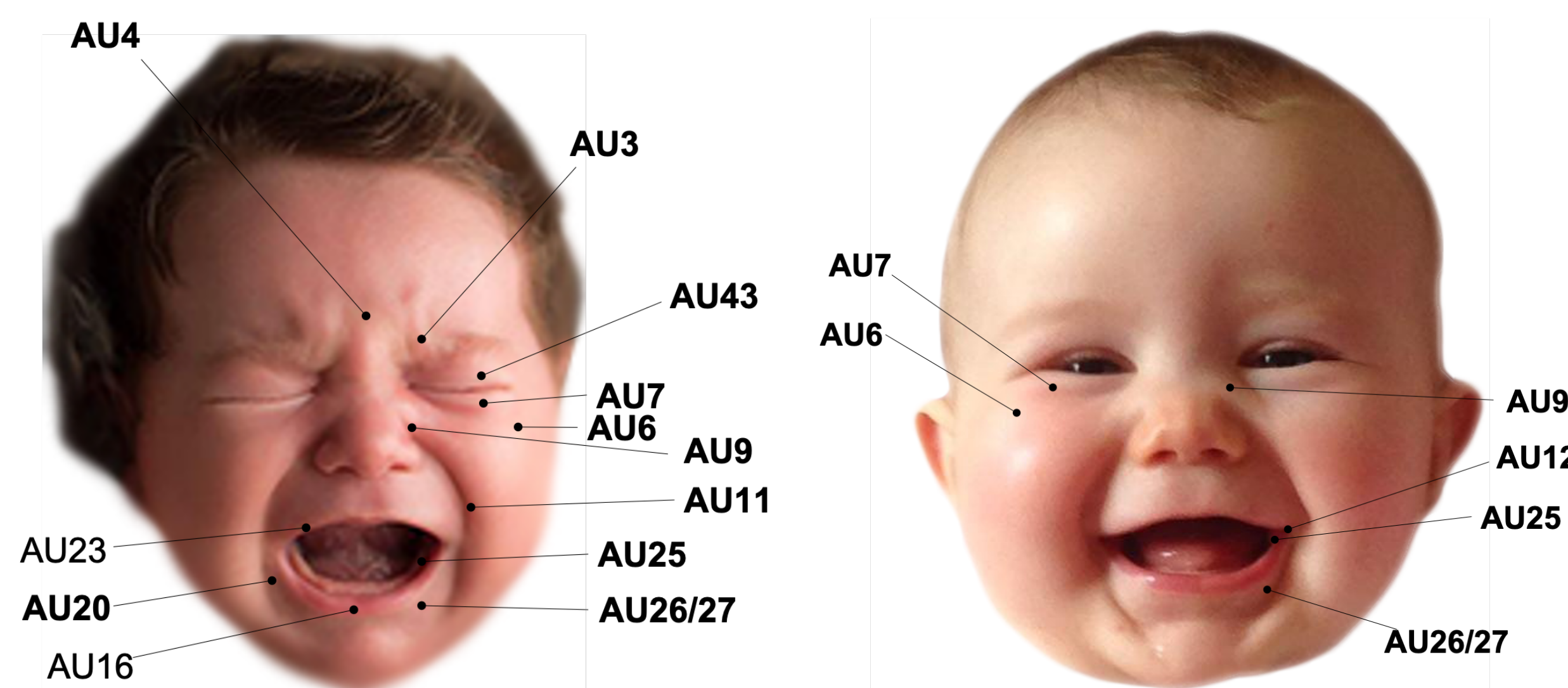
### Oster's (2017) Facial Action Coding System for Infants and Young Children (Baby FACS)

- A fine-grained, comprehensive coding system for objectively identifying facial muscle action units (AUs) in infants' and children's expressions.
- The intensity of the AUs was coded on a 4-point scale (0-3).
- Inter-coder reliability on AUs according to Baby FACS formula was .70.

### Variables

- Complexity of facial configurations:** the number of independent AUs in a configuration (e.g., expression coded as AUs 6+12+26 has N of 3 AUs).
- Variability of facial Configurations:** The number of uniquely different facial configurations (e.g., AUs 6+12 and AUs 6+12+26 are two different AU configurations).
- AU (Intensity):** The intensity of each AU on 4-point scale (0-3).
- Rated Intensity:** The intensity of expressions perceived by untrained raters.

**Figures: Negative (Cry Face) and Positive (Smile) Expressions**



## Results

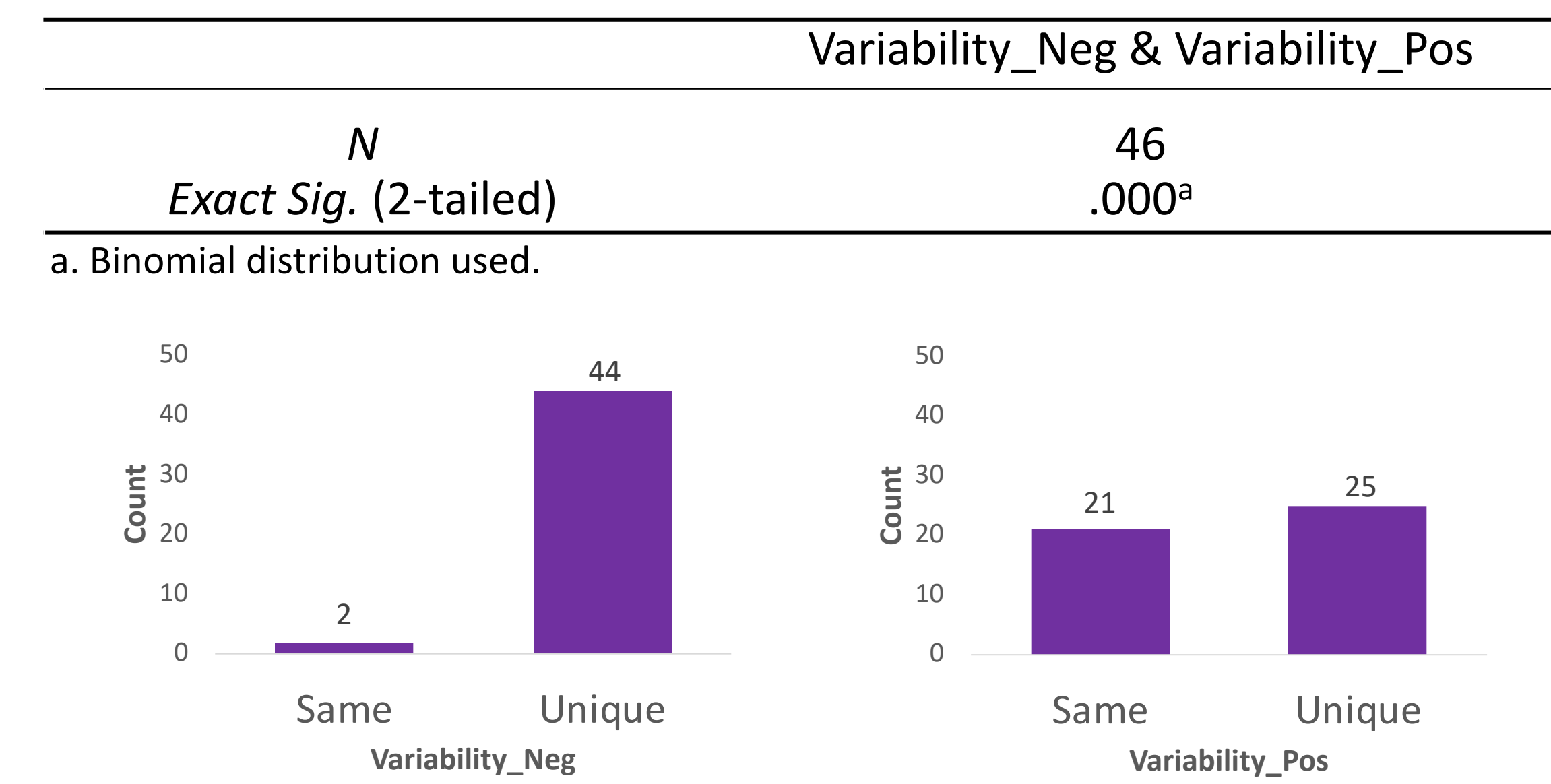
### 1. Differences between positive and negative faces: Paired Sample T-Test

	Paired Differences (N = 46)					t	df	Sig. (2-tailed)
	M	SD	SE	95% CI				
				Lower	Upper			
<b>Observers' Rated Intensity</b>	.057	.74	.11	-.1621	.2752	.52	45	.605
<b>Baby FACS Coded N of AUs</b>	3.48	2.32	.34	2.7903	4.1662	10.18***	45	.000

- Intensity ratings of positive and negative faces did not differ significantly
- The number of AUs in negative faces was higher than in positive faces (i.e., negative faces were more complex than positive)

### 2. Variability of positive vs. negative faces: McNemar Test

There were significantly more unique AU configurations in negative than positive expressions.



### 3. Significant AU intensity predictors of Observers' Rated Intensity of positive and negative expressions: Regression Analysis

- Separate regression analyses conducted for negative and positive facial expressions.

Negative <sup>a</sup>						Positive <sup>b</sup>					
IV	B	SE	$\beta$	t	Sig.	IV	B	SE	$\beta$	t	Sig.
AU1						AU1					
AU2						AU2					
<b>AU3</b>	.34	.09	.51	3.88	.000	<b>AU3</b>					
<b>AU4</b>	.29	.06	.58	4.70	.000	<b>AU4</b>					
AU5						AU5					
<b>AU6</b>	.28	.07	.51	3.88	.000	<b>AU6</b>	.29	.09	.44	3.23	.002
<b>AU7</b>	.30	.07	.54	4.20	.000	<b>AU7</b>	.26	.07	.52	4.07	.000
AU8						<b>AU8</b>					
AU9	.18	.10	.26	1.81	.078	AU9					
AU10						<b>AU10</b>					
<b>AU11</b>	.26	.08	.46	3.47	.001	<b>AU11</b>					
<b>AU12</b>						<b>AU12</b>	.54	.11	.61	5.06	.000
AU15						<b>AU15</b>					
AU16						AU16					
AU17						<b>AU17</b>					
<b>AU19</b>						AU19					
<b>AU20</b>	.36	.07	.64	5.59	.000	AU20					
AU22						<b>AU22</b>					
AU23						AU23					
<b>AU25</b>	.24	.08	.42	3.06	.004	<b>AU25</b>	.36	.08	.56	4.45	.000
AU26	.17	.08	.29	2.01	.051	<b>AU26</b>	.21	.08	.39	2.81	.007
<b>AU27</b>	.33	.13	.36	2.52	.015	AU27	.37	.20	.26	1.81	.077
AU38						<b>AU38</b>					
<b>AU43</b>	.13	.06	.31	2.18	.035	<b>AU43</b>					
AU47						<b>AU47</b>					

a. Independent Variable: AU Intensity; Dependent Variable: Rated Intensity Negative  
 b. Independent Variable: AU Intensity; Dependent Variable: Rated Intensity Positive  
 \*Only significant (and marginal) results are listed. **Highlighted AUs:** few or no cases  
 \*\*The results of analyses limited to cry faces were similar

## Discussion

Our coding and analyses of positive and negative infant facial expressions in the *City Infant Faces Database* largely confirmed our hypotheses.

- Negative expressions involve greater complexity and variability than positive expressions in terms of their constituent facial muscle actions.
- There were both similarities and differences in the AUs intensities predicting the observers' intensity ratings of negative and positive expressions.

### Similarities between positive and negative expressions:

- Cheek raising (AU 6) and lip and mouth opening (AUs 25/26/27) intensities predicted the perceived intensity of both positive and negative faces, consistent with Messinger's findings.
- AU 7 (eyelid tightening) was an additional predictor of the perceived intensity of both positive and negative expressions

### Differences between positive and negative expressions:

- The intensity of AU12 (lip corner puller), the principal component of smiles, predicted the perceived intensity of smiles and was not present in negative faces.
- AU intensity predictors of rated negative expression intensities: Brow knitting and knotting (AUs 3 & 4), closed eyes (AU 43), nasolabial furrow deepener (AU 11), and horizontal lip stretch (AU 20)

### Strengths/Limitations and Future Analyses

- Unlike studies reported by Messinger and colleagues, which focused only on cry faces, we analyzed a wider variety of negative facial expressions.
- Mothers were not given specific criteria for facial configurations of positive and negative emotions they contributed to the database.
- Future analyses will examine whether combinations of two or more AUs are better predictors of the perceived intensity of positive and negative expressions.

## References

Darwin, C. (1872). *The expression of the emotions in man and animals* (3d edition edited by P. Ekman). Oxford University Press, USA.

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