Putting 'Context' in Context: The Effects of Body Posture and Emotion Scene on Adult Categorizations of Disgust Facial Expressions

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Abstract

Affective face perception is influenced by non-facial contextual elements. However, investigations often conflate body posture and emotion scene, making it unclear whether posture or the combination of posture and scene produces perception-altering effects. This study examined adults’ categorizations of disgust facial expressions superimposed onto isolated emotion postures or postures embedded in emotion scenes. Results indicated that emotional postures exerted a significant contextual effect on adults’ emotion categorizations of disgust faces. Notably, postures in emotion scenes exerted a stronger contextual effect than isolated postures for sadness and fear contexts. These findings suggest that contextual elements exert varying degrees of influence on emotion perception and produce combinatorial effects.

Recent research suggests that non-facial cues, including body posture (e.g., Meeren, van Heijnsbergen, & de Gelder, 2005) and emotional scene (e.g., Righart & de Gelder, 2006, 2008), are rapidly integrated and produce influential effects on face perception (Wieser & Brosch, 2012; see Kret, Roelofs, Stekelenburg, & de Gelder, 2013). Such studies have challenged the long-held notion that affective facial perception is invariant to external (i.e., non-facial) influences (e.g., Aviezer, et al., 2008; Barrett, Mesquita, Gendron, 2011). However, this research has suffered from an overly broad operationalization of "context," using the term to "denote any cue that is external to the face" (Hassin et al., 2013, p. 61). The present investigation examined the contextual effects of body posture and body posture within a scene on adults' emotional categorizations of disgust facial expressions.

One explanation of how non-facial cues influence perception of facial affect is the notion of *emotion seeds* (see Aviezer et al. 2008; see also Fugate, 2013; Lindquist & Gendron, 2013). This theory posits that facial expressions are more likely to be miscategorized when accompanied by contextual cues corresponding to perceptually similar facial expressions. Such miscategorization has been referred to as the *confusability effect* (Hassin et al., 2013). For example, a disgust facial expression in an angry context is more likely to be categorized as anger than disgust due to the high physical similarity between anger and disgust facial expressions (see Susskind, Littlewort, Bartlett, Movellan, & Anderson, 2007). Conversely, a disgust facial expression in a fear context is less likely to be categorized as fear and more likely to be categorized as disgust due to the low perceptual similarity of fear and disgust facial expressions (Aviezer et al., 2008).

However, the above research has been inconsistent in operationalizing "context." For example, the stimuli in the seminal research by Aviezer and colleagues (2008) included four

"contexts" comprised of two isolated emotion body postures (i.e., anger and fear) and two emotion body postures embedded in emotion scenes (sadness: a sad posture in front of a tombstone; disgust: a pincer posture holding a soiled undergarment). The inclusion of extra-postural elements in some images but not others makes it impossible to determine whether the posture, scene, or their combination accounted for observed confusability effects (see also Aviezer, Hassin, & Bentin, 2012; Aviezer et al., 2009; Aviezer, Bentin, Duradev, & Hassin, 2011).

This study further examined the confusability effect by comparing the effects of isolated emotion body postures and emotion body postures embedded in emotion scenes on adults' emotion categorizations of disgust facial expressions. A face-scene condition was omitted because the combination appeared unnatural and previous research indicates minimal confusability effects in such conditions (Righart & de Gelder, 2008). Consistent with previous research, we predicted that contextual emotion cues (i.e., posture or posture-scene) would influence participants' categorizations of disgust facial expressions as a function of the emotion expressed by each contextual cue. Additionally, we predicted that posture-scene combinations would result in increased miscategorization of disgust faces than posture alone.

Method

Stimuli

Stimuli Components. Emotional elements consisted of facial expressions, emotion postures, and emotion scenes. All stimuli were validated independently to ensure that each component communicated the intended emotion.

Facial Expressions. Six images of six actors (3 female) from diverse racial backgrounds (2 Asian, 2 Black, 2 White) conveying the facial expression of disgust were taken from the

NimStim set of facial expressions (Tottenham et al., 2009; see Supplementary Materials, Table 1. Using multiple well-validated facial expressions minimized familiarization effects and allowed us to collapse across actors in the analyses.

Emotion Postures. Ten images of two actors (1 female) posturally expressing five emotions (disgust, anger, sadness, fear, joy) were selected from a validated set of postural stimuli (Lopez, Reschke, Knothe, & Walle, 2017; see Supplementary Materials, Table 2). Additionally, two neutral postures (1 female) were validated using dimensional ratings of valence and arousal (Russell, Weiss, & Mendelsohn, 1985; see Supplementary Materials, Table 3).

Emotion Scenes. Scene images consisted of 18 pictures depicting 6 emotions (disgust, anger, sadness, fear, joy, neutral) with 3 exemplars per emotion to minimize familiarization effects (see Supplementary Materials, Table 4). All scene stimuli were accurately recognized as depicting the intended emotion (range: 76%-100%). Scene stimuli within emotion categories were rated similarly in affective valence and arousal, thus allowing scenes to be collapsed by emotion category in the analyses.

Stimuli Combinations. The above emotional elements were used to create face-posture combinations and face-posture-scene combinations (See Supplementary Materials, Figure 1).

Face-Posture Stimuli. Facial expressions were superimposed onto body postures in a white background using Adobe Photoshop, resulting in the creation of 36 distinct face-posture stimuli.

Face-Posture-Scene Stimuli. Face-posture combinations were embedded into emotion scenes that were congruent with the posture (e.g., disgust face on a joy posture in a joy scene), resulting in 108 unique face-posture-scene composites (6 posture-scene emotions x 6 actors x 3 scene exemplars).

Participants

Undergraduate students at a research university took part in the study in exchange for course credit. All participants were fluent English speakers. Separate samples were included to avoid familiarity effects that may have resulted from participants seeing the same face-posture image multiple times.

Face-Posture Ratings. The face-posture condition included 24 participants (11 female; M_{age} = 19.29 years, SD = 1.28). Nine participants were Hispanic, 5 were Asian, 2 were African American, 2 were Caucasian, 3 were of mixed ethnicity, and 1 did not report information on ethnicity.

Face-Posture-Scene Ratings. The face-posture-scene condition included 22 participants (8 female; M_{age} = 19.68 years, SD = 1.70). Fifteen participants were Hispanic, 4 were Asian, 1 was African American, 1 was Pacific Islander, and 1 was of mixed ethnicity.

Procedure

Stimuli were presented in grayscale. Participants were randomly assigned to the face-posture condition *or* face-posture-scene condition. Participants in the face-posture condition viewed all 36 face-posture stimuli (6 congruent, 30 incongruent). Participants in the face-posture-scene condition viewed only 36 of the 108 face-posture-scene stimuli (6 congruent, 30 incongruent) to ensure that any difference between conditions was due to the addition of scene and not the number or congruency of images rated. Each block of 36 face-posture-scene stimuli was counterbalanced by actor, posture-scene, and scene exemplar. This ensured that participants in both conditions saw each actor six times and each posture six times, with participants in the posture-scene condition seeing each scene exemplar only twice (once per actor gender).

The study took place in a campus computer lab with participants seated at separate computers with 20" monitors. Participants first completed a demographics questionnaire. Next, stimuli were displayed to each participant in a random order with the prompt, "Select the emotion that best describes the facial expression," with 5 options displayed vertically below the image: joy, sadness, fear, anger, disgust. Participants could take as much time as needed to respond. The entire survey took approximately 10 minutes. Procedures were approved by the Institutional Review Board of the University of California, Merced.

Results

Participants' emotion categorizations organized by condition (Face-Posture and Face-Posture-Scene) are provided in Table 1.

Participants' categorizations of disgust facial expressions were analyzed using two distinct measures common in studies of face perception: (a) *accuracy* (i.e., the percentage of categorizations matching the face), and (b) *contextual influence* (i.e., the percentage of categorizations matching the posture or posture-scene). Accuracy and contextual influence were analyzed separately for each condition (i.e., Face-Posture, Face-Posture-Scene) using a repeated-measures analysis of variance with Emotion as a within-subjects factor. Subsequent Bonferroni-corrected pairwise comparisons ($\alpha = .003$) examined differences between emotion contexts. Preliminary analyses revealed no significant effects of image gender or participant gender (Fs < 2.84, ps > .09); thus, subsequent analyses collapsed these factors.

Face-Posture Condition

Accuracy. Participants' disgust ratings varied significantly as a function of Emotion, $F(5, 858) = 20.52$, $p < .001$, $\eta_p^2 = .11$ (see Table 2). Pairwise comparisons revealed that participants were significantly more accurate in disgust contexts than other contexts (ps < .002) and

significantly less accurate in anger contexts than other contexts (*p*s < .001). Participants' accuracy did not differ significantly between the other contexts (*p*s > .14).

Contextual Influence. Participants' ratings matching the context varied significantly as a function of Emotion, $F(4, 715) = 73.99$, $p < .001$, $\eta_p^2 = .29$ (see Table 2). Pairwise comparisons revealed that participants' categorizations were influenced by postural elements significantly more in anger contexts than sadness, fear, and joy contexts (*p*s < .001), and significantly more in sadness and fear contexts than joy contexts (*p*s < .001). Contextual influence in sadness and fear contexts did not differ significantly ($p = .17$), nor did it differ significantly between anger and disgust contexts ($p = .89$).

Face-Posture-Scene Condition

Accuracy. Participants' disgust ratings varied significantly as a function of Emotion, $F(5, 786) = 22.85$, $p < .001$, $\eta_p^2 = .12$ (see Table 2). Pairwise comparisons revealed that participants were significantly more accurate in disgust contexts than all other contexts (*p*s < .001) and were significantly less accurate in anger contexts than other contexts (*p*s < .001). Participants' accuracy did not differ significantly between the other emotion contexts (*p*s > .24).

Contextual Influence. Participants' ratings matching the context varied significantly as a function of Emotion, $F(4, 655) = 40.00$, $p < .001$, $\eta_p^2 = .20$ (see Table 2). Pairwise comparisons revealed that participants' categorizations were influenced by posture-scene elements significantly more in anger contexts than sadness and joy contexts (*p*s < .001), and significantly more in sadness and fear contexts than joy contexts (*p*s < .001). However, the influence of posture-scene in fear contexts did not differ significantly from anger ($p = .004$) or sadness contexts ($p = .34$). Additionally, contextual influence did not differ significantly between anger and disgust contexts ($p = .68$).

Comparing Posture and Posture-Scene

Pairwise comparisons examined differences in accuracy and contextual influence between conditions (face-posture vs. face-posture-scene) for each context emotion (see Table 2).

Accuracy. Disgust categorizations were significantly lower in the posture-scene condition than the posture condition for contexts of sadness ($p = .03$), fear ($p = .01$), and neutral ($p = .01$). No other comparisons between conditions were statistically significant ($ps > .88$).

Contextual Influence. Categorizations matching the non-face emotion were significantly enhanced by the addition of scene for contexts of sadness ($p = .01$), fear, *(*$p = .02$), and joy *(*$p < .001$). Importantly, posture-scenes categorically shifted participants' perception of disgust faces in fear and sadness contexts from predominantly matching the face to matching the context. No other comparisons between conditions were statistically significant ($ps > .28$).

Discussion

In support of our hypotheses, participants' categorizations of disgust facial expressions varied as a function of the emotion depicted by the contextual elements in the face-posture condition. Specifically, posture alone was sufficient to elicit the confusability effect for anger contexts, but not fear, sadness, or joy contexts. The addition of scene resulted in a stronger confusability effect than posture alone for the sadness and fear contexts, but not for disgust, anger, or joy contexts. Importantly, the addition of scene with posture resulted in a categorical shift in the perception of disgust faces embedded in fear and sadness contexts not previously documented.

These findings have important contributions for research on emotion perception. First, activating the confusability effect may require a sufficient amount of contextual information, with emotions lower in perceptual similarity with the target facial expression (e.g., sadness and

fear in the case of disgust) requiring more contextual information (e.g., posture *and* scene) than emotions higher in perceptual similarity (e.g., anger; Susskind et al., 2007). Interestingly, disgust faces combined with joy posture-scenes were rarely miscategorized. This aligns with research suggesting that the perception of emotional valence shifts categorically across valence only when the observed facial expressions are of extremely high intensity (Aviezer, Trope, & Todorov, 2012).

Moreover, our findings suggest that emotion perception involves appreciating how emotional elements relate with one another. For example, the shift in sadness categorization necessitated a scene to push the viewer beyond seeing a face and instead seeing the relational significance of the individual with the environment. This lends support for emotion theory (e.g., Barrett & Campos, 1987), paradigms (e.g., Carstensen, Gottman, & Levenson, 1995), and coding approaches (e.g., Coan & Gottman, 2007) that contextualize emotional communication. Furthermore, the findings are informative for helping individuals who struggle with emotion perception, as many interventions typically emphasize the face (e.g., Tanaka et al., 2012), and for examining the role of contextual cues in emotion perception across different cultures (e.g., Masuda et al., 2008).

Limitations and Future Directions

There are myriad other non-facial components involved in emotion perception not examined in the current study. These include vocal affect (e.g., de Gelder & Van den Stock, 2011), interpersonal relations (e.g., Mumenthaler & Sander, 2012), situational information (e.g., Carroll & Russell, 1996), personal history (e.g., Lagattuta, 2014), and implicit biases of the perceiver (e.g., Phelps et al., 2000). Research examining how such elements influence emotion perception, particularly with less caricatured expressions, is needed.

Additionally, our use of congruent pairings of non-facial cues limits our understanding of how various cues interact to influence emotion perception. Different combinations of emotion-related elements (e.g., face, posture, scene, voice) may differentially influence emotion perception, particularly when such cues are incongruent (e.g., a disgust face on a fear posture in a sad scene; e.g., Kret & de Gelder, 2010). Furthermore, specific combinations of contextual elements may result in the perception of emotions not identified when the components are viewed in isolation.

Finally, it is possible that participants used processes of elimination to determine the expressed emotion (see Nelson & Russell, 2016) or were biased by the presence of specific emotion terms (see Lindquist & Gendron, 2013). Including additional emotion choices (e.g., pride) may have yielded different results. The emotion choices also may have prevented identification of shades of specific emotions or emotion blends (see Larson, 2017; Plutchik, 2001), such as contempt or bittersweet. Allowing participants to free-label the images could capture such gradation and nuance in emotion perception.

Conclusion

As research moves toward understanding emotions in context, caution is needed to ensure that researchers not fall into the trap that long ensnared the study of facial affect. Specifically, there is no single, all-important component of emotion perception. As evident in the present study, even the influence of “context” differs across contexts. We encourage that future research examine the interrelations between sources of contextual information to further improve our understanding of emotion perception.

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Table 1

Proportion agreement of emotion categorizations of disgust facial expressions on emotion postures or emotion posture-scene combinations

	Emotion Categorization				
Posture	Disgust	Anger	Sadness	Fear	Joy
Disgust	0.75	0.05	0.03	0.17	0.00
Anger	0.20	0.74	0.04	0.02	0.00
Sadness	0.49	0.09	0.36	0.06	0.00
Fear	0.52	0.06	0.00	0.42	0.00
Joy	0.47	0.31	0.13	0.06	0.03
Neutral	0.56	0.13	0.26	0.04	0.01
Posture + Scene					
Disgust	0.76	0.14	0.08	0.01	0.01
Anger	0.17	0.73	0.08	0.02	0.00
Sadness	0.36	0.09	0.52	0.01	0.02
Fear	0.36	0.04	0.03	0.57	0.00
Joy	0.43	0.24	0.16	0.02	0.15
Neutral	0.40	0.20	0.35	0.04	0.01

Table 2

Raw mean accuracy and contextual influence for the Face-Posture and Face-Posture-Scene conditions

Context	Posture Only	Posture + Scene	*t*	*p*	Cohen's *d*	95% CI *LL*	95% CI *UL*
			Accuracy				
Disgust	0.75$_a$	0.76$_a$	0.15	.88	0.05	-0.11	0.10
Anger	0.19$_b$	0.17$_b$	0.59	.56	0.18	-0.07	0.12
Sadness	0.49$_c$	0.36$_c$	2.18	.03	0.66	0.01	0.25
Fear	0.52$_c$	0.36$_c$	2.65	.01	0.80	0.03	0.27
Joy	0.47$_c$	0.43$_c$	0.67	.51	0.20	-0.08	0.16
Neutral	0.56$_c$	0.40$_c$	2.58	.01	0.78	0.03	0.27
			Contextual Influence				
Disgust	0.75$_a$	0.76$_a$	0.15	.88	0.05	-0.11	0.10
Anger	0.74$_a$	0.73$_a$	0.16	.88	0.05	-0.10	0.12
Sadness	0.35$_b$	0.52$_b$	2.72	.01	0.82	-0.28	-0.04
Fear	0.42$_b$	0.57$_b$	2.42	.02	0.73	0.02	0.27
Joy	0.03$_c$	0.14$_c$	3.55	< .001	1.07	-0.18	-0.05

Note: Letters next to each percentage designate which Bonferroni-corrected vertical comparisons were significantly different within accuracy and contextual influence.

Supplementary Table 1

Validation of facial expression stimuli (proportion agreement)

	Female-07	Female-14	Female-17	Male-36	Male-40	Male-45
Disgust	0.98	1.00	0.96	0.91	0.98	1.00

Note: Validation data for models 07-40 are from Tottenham et al. (2009). Model 45 is not reported in Tottenham et al. (2009), but is provided as part of the stimuli set. Thus, validation data for model 45 are from a group of 25 UC Merced undergraduates (9 Male, 16 Female, Age: 18-22).

Supplementary Table 2

Validation of postural stimuli

Emotion Posture	Model Gender	Proportion Agreement
Disgust	Female	1.00
	Male	1.00
Anger	Female	0.76
	Male	0.81
Sadness	Female	1.00
	Male	0.95
Fear	Female	0.95
	Male	1.00
Joy	Female	1.00
	Male	1.00

Note: Validation data are from Lopez, Reschke, Knothe, & Walle (2017).

Supplementary Table 3

Dimensional validation of neutral postural stimuli

		Dimensions	
	Model Gender	Valence	Arousal
Neutral	Female	5.00	4.73
	Male	4.94	5.00

Note: Neutral postures were validated using dimensional ratings of valence and arousal by a sample of 21 undergraduate students (12 female; M_{age} = 19.05 years, *SD* = 1.28). The dimensional scales ranged from 1 (negative valence, low-arousal) to 9 (positive valence, high-arousal).

Supplementary Table 4

Descriptions and validation data for emotion scene stimuli

Emotion Scene	Name	Proportion Agreement	Dimensions	
			Valence	Arousal
Disgust	Overflowing Toilet	1.00	1.21	6.53
	Garbage in Street	1.00	1.29	6.38
	Dirty Dumpsters	0.90	1.67	6.22
Anger	Car Boot	0.76	1.58	7.00
	Dog Ripped Couch	0.81	1.28	7.50
	Shopping Cart Dents Car	0.81	2.00	7.05
Sadness	Funeral	1.00	1.00	5.94
	Burial	0.95	1.00	4.71
	Child funeral	1.00	1.05	4.95
Fear	Alligator	0.95	1.83	8.28
	Dog in Park	1.00	1.82	8.35
	Dog in Alley	1.00	1.16	7.74
Joy	Car Gift	1.00	9.00	8.88
	Table with Presents	1.00	8.88	8.41
	Birthday Party	0.95	8.26	7.84
Neutral	Conference Room	-	4.81	3.38
	Empty Room	-	4.89	4.11
	Hallway with Escalator	-	5.65	4.55

Note: Categorization data were provided by 26 undergraduate students (18 female; M_{age} = 21.15 years), who indicated which of the following five emotions was communicated: joy, sadness, fear, anger, disgust. Dimensional data were provided by 21 undergraduate students (12 female; M_{age} = 19.05 years, *SD* = 1.28). The scale for Valence and Arousal ratings center on 5 and range from 1 (negative valence / low-arousal) to 9 (positive valence / high-arousal).

A

B

C

D

E

F

Supplementary Figure 1. Examples of posture and posture-scene stimuli. All stimuli feature disgust facial expressions. (A) Disgust posture and posture-scene. (B) Anger posture and posture-scene. (C) Sadness posture and posture-scene. (D) Fear posture and posture-scene. (E) Joy posture and posture-scene. (F) Neutral posture and posture-scene.