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Inherently Ambiguous: Facial Expressions of Emotions, in Context

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Abstract

With a few yet increasing number of exceptions, the cognitive sciences enthusiastically endorsed the idea that there are basic facial expressions of emotions that are created by specific configurations of facial muscles. We review evidence that suggests an inherent role for context in emotion perception. Context does not merely change emotion perception at the edges; it leads to radical categorical changes. The reviewed findings suggest that configurations of facial muscles are inherently ambiguous, and they call for a different approach towards the understanding of facial expressions of emotions. Prices of sticking with the modal view, and advantages of an expanded view, are succinctly reviewed.

Keywords
basic emotions, body perception, context, emotion perception

Since the second half of the 20th century the cognitive sciences enthusiastically endorsed the idea that there are *basic* facial expressions of emotions, that these basic expressions are *universal*, and that they are created by specific configurations of *facial muscles* (Ekman, 1972, 1993; Izard, 1971, 1994). Hence studying emotional expressions of isolated faces dominated the scientific inquiry of emotion perception, first in social and cognitive psychology and more recently in social and cognitive neuroscience. Although in recent decades there have been a growing number of alternative approaches (Aviezer, Hassin, Bentin, & Trope, 2008; Barrett, Lindquist, & Gendron, 2007; Carroll & Russell, 1996; Meeren, van Heijnsbergen, & de Gelder, 2005), it is fair to say that, to date, the cognitive- and neurosciences are still largely under the influence of the basic expressions view.

We review evidence from various laboratories that strongly suggests an inherent role for context in the processing of facial expressions (given space constraints we only highlight key findings; for more exhaustive reviews see Ambady & Weisbuch, 2011; Russell, 1997). In some cases the context is powerful enough to lead to a categorical shift in the perceived emotion, thereby turning what seems to be an unequivocally disgusted face into a similarly unequivocal angry face (to take just one example). These findings cannot be easily accommodated in the basic expressions view, and they call for a different understanding of facial expressions of emotions.

We do not dispute the empirical fact that some facial expressions yield consensual categorizations; that is, people tend to agree that they express a specific emotion. We note, however, that these reactions characterize emotion perception of bodiless

Author note: Shlomo Bentin died in a car accident after this paper was accepted for publication, but before it was published. Shlomo was one of a kind and we loved working with him. He will be sorely missed.
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and out-of-context faces, which were carefully posed, meticulously piloted, and tested in consensus-increasing paradigms (Russell, 1994). Nor do we dispute the important discoveries that this view yielded and is likely to continue to yield. We simply propose that this view (like all scientific dogmas) is limited, that "basic" facial expressions are not as basic as they may seem, that their role is overemphasized, and that this emphasis has costs.

A few definitions before we continue. The processes we review here go by many names (e.g., emotion perception, recognition). For ease of discussion we will use one term: face-based emotion categorization (henceforth: FEC). We use "context" to denote any cue that is external to the face, and we use "basic expression" to denote an expression of one of the so-called basic emotions. Throughout this paper we use the basic expressions lingo (e.g., we refer to *fearful faces*). These expressions should be read as shorthand for: faces that, in isolation, and when one uses the frequently used categorization methods, are likely to be categorized as X (e.g., fearful).

Faces in Context

The controversy regarding basic facial expressions (and their universality) is in no way new. Duchenne (1872/1990) applied electro-muscular stimulation to the face and re-created compelling facial expressions, despite the fact that his subjects experienced no emotion. Facial expressions, he argued, revealed the *uniquely human*, *universal*, *god-given* gift of emotional communication (Bell, 1824; Fridlund, 1994). A few years later Darwin (1872) argued against the idea that facial expressions are *divinely* created and *uniquely* human yet he, too, may be read as suggesting that there are *basic and universal* facial expressions.

Early 20th Century

The picture began to change early in the 20th century. Consider, for example, the influential work of Landis (1929), who photographed the facial expressions of participants whilst they were engaged in emotionally evocative situations (such as surprise firecrackers exploding under their chair). He then presented the images to a new group of participants, and asked them to describe the photographed person's emotion. Landis's conclusions were unequivocal: "it is practically impossible to name accurately the 'emotion' being experienced by a subject when one has only a photograph of the face" (p. 69).

Other studies did not yield such extreme conclusions, but nevertheless demonstrated an important role for context. Goodenough and Tinker (1931) paired facial expressions with short stories that implied various emotions, and their results showed that verbal contexts affected the attribution of emotional states. A decade later Munn (1940) used a different approach: He presented participants with candid pictures from magazines such as *Life*. In one condition the faces were presented in isolation (e.g., a fearful face), and in another they were embedded in a full visual scene (e.g., a fearful face displayed by a woman fleeing an attacker). His results, too, indicated the importance of context.

These and other studies were integrated in two highly influential reviews by Tagiuri and colleagues (Bruner & Tagiuri, 1954; Tagiuri, 1969), who concluded that "all in all, one wonders about the significance of studies of the recognition of 'facial expressions of emotions', in isolation of context" (Bruner & Tagiuri, 1954, p. 638).

Late 20th Century

The basic expressions view received its full scientific renaissance with the works of Tomkins (1962), who inspired the work of Ekman (1972) and Izard (1971). The theoretical hallmark of this theory is the postulation of a small number of bio-behavioral, innate (Izard, 1994) basic emotion programs (e.g., fear, anger), each equipped, by definition, with a discrete and characteristic facial expression which is universally recognizable (Ekman, 1993). A basic premise of this view is that specific emotional categories can be directly "read out" in a bottom–up manner from the configuration of the facial expression musculature (Buck, 1994; Nakamura, Buck, & Kenny, 1990).

The impact of this research paradigm cannot be overestimated. To illustrate, a commercially available set of emotional faces developed by Ekman and Friesen (1976) has been cited over 1,850 times. More importantly, the basic emotion paradigm has shaped the way generations of scientists think and test facial expressions of emotion, while at the same time deeply permeating popular culture (e.g., the basic expression view forms the basis of the TV series *Lie to Me*).

This view has not gone uncontested, though. Russell (1980) proposed that the building blocks of emotions, and emotional expressions, are affective dimensions (henceforth: the dimensional view). According to Russell, emotions (and their expressions) are points on a two-dimensional space, created by the two bipolar dimensions of valence and arousal (Russell, 1980, 2003; Russell & Barrett, 1999).

Based on this view, Russell and Bullock (1986) and Russell (1997) suggested a two-stage model. In the first stage, valence and arousal are rapidly and effortlessly read from the face. In a second stage, dimensional values are transformed into more specific emotional labels. The latter process takes as input the values of valence and arousal, but also—and more importantly for our purposes—contextual information and top–down processing (Larsen & Diener, 1992; Lindquist, Barrett, Bliss-Moreau, & Russell, 2006; Russell, 2003). Using this model Russell and his colleagues could predict when contexts affect FEC more (vs. less), predictions that were partially tested using the Goodenough–Tinker paradigm (Carroll & Russell, 1996). In the following years the Goodenough–Tinker paradigm became quite popular, and the results indeed varied from face- to context-dominance (Carroll & Russell, 1996; Fernández-Dols & Carroll, 1997; Matsumoto, Hwang, & Yamada, 2010; Nakamura et al., 1990).

Early 21st Century

The topic of contextualized emotion perception has regained new interest in recent years. Halberstadt and colleagues, for example, examined the role of the encoding context on FEC (Halberstadt, 2005; Halberstadt & Niedenthal, 2001; Halberstadt, Winkielman, Niedenthal, & Dalle, 2009). In their studies, participants viewed an ambiguous angry/happy facial expression while trying to silently explain in their head why the target person could be angry (or other negative concepts) versus happy (or other positive concepts). Later, participants viewed short movies in which the target's face changed gradually from anger to happiness, and were asked to freeze each movie at the precise image seen at the first stage. As predicted, the context in which the ambiguous face was encoded created a systematic shift (Halberstadt & Niedenthal, 2001).

Another paradigm that enjoyed renewed renaissance is that of manipulating visual context. In one such study, participants were required to categorize facial expressions which were presented against backgrounds of natural scenes (e.g., a garbage dump vs. a field of flowers; Righart & de Gelder, 2008). The results showed a significant effect of context on FEC. In a related set of experiments, Masuda et al. (2008) examined how FEC of a target's facial expression is affected by the presence of surrounding individuals. Participants viewed a cartoon image of a central figure displaying, for example, an angry face, while in the background a group of other individuals displayed happiness. The results indicated that Japanese were influenced by the surrounding context, whereas Westerners were not, thereby demonstrating two types of context effects: visual and cultural.

Strong objections to the basic expressions view were repeatedly voiced by Lisa Feldman Barrett and her colleagues. Barrett (2006) proposed *the conceptual act* model, in which facial muscles convey basic affective information (e.g., approach vs. avoid) and more specific emotions are inferred using accessible conceptual context (i.e., words). In one set of studies, the role of accessibility was examined using a semantic satiation procedure. The results showed that participants' performance depended on conceptual satiation (Barrett et al., 2007; Lindquist et al., 2006). More recent studies supported other predictions of this model (Barrett & Kensinger, 2010).

When Faces Have Bodies

In our own work we examined the effects of body language and contextual paraphernalia on FEC. We focused on bodies because we had an intuition that faces are usually accompanied by bodies, and that bodies, like faces, are expressive. We were also encouraged by the fact that face and body processing share many cognitive and brain characteristics (de Gelder, 2006; Peelen & Downing, 2005; Yovel, Pelc, & Lubetzky, 2010).

We proposed two simple hypotheses. First, based on the arguments briefly presented earlier, we predicted that bodies would serve as powerful contexts. Second, we hypothesized that perceptual similarity—that is, the perceived similarity between facial expressions—is an important determinant of context effects. To take an example, the categorization of a smiling face is unlikely to be strongly affected by a context displaying disgust, because the two facial expressions (happiness, disgust) are very dissimilar. An angry face, however, is more likely to be affected by disgust context because the facial expressions of anger and disgust are relatively similar (Susskind, Littlewort, Bartlett, Movellan, & Anderson, 2007).

In our first set of studies, we seamlessly planted faces which in isolation are consensually categorized as conveying disgust on bodily postures that in isolation are consensually categorized as conveying other emotions (Aviezer, Hassin, Bentin, & Trope, 2008). This resulted in a design with four levels of perceptual similarity: low, medium, high, and an identity (disgust face on a disgust body). Participants in all experiments were asked to choose, amongst six options, which emotion is conveyed by *the face*.

Three experiments documented powerful effects of context on FEC, and showed that the impact of context in the high similarity condition was robust. For example, the categorization of "disgust facial expressions" as disgust-expressing dropped from 91% in the identity condition to a mere 11% in the high-similarity condition. Similarly, the categorization of "sadness expressions" dropped from 72% in the identity condition to a mere 17% in the high-similarity condition (Aviezer et al., 2009; Aviezer, Hassin, Bentin, & Trope, 2008; Aviezer, Hassin, Ryan, et al., 2008). Supporting our second hypothesis, these experiments revealed that the magnitude of contextual influence was strongly correlated with the degree of perceptual similarity: The more similar the facial expressions, the stronger the influence of context. We refer to this finding as the *confusability effect*.

Early and Automatic

The categorization data do not tell us much about the underlying process: Does context affect late and relatively controlled stages of processing (e.g., the judgment) or relatively early and automatic ones? Support for the latter view emerged from an eye-tracking experiment which demonstrated that initial fixations in the face space are strongly affected by the context (Aviezer, Hassin, Bentin, & Trope, 2008). Specifically, context shifts the scanning pattern of emotional expressions in context-congruent ways. To further examine this issue we conducted a series of experiments in which we examined three markers of automaticity: intentionality, stoppability and effortlessness (Bargh, 1994). In one of these experiments participants viewed the stimuli described earlier and were instructed in various ways, and motivated by means of a monetary prize, to avoid using the bodies. Neither motivation nor instructions made a difference. The results of another experiment showed that the effects of bodily context do not diminish under cognitive load (Aviezer, Bentin, Dudarev, & Hassin, 2011).

Taken together, then, these studies suggest that the process of integrating bodies and faces is automatic. This work also sheds light on another aspect of the underlying process. In some component appraisal theories (e.g., Scherer, Mortillaro, & Mehu, 2013), physical similarity brings with it appraisal

similarity. Which of the two is at work here? While dissociating the two may prove to be difficult, the results of this series of studies—especially those in which we applied load—suggest that effortful appraisals are not necessary for obtaining our context effects.

An objection. One might argue that the stimuli we created are artificial and unnatural, and hence that the conclusions that can be drawn from them are limited (Matsumoto & Sung Hwang, 2010). There are at least two reasons to reject this argument. First, we see no reason to a priori assume that these face–body combinations are unnatural, and we know of no data to support this postulation. While intuition may suggest that we usually do not experience incongruency between faces and bodies ("oh, this guy has a fearful face yet disgusted body"), we note that this intuition is not very telling: The high-confusability combinations do not result in felt incongruency too; they simply feel . . . natural.

Second, even if we were to agree with the premise—that is, that the stimuli we used are rare in "real life"—we cannot agree with the conclusion. Testing the cognitive system at its boundaries is crucial for the scientific investigation of the mind. This is why we also think that studying faces in isolation—stimuli that intuition suggests are not very frequent in "real life"—is important for understanding emotion perception.

Faces on Bodies: New Discoveries

We argued in the introduction that the study of FEC stands to gain from expanding the focus of investigation. One area in which our approach has already led to new theoretical gains is in the characterization of deficits of neuropsychological conditions. To take one example, when examined with faces in isolation, individuals with pre-symptomatic Huntington Disease (HD) show impairments in explicit categorization of emotional faces, particularly disgust (Gray, Young, Barker, Curtis, & Gibson, 1997; Sprengelmeyer et al., 1997). Traditionally, data of this sort were taken to mean that these patients have a fundamental impairment in FEC. Using our stimuli, however, we showed that the patients' *confusability effect* (that is, the diminishing effect of context as a function of a decrease in expression similarity) was normal (Aviezer et al., 2009). It seems reasonable to assume that low-level processing of facial expressions is a prerequisite for the confusability effect, as is the process(es) that integrates faces and contexts. Hence we take our results to suggest that these processes are intact in HD pre-symptomatic patients, and that their deficits lie elsewhere. This fine-grained analysis opens the way for a more thorough understanding of the deficits that characterize HD patients on the one hand, and emotion perception in general on the other. Using similar logic we were able to gain new insights into the cognitive deficits of LG, a patient with a rare form of developmental visual agnosia (Aviezer, Hassin, & Bentin, 2011).

Interim summary: Faces and bodies. Taken together, the evidence suggests that bodily contexts play a crucial role in FEC and that FEC is more complex than the modal view assumes. Our results imply that facial expressions of emotions are inherently ambiguous, not in the sense that, in isolation, they look amorphous, but rather that context can easily shift their categorization. This ambiguity is structured: it is constrained by similarity. When facial expressions are very similar, context can easily swing FEC from one category to another. When they are less similar, the context is less powerful (but still quite potent). One possible mechanism for the integration of contexts and faces involves eye movements. Bodily contexts can shift the scanning of faces, from scanning patterns of one emotion to those of another. Furthermore, new results from our laboratory suggest that context has similar effects on attention (Dudarev, Aviezer, Bentin, & Hassin, 2012), so it is possible that attention and eye movements work together on this task.

Basic Expressions Revisited

We reviewed evidence from multiple research projects in numerous laboratories, all providing support for the idea that contexts play an important role in FEC. There is no doubt that the class of models that is implied by these findings is more complex than the basic expressions view (for a possible model, see, Aviezer, Hassin, Ryan, et al., 2008). Although parsimony suggests that simpler models should be preferred, one has to weigh the gains of simplicity against its costs. In the previous section we detailed some advances that could not have been made within the basic expressions view; in the following paragraphs we outline possible costs for sticking with it.

First, consider the wide-scale attempts to link specific emotions to well-defined brain structures. In recent decades we experienced a few "highs," during which it seemed that research successfully identified brain regions that specialize in basic emotions (Adolphs, 2002; Calder, Lawrence, & Young, 2001; Sprengelmeyer et al., 1997). Yet it seems fair to say that the news about (some of) these identifications was premature, and that currently, the picture seems more complex than it had appeared (Barrett, 2006; Johnson et al., 2007; Pessoa & Adolphs, 2010). Given the centrality of this endeavor to social and affective neurosciences, and given the time and resources devoted to it, this state of affairs might be informative. It may suggest, for example, that our current techniques of probing the brain are not sufficiently developed, or that we use the wrong level of analyses. More relevant to our discussion, however, these difficulties may partly stem from assuming the basic expressions view, which leads us to look for brain areas (or neural patterns) specialized in FEC of "basic expressions." But if the task of categorizing faces is not as simple as is suggested by this view, then performing it may require more complex processes, and maybe even (explicit) strategies. Hence FEC may rely on more general mechanisms of inference and categorization, thereby rendering the difficulties in locating brain areas devoted to the processing of "basic expressions" less surprising.

Second, consider the question of whether FEC can occur without conscious awareness of the face. Until very recently the evidence for non-conscious FEC was mixed, at best. Crudely summarizing it, it suggests that we can non-consciously discriminate between positive expressions (aka, smiles) and negative ones (all the rest), but not much more (Eastwood & Smilek, 2005; Moradi, Koch, & Shimojo, 2005). From the perspective of the basic expressions view, these failures mean that unconscious processes cannot recognize clear and unequivocal objects.

These failures, then, indicate severe limitations. From the current perspective, however, this failure is not that simple. If FEC requires complex computations and strategies, then it may require more time and resources than those available in typical subliminal priming experiments. And indeed, recent evidence from experiments that use continuous flash suppression, a technique that allows for very long subliminal presentations, provides partial support for the prediction that unconscious processes can indeed distinguish between various emotional expressions (Jiang & He, 2006; Sterzer, Hilgenfeldt, Freudenberg, Bermpohl, & Adli, 2011; Yang, Zald, & Blake, 2007). These recent developments illustrate, once again, the potential costs of sticking with the basic expressions view.

Coda

The accumulated evidence shows that reading facial expressions is not as simple and straightforward as the basic expression view assumes. Facial expressions of emotions are inherently ambiguous, so much so that some contexts easily shift FECs one way or the other. So although it seems to us that in "real life" we *see faces* as angry, fearful, and so forth, it is not the faces that we see, it is face-context combinations. We are old enough to refrain from recommending that scientists of the mind stop using terms such as, for example, *fearful facial expression*. People, present company included, would not. But we note that, theoretically, this is the right thing to do. The expression *fearful face* (for example) should be taken as shorthand for *a face that, in isolation, and when one uses one of the frequently used categorization methods, is somewhat likely to be categorized as fearful*. The reviewed evidence should provide strong incentive to expand the cognitive, social, and neuroscientific inquiry of the nature of emotion categorization. A few examples of the possible gains inherent in an expanded approach were described.

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