The "Disgust Face" Conveys Anger to Children

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What does the "facial expression of disgust" communicate to children? When asked to label the emotion conveyed by different facial expressions widely used in research, children ($N = 84$, 4 to 9 years) were much more likely to label the "disgust face" as *anger* than as *disgust*, indeed just as likely as they were to label the "angry face" as *anger*. Shown someone with a disgust face and asked to generate a possible cause and consequence of that emotion, children provided answers indistinguishable from what they provided for an angry face—even for the minority who had labeled the disgust face as *disgust*. A majority of adults ($N = 22$) labeled the same disgust faces shown to the children as *disgust* and generated causes and consequences that implied disgust.

Keywords: disgust, anger, facial expressions, understanding

Parents and psychologists alike assume that a child, even as a baby, can read others' emotions from their facial expressions. This ability has been thought to be essential to mother–infant interaction and to provide the bedrock on which the child builds knowledge about emotion. Much psychological theory and research specifically presupposes that a young child interprets certain facial expressions in terms of discrete "basic" emotions, indeed, the same emotions an adult would read from these facial expressions, and that (barring deception) these facial displays represent the expresser's true emotions. That is, the child correctly interprets the "happy face" as happy, the "sad face" as sad, the "disgust face"—which is the topic of the present study—as disgust, and so on.

Although the evidence is far from definitive, much evidence has been interpreted as consistent with this assumption. Infants as young as 5 months who have been habituated to one type of facial expression dishabituate when shown a new type (Bornstein & Arterberry, 2003; Izard, 1971; Ludemann, 1991; Nelson & Dolgin, 1985; Serrano, Iglesias, & Loeches, 1992, 1995; Thomas, De Bellis, Graham, & LaBar, 2007; Walker-Andrews, 1997). This early sensitivity to changes in facial expression has been cited as contributing to the development of the mother–infant relationship (e.g., Bowlby, 1969, 1988; Izard, 1971; Montague & Walker-Andrews, 2001; Muir, Lee, Hains, & Hains, 2005). By 12 months, infants also use the facial expressions of others to decide whether to approach or avoid an object (e.g., Hornik, Risenhoover, & Gunnar, 1987; Klinnert, Campos, Sorce, Emde, & Svejda, 1983; Klinnert, Emde, Butterfield, & Campos, 1986; Moses, Baldwin, Rosicky, & Tidball, 2001; Mumme & Fernald, 2003; Repacholi, 1998). After 18 months, children begin to speak about emotions in a surprisingly sophisticated manner (Bretherton & Beeghly, 1982; Ridgeway, Waters, & Kuczaj, 1985; Wellman, Harris, Banerjee, & Sinclair, 1995). Still other research has been interpreted as showing that preschoolers can categorize facial expressions, attribute different emotions to them, and match stereotypical emotional situations to them (e.g., Denham & Couchoud, 1990; Harrigan, 1984; Izard, 1971; Markham & Adams, 1992; Vicari, Reilly, Pasqualetti, Vizzotto, & Caltagirone, 2000; Wiggers & van Lieshout, 1985), although not in an adult-like manner (Widen & Russell, 2003, 2008a). Although the research cited so far establishes that children perceptually distinguish between different types of expressions and find some emotional meaning in them, it has not pinpointed the precise meaning that young children find in a facial expression. Exploring that question is the general motive behind the present study.

Another source for the assumption that young children can read facial expressions is the theory that facial expressions for what have been called basic emotions evolved as part of an emotion signaling system (Ekman, 1972; Izard, 1971; Tomkins, 1962). This evolutionary account requires not just the production of emotion-signaling faces but their recognition as well; after all, there is no adaptive value in producing an unrecognized signal. Attachment theory may also contribute to this assumption in its emphasis on the importance of communication via facial expression for early parent–child relationships (e.g., Ainsworth, 1979; Bowlby, 1969, 1988; Minagawa-Kawai et al., 2009).

As children get older and their cognitive and verbal skills increase, they acquire scripts for different emotions (Fehr & Russell, 1984; Widen & Russell, 2008c). The script specifies the emotion's facial expression, label, causes, behaviors, consequences, and so on; all aligned in a causal and temporal order and embedded in a set of social norms. As they acquire scripts, chil-

dren can use any one part of the script as a basis for inferring the other parts. This account raises the intriguing question of how the child gets a toehold on building the script in the first place: where does the child begin? One suggested answer has been that children first understand the emotional meaning of facial expressions (e.g., Denham, 1998; Harris, 1989; Izard, 1994; Pons, Harris, & de Rosnay, 2004; Saarni, 1999; Walker-Andrews, 1997). If on the basis of a facial expression the child knows that someone is feeling, for example, disgust, then the child can notice what situation caused the disgust, what label adults use for the feeling, and so on—facial expression provides the child with the needed toehold for building a script.

In the present study, we focus on how children interpret the conventional "facial expression of disgust," an example of which is shown in Figure 1. The most prominent feature of this face is the nose wrinkle, Action Unit (AU) 9 in Ekman and Friesen's (1978) Facial Action Coding System. The common assumption appears to be that children interpret that face as expressing disgust. For example, 18-month-olds used the disgust face shown by an adult to decide which food to give that adult (Repacholi & Gopnik, 1997). When an adult displayed the disgust face toward one of two toys, 14-month-olds avoided that particular toy (Hornik et al., 1987; Repacholi, 1998). In these studies, the investigators interpreted their findings by supposing that the children interpreted the adult's disgust face as conveying specifically disgust. The disgust face would seem to be a particularly strong example of an emotion signal with evolutionary roots. According to one view, this face evolved from the act of spitting out rotten or poisonous foods (e.g., Frijda, 1986). It is easy to speculate that offspring who witnessed a caregiver displaying the disgust face in response to a particular

Figure 1. An example of the "disgust facial expression." The actual disgust faces used in the current study (not shown) were posed by a 12-year-old girl and provided by Linda Camras (which may be viewed online at http://condor.depaul.edu/~lcamras/images/ddisg) and by two adult women (Ekman & Friesen, 1976: NR3-29, PF1-24).

food would thereby learn what foods to avoid without having to ingest them. This signaling system would seem especially important for preverbal infants and toddlers who could not acquire the same information from the caregiver's verbal instruction.

There are two problems with the assumption that young children attribute disgust to the disgust face. First, although suggestive, the evidence with infants is not definitive in establishing the precise meaning they attribute to the disgust face. For example, it is not clear that the infants in Repacholi and Gopnik's (1997) study interpreted the adult's disgust face as showing disgust; the infants might have interpreted the adult as reacting with anger or sadness or general displeasure to the food and still avoided giving that food to the adult.

The second problem is that other empirical evidence is inconsistent with this assumption. Contrary to expectations, only a small minority of preschool children label the disgust face as *disgust* at an age when most children can provide conventional labels for the expressions of happiness, sadness, anger, fear, and surprise (e.g., Gosselin & Laroque, 2000; Widen & Russell, 2003, 2008a, in press). It is also an age much greater than that of the infants in Repacholi and Gopnick's (1997) study. This labeling task can also be reversed so that children are presented with an array of different facial expressions. When asked to find the disgusted person in the array, the majority of preschoolers fail to choose the person with the disgust face (Bullock & Russell, 1984; Harrigan, 1984; Izard, 1971; Widen & Russell, 2008b).

The results described so far all relied on the child knowing the meaning of the label *disgust* (by which term we include close synonyms). This feature of the studies raises the question of whether children's inability to label the disgust face as *disgust* is due to a vocabulary problem. However, even for preschoolers who had spontaneously used the word *disgust* in an earlier conversation, only 17% labeled the disgust face as *disgust*, compared with 81% who used the conventional label on average for all other faces shown (Widen & Russell, 2003, Study 3). Further evidence that preschoolers do understand the label *disgust* comes from studies in which children generated a recognizable cause of disgust from the label alone: They were simply asked what might make someone feel disgusted (Russell & Widen, 2002; Widen & Russell, 2004). Performance for *disgust* was as high as for *angry* and *scared*. Similarly, when this task is turned around so that preschoolers are given a story specifying a cause and a consequence of disgust, they are more likely to label the emotion of the protagonist of that story as *disgust* than they are to label the disgust face as *disgust* (Widen & Russell, 2002, 2009, Study 2, in press; Wiggers & van Lieshout, 1985).

Although most preschoolers do not label the disgust face as *disgust*, they are not silent when presented with this expression. Instead, they most often label the person showing it as *angry* (Gosselin & Larocque, 2000; Markham & Adams, 1992; Widen & Russell, 2003, 2008a, 2008b). Whether children quickly abandon the label *anger* for the disgust face and begin to label it as *disgust* when they are beyond preschool age is not known. To examine this possibility, in the present study we extended the age range of the children asked to label faces to 9-year-olds.

More important, we asked whether these children genuinely believe that someone displaying the disgust face is angry. Or, do they use the label *anger* to cover what they know to be two different emotions—perhaps because the word *disgust* does not

come to mind even when they have it in their vocabulary. To examine this question, we relied on a storytelling task in which children were asked to generate a cause of someone showing a specific facial expression ("What made her feel like this?") and then to generate a behavioral consequence ("When she looked like this, what did it make her do?"). Although the task of generating causes and consequences may seem demanding, even 3-year-olds can successfully describe causes for emotions they know (Russell & Widen, 2002; Widen & Russell, 2004), and 4-year-olds can also describe consequences (Russell, 1990).

To our knowledge, no one before had asked children to describe how someone displaying the disgust face might behave, although it is possible that a behavioral consequences may be the most noticeable aspect of disgust. That is, even a child who does not use the word *disgust* and who does not know what causes disgust could well know consequences of being disgusted (i.e., spitting something out or saying "ew, yuck!"). When asked to generate a cause of the disgust face, preschoolers offered causes that (according to adult judges) were relevant to disgust on only 8 to 15% of trials (Russell & Widen, 2002; Widen & Russell, 2004). However, the children in these studies were 5 years or younger, and older children may perform better. Moreover, these studies failed to examine children's "errors," which may reveal more about their interpretation of facial expressions than an examination of their "correct" responses alone (Widen & Russell, 2003).

Overview of Current Study

In the current study, children aged 4 to 9 years were given an opportunity to label various faces, including two opportunities to label a disgust face. We also asked the children to tell a story about what would cause someone to show the disgust face and what the consequences of feeling that way would be. The question was whether children generated causes that (adult judges agreed) are more relevant to disgust or, instead, to anger or some other emotion. Similarly, when telling a story about the consequences of feeling the way one feels when showing a disgust face, would children describe consequences that (adult judges agree) are relevant to disgust? Perhaps based on their history of observations of events that lead up to and follow others' disgust faces, school-aged children will be able to describe disgust-appropriate causes and consequences, even if some of them still do not label the disgust face as *disgust*. Conversely, this task allowed us to ask whether children who do label the disgust face as *disgust* really interpret that face as disgust, in the sense of inferring a disgust-related cause and consequence. The same storytelling task was given to the participants for the happy and angry faces. The happy face was included to verify that children in this particular sample were able to perform the storytelling task per se. The angry face was included to compare the stories they told for this face to those they told for the disgust face. We did not include more facial expressions in the storytelling task so that the younger children would not tire of the task and because previous research has already established that even 3-year-olds can perform well on this task for such emotions as sadness and fear.[1]

Method

Participants

Participants were 84 children enrolled in preschools and after-school care programs in or near Boston. All children were proficient in English. There were 28 children (14 girls and 14 boys) in each of three age groups: 4 to 5 years (48 to 69 months; $M = 57.5$ months, $SD = 6.0$ months), 6 to 7 years (66 to 91 months; $M = 77.9$ months, $SD = 6.8$ months), and 8 to 9 years (85 to 118 months; $M = 98.1$ month, $SD = 8.6$ months). A group of 22 university-aged adults were also included; they received course credit in exchange for their participation.

Materials

Facial expressions for storytelling task. We did not use the specific disgust face shown in Figure 1. Instead, we used one developed in another lab and used in various previous studies as a prototypical disgust face. We used four 5" × 7" black-and-white glossy photographs of prototypical facial expressions posed by a 12-year-old girl (neutral, happiness, anger, disgust). The photographs were provided by Linda Camras. Camras, Grow, and Ribordy (1983) described the development of the photographs, their coding according to Ekman and Friesen's (1978) Facial Action Coding System, and their use in a study on recognition of facial expressions. This set of photographs has been used in a variety of subsequent studies (for a review, see Widen & Russell, 2008c). More important, the disgust face developed by Camras shows a strong AU 9 and may be viewed online at http://condor.depaul.edu/~lcamras/images/ddisg.

Facial expressions for free labeling. Two sets of 6 black and white 5" × 7" photographs (each set posed by a different woman) of prototypical facial expressions of emotion (happiness, sadness, anger, fear, surprise, disgust) were selected from Ekman and Friesen's (1976) widely used Pictures of Facial Affect. Here again, we did not use the disgust face of Figure 1, but chose faces accepted in previous research as prototypical examples of the disgust face. The two disgust faces used here were posed by adult women (NR3–29, PF1–24) and both showed strong examples of AU 9.

Procedure

The experimenter began by spending time playing and chatting with each child until the child seemed comfortable with the experimenter. On a subsequent visit, she invited an individual child to play a game with her.

Story-telling task. The experimenter then introduced a game:

> In this game, we are going to take turns telling a story about things that happen to a girl who is 10 years old. This is what she looks like [showing the neutral facial expression]. First, we need to name the girl. Should we name her Sally or Suzie? [Pauses for child's response] Great. Okay, so her name is S [Sally or Suzie, as the child chose].

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[1] In a previous study, 42% of 3-year-olds told cause stories for sadness and fear that adults agreed were appropriate (Widen & Russell, 2004). Given the difficult generative nature of this task, 42% correct was a high level of performance in this study.

Now, I'll take a turn. I think that S lives with her mom and her dad. Now it's your turn.

This turn-taking procedure continued for two more turns each. The emotion trials were then introduced into the game.

The first emotion was presented as an (unlabeled) facial expression, either happiness, anger, or disgust, displayed throughout the trial. The child's task consisted of two parts: First, to describe the cause of S's emotion, and, second, to describe the behavioral consequence of the same emotion. The experimenter began the first trial with,

Okay, let's make up a new story about S. One day, a long time later, something happened to S. It made her feel like this [show face]. She felt so much like this [pointing] that everyone could tell she felt like this [pointing]. What happened? What made S feel like this? [pointing].

After the child responded, the experimenter asked, "And, when S looked like this [pointing], what did it make her do?" This procedure was repeated for the other two emotions. The three emotions were presented in random order.

If the response was a "nonstory," the experimenter prompted the child. (A *nonstory* was a response devoid of information about why S would have any emotion, e.g., the child did not respond, said "I don't know," or "I can't think of anything.") The first prompt was repeating the question. The second was suggesting that someone was there with S (a friend), and asking what the friend might have done to make S feel that way. The third was asking "What would make *you* feel this way?" If the child did not respond to any of the three prompts, the response was scored as a "nonstory." The experimenter then completed the story with a predesignated ending. (For the anger cause: "Her dad sent her to her room and that made her feel like that;" for the angry consequence: "She yelled at another kid and told him to stop it;" for the disgust cause: "She took a bite of an apple, but it was rotten inside, and that made her feel like that;" for the disgust consequence: "He had something gross on his hands so he washed them."). The experimenter used no emotion label in these stories.

Priming.   The experimenter next initiated a conversation in which each of the target emotion labels (*happy, sad, angry, scared, surprised, disgusted*) for the labeling task was introduced by saying, "Next, we are going to play a game about feelings. Feelings are like when you feel happy or sad. Do you ever feel *happy*? What about *sad*? Do you ever feel *sad*?" And so on, until each of the target emotion labels had been mentioned. The purpose of this step was to make the emotion labels that the child knew more accessible in the child's memory; there was no effort to teach the child any of the emotion labels. For the word *disgusted*, however, we did add this: "*Disgusted* is a feeling, too—like when something is really yucky." Our purpose was to ensure that the children have every opportunity to refresh their memory of the word *disgust* and to prime the word *yucky*, which in our scoring method counts as a synonym of *disgust*. The experimenter did not discuss when or why these emotions might occur. If the child spontaneously offered an example of when someone had felt a particular emotion, the experimenter listened but did not comment on the child's story or encourage further explanation. Every effort was made throughout the experiment to use a neutral tone of voice when presenting the emotion words.

Labeling facial expressions.   The order of presentation for the two sets of six facial expressions was counterbalanced: half the children saw Rhonda first, half Alice. In the Rhonda-first condition, the experimenter introduced the faces by saying, "Today, I brought some pictures of a woman named Rhonda with me." The experimenter then described the game and showed the child the six facial expressions, one at a time in a random order. For the first face, the experimenter said, "One day, Rhonda felt like this [pointing to the face]." For the remaining Rhonda faces, the experimenter said, "The next day, Rhonda felt like this [pointing to the picture]." After each picture, the experimenter asked, "How do you think Ronda feels in this picture?" Responses were not corrected and all were mildly praised (e.g., "Good answer;" "You are good at this game."). If no response was given, the experimenter used various prompts (Look very closely. What do you think happened to make Rhonda feel this way?). If the child still did not respond, the experimenter went on to the next photograph, and, after all the trials for both sets of photographs, returned to any to which the child had not responded. At no time did the experimenter use the word *emotion*, provide any emotion label, or otherwise direct the child to try to use an emotion label beyond asking how Rhonda was feeling. After seeing all six of the first set of faces, the experimenter introduced the second set: "That was great. Do you know what else I brought with me today? I brought some pictures of Alice. Would you like to see them?"

Adult Comparison Group

The adults completed the storytelling first and labeling task second, both in a questionnaire format. For half the adults, Alice was first, for half, Rhonda was. Participants were asked to label the emotion in each facial expression with one word if possible. The faces in the storytelling and face-labeling trials were presented in different random orders.

Scoring

Scoring the story-telling task.   Collectively, the children had 504 (84 children × 3 emotions × 2 questions [cause, consequence]) opportunities to make a response. Of these, 37 were nonstories and were not read to the raters. Adults had 132 (22 adults × 3 emotions × 2 questions) opportunities to make a response. Of these, nine were nonstories. The remaining 590 children's and adults' stories were read to three raters (blind to the participant's age, sex, and the target emotion), who made five judgments: (a) best-guess rating: Their best guess as to which of six emotions the participant was responding; (b) cause versus consequence rating: Whether the response was the emotion's cause or its consequence; (c) plausibility rating: (no longer blind to the target emotion) A yes/no judgment on the plausibility of the participant's response for the emotion to which the participant was responding. After making ratings a through c, the judges heard both the cause and the consequence together (cause + consequence story) for each trial and made (d) a best-guess rating and (e) plausibility rating as to emotion implied. For all ratings, each rater made her judgment independently of other raters. For those stories on which the three raters did not agree as to specific emotion or plausibility, consensus was reached by discussion. Two rating procedures (best-guess and plausibility) were used because

each procedure has drawbacks, and so a robust result is best established through a convergence across procedures.

Reliability of best guess. For the best-guess procedure, the rater chose from a list (*happiness, surprise, fear, disgust, anger, sadness*) the emotion that best suited the participant's response. For the best-guess ratings of children's cause stories, prior to discussion, at least two out of three raters agreed on a specific emotion for 79.4% of the stories (chance = 4.6%; comparison of proportions, one-sided: $p < .001$); for adults, 98%. For the best-guess ratings of children's consequence stories, 77.8% (chance = 4.6%; comparison of proportions, one-sided: $p < .001$); for adults, 100.0%. For the best-guess ratings of children's cause + consequence stories, 84.1% (chance = 4.6%; comparison of proportions, one-sided: $p < .001$); for adults, 100.0%. Examples of children's stories scored as correct by the best-guess criterion are: happiness cause "Everyone was playing with her," happiness consequence "Hug her mom," anger cause "People weren't playing fair," anger consequence "Punch the kid in the face," disgust cause "She saw something gross," disgust consequence "Run inside so she doesn't get stinky, too."

Judges also made best-guess ratings for each response on the storytelling task as to whether it was a cause or a consequence. Prior to discussion, at least two out of three raters agreed whether the response was a cause or a consequence for 83.7% of the stories (chance = 4.6%; comparison of proportions, one-sided: $p < .001$); for adults, 100.0%.

Reliability of plausibility ratings. For the plausibility rating, the three raters were first told the target emotion for the response and whether it was to be a cause or consequence. They were then asked to decide, independently of each other, whether the response was plausible for the target emotion and cause or consequence. Prior to discussion, at least two out of three raters agreed on whether the response was plausible for 94.4% of the cause stories (chance = 12.5%; comparison of proportions, two-sided: $p < .001$), 91.7% of the consequence stories (chance = 12.5%; comparison of proportions, two-sided: $p < .001$), and 98.0% of the complete cause + consequence stories (chance = 12.5%; comparison of proportions, two-sided: $p < .001$); for adults the corresponding figures were 100.0%, 97.8%, and 100.0%. Examples of children's stories for which the best-guess had been rated as

incorrect, but the response was rated as plausible are: "Go play at the playground," which was generated and rated as plausible for *angry consequence*, but for which the best-guess rating was *happy consequence*, "She didn't know her friend was coming over," which was generated and rated as plausible for *happy cause*, but for which the best-guess rating was *surprised cause*, and "She didn't want to eat breakfast," which was generated and rated as plausible for *disgust cause*, but for which the best-guess rating was *sad consequence*.

Free labeling. The labels scored as "correct" (i.e., the conventional meaning of the facial expression) were: for happiness, *happy, excited, glad*; for fear, *scared, afraid, frightened, nervous, worried*; for disgust, *disgusted, yucky, gross*; for anger, *angry, mad, grumpy, frustrated, furious*; for sad, *sad, disappointed, upset, lonely*; and for surprise, *surprised, shocked*.

Children had a total of 1,008 opportunities to provide a label. Of these, 687 (68.2%) were emotion labels scored as correct for the face shown, 318 (31.5%) were emotion labels scored as incorrect for the face, and three (0.2%) were other responses (e.g., "I dunno"). Adults had a total of 264 opportunities to provide a label. Of these, 224 (84.8%) were emotion labels scored as correct for the face shown, 22 (8.3%) were emotion labels scored incorrect for the face, and 18 (6.8%) were other responses.

Results and Discussion

Free Labeling of Facial Expressions

Correct responses. The percentage of children who provided a correct label for at least one of the two faces for a given emotion ranged from an average of 100% for happy and sad to 23% for disgust. Figures for each age group and for adults are shown in Table 1. For present purposes, the highlight of the table is that less than one third of even the oldest children, 8 to 9 year olds, labeled at least one of the disgust faces as *disgust*. In contrast, 63% of adults did so.

In a mixed-design analysis of variance (ANOVA; $\alpha = .05$) for the children's data, age (3 levels: 4 to 5, 6 to 7, 8 to 9 years) and sex (2 levels) were between-subjects factors, and facial emotion (4 levels: anger, fear, surprise, disgust; happy and sad faces omitted

Table 1

Proportion of Children Who Labeled at Least One of Two Facial Expressions for an Emotion Correctly

| | Children | | | | |
Facial expression	4 to 5 years	6 to 7 years	8 to 9 years	*M*	Adults
Happiness	1.00	1.00	1.00	1.00	1.00
Sadness	1.00	1.00	1.00	1.00	0.93_e
Anger	1.00	0.96	0.96	0.98_a	0.86_f
Fear	0.50	0.61	0.46	0.52_b	0.70_g
Surprise	0.71	0.93	0.89	0.85_c	0.95_e
Disgust	0.07	0.32	0.29	0.23_d	0.63_g
M	0.57_a	0.71_b	$0.65_{a,b}$		

Note. Maximum cell $M = 1.00$. For children's analysis, happiness and sadness had no variance and were not included in the analysis of variance; for the adults' analysis, happiness was not included for the same reason. According to least significant difference comparisons, means in the same column that do not share a subscript differ at $p < .03$; means in the same row that do not share a subscript differ at $p < .02$.

Table 2
How Children and Adults Labeled the Two "Disgust" and Two "Angry" Faces

Facial expression	Response category					
	Happiness	Surprise	Fear	Anger	Disgust	Sadness
Children (maximum/cell = 168)						
Disgust	0	1	1	123	32	10
Anger	0	0	2	149	5	11
Adults (maximum/cell = 44)						
Disgust	0	0	0	11	28	0
Anger	0	0	0	38	0	0

because of lack of variance) was the within-subject factor. The dependent variable was whether children labeled at least one of the two faces correctly, scored 1 and 0, respectively. There were main effects for facial emotion, $F(3, 324) = 70.13$, $p < .001$, age, $F(2, 78) = 3.10$, $p = .05$ (Table 1) , and sex, $F(1, 78) = 4.64$, $p = .03$, boys' performance (.60), was significantly lower than girls' (.69). Performance on disgust was significantly lower ($p < .001$) than on each of the other faces. (It follows that performance on the disgust face was also lower than on the happy and sad faces.) The Age × Facial Emotion interaction was not significant ($p = .25$): At each age, the same rank ordering for the facial emotions occurred.

In a comparable ANOVA for adults' data, there was a main effect for facial emotion, $F(4, 84) = 4.94$, $p = .004$.

Labeling the disgust face. Children infrequently labeled the disgust face as *disgust*, but they did label it. Children's responses to the disgust and angry faces showed a remarkable similarity (see Table 2). Adults' responses were more distinct.

Stories Told for Facial Expressions

In examining the stories children imagined for each facial expression, we focused on their cause + consequence stories because the judges' ratings of these stories was higher on average than their ratings of responses to the cause question alone or the consequence question alone. Thus, the cause + consequence stories provided

the most generous measure of children's understandings of the faces.

Correct responses. The first question was whether the child's imagined cause + consequence story for a face[2] was appropriate to the emotion allegedly signaled by that face. In a mixed-design ANOVA ($\alpha = .05$), age (3 levels: 4 to 5, 6 to 7, 8 to 9 years) and sex (2 levels) were between-subjects factors, and facial emotion (3 levels: happiness, anger, disgust) were within-subject factors. The dependent variable, a child's performance, was based on whether the best-guess ratings of the cause + consequence story implied the conventional emotion, scored 1 or 0, respectively.

The main effect for facial emotion was significant, $F(2, 156) = 195.69$, $p < .001$ (Table 3, top). As expected, performance was lowest for disgust. The effects of facial emotion replicated at each age (see Figure 2); the Age × Facial Expression interaction was not significant ($p = .20$). Parallel analyses of the best-guess ratings of responses to the cause question alone and the consequence question alone showed the same results (see Table 3).

The same analyses were repeated with the less stringent plausibility ratings, and the same effects were found. There was one additional significant effect. In the analysis of children's responses to the consequence question, the main effect for age was significant, $F(2, 78) = 5.81$, $p = .004$: 4- to 5-year-olds' (.57) performance was marginally lower ($p = .07$) than 6- to 7-year-olds' (.65) and significantly lower ($p = .001$) than 8- to 9-year-olds' (.73); 6- to 7-year-olds' and 8- to 9-year-olds' performance did not differ significantly. For adults' imagined causes and consequences for the happy and angry faces, the best-guess ratings (see Table 3) and plausibility ratings were similar to those for the children. In contrast, for the disgust face, the ratings of adults' responses were higher than children's.[3]
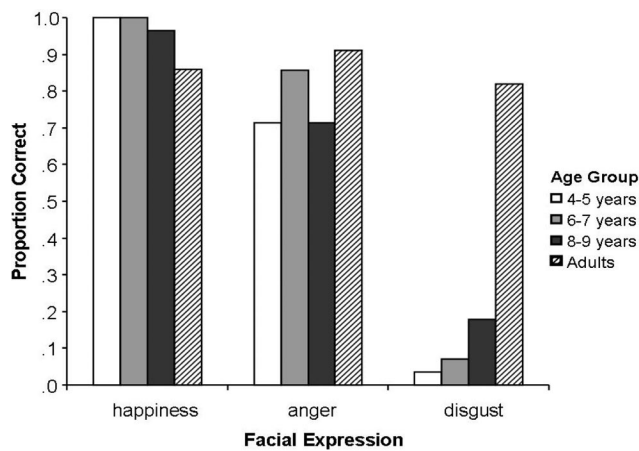

Figure 2. Children's and adults' proportion of "correct" responses to the cause + consequence story.

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[2] Overall, 92.9% of children's responses to the cause question were rated as causes, and 85.3% of children's responses to the consequence question were rated as consequences. Correctness as to cause versus consequence was ignored in subsequent analyses.

[3] For adults, for the cause questions, $F(2, 42) = .68$, $p = .51$, and the cause + consequence stories, $F(2, 42) = .59$, $p = .56$, the main effect for facial emotion was not significant by best-guess ratings: Adults' performance on the disgust was as high as was their performance on happy and angry. For the consequence questions, the main effect for facial emotion was significant, $F(2, 42) = 15.96$, $p < .001$: Adults' performance on disgust was significantly lower ($p < .001$) than on happy and angry, which did not differ significantly from each other. These same results were found with the less stringent plausibility ratings.

Table 3
Children's and Adults' Proportion of "Correct" Responses, by Best-Guess Ratings, for the Cause + Consequence Story and to the Cause Questions and the Consequence Questions

	Children				
Facial emotion	4 to 5 years	6 to 7 years	8 to 9 years	*M*	Adults
Cause + Consequence					
Happiness	1.00	1.00	0.96	0.99_a	0.86
Anger	0.71	0.86	0.71	0.76_b	0.91
Disgust	0.04	0.07	0.18	0.10_c	0.82
M	0.58	0.64	0.62		0.86
Cause					
Happiness	0.93	1.00	0.96	0.96_d	0.77
Anger	0.61	0.68	0.71	0.67_e	0.64
Disgust	0.04	0.07	0.14	0.08_f	0.77
M	0.52	0.58	0.61		0.73
Consequence					
Happiness	0.82	0.96	0.93	0.90_g	0.91_j
Anger	0.50	0.71	0.61	0.61_h	0.95_j
Disgust	0.00	0.00	0.11	0.04_i	0.41_k
M	0.44	0.60	0.55		0.76

Note. Maximum possible for each cell = 1.00. In the analysis of the responses the cause question, the main effect for emotion was significant (middle), $F(2, 156) = 157.89$, $p < .001$; this main effect was also significant in the analysis of the responses the consequence question (bottom), $F(2, 156) = 157.41$, $p < .001$. According to least significant difference comparisons, means column that do not share a subscript differ at $p < .001$. Comparisons were made only within each response type.

How children interpret the disgust face. Children did not imagine a cause or a consequence for the disgust face that was (according to adult judges) appropriate to disgust. We now ask what emotions the children's stories did imply. Table 4 reports best-guess ratings for the stories children generated for the happiness, anger, and disgust faces. Similar results were obtained with the plausibility ratings. Children's responses for the disgust face were significantly more likely to be rated as implying anger than disgust (dependent measures *t* tests): cause + consequence story, $t(83) = 6.70$, $p < .001$; cause, $t(83) = 5.62$, $p < .001$; consequence, $t(83) = 8.03$, $p < .001$. Indeed, children's responses to the cause question for the disgust face were also significantly more likely to be rated as other emotions other than as disgust, $t(83) =$

Figure 3. Proportion of children's responses to cause + consequence story for the "disgust face" that were best-guess rated as disgust, anger, or other (sadness, fear, surprise).

3.83, $p < .001$. These results for the disgust face contrast with results for the other faces. For the happy face and the angry face, cause + consequence, cause, and consequence responses all implied the target emotion.

Changes with age in the emotion implied by stories for the disgust face were revealing and are graphed in Figure 3 for the cause + consequence stories. Figure 3 groups children by the age groups used so far, but we analyzed the data with age in months (48 to 118) as a single continuous variable. We report results with the best-guess rating procedure, but similar results occurred with the plausibility ratings. As age increased, the cause + consequence story and responses to the consequence question for the disgust face were significantly more likely to imply disgust ($r = .24$, $p = .03$, $r = .25$, $p = .02$, respectively); and unrelated to the implication of other emotion or anger. As age increased, responses to the cause question, however, were only marginally more likely to imply disgust ($r = .19$, $p = .08$) and were significantly less likely to imply other emotion ($r = -.22$, $p = .04$); and unrelated to the implication of anger ($r = .14$, *ns*). In short, we found a weak tendency for children as they grow older to associate the disgust face with a cause or consequence appropriate to disgust, but no decrease in their tendency to associate that face with anger.

Adults. We also analyzed the kinds of causes and consequences adults imagined for the disgust face. According to the best-guess procedure, very few adults' cause + consequence stories or responses to the cause question implied anything other than disgust (see Table 3). Their responses to the consequence question, however, showed more variability: 41% of responses implied disgust, but 46% implied either anger or another emotion. Responses to the cause question for the angry face also implied other emotions with a high frequency. Similar results occurred with the plausibility ratings.
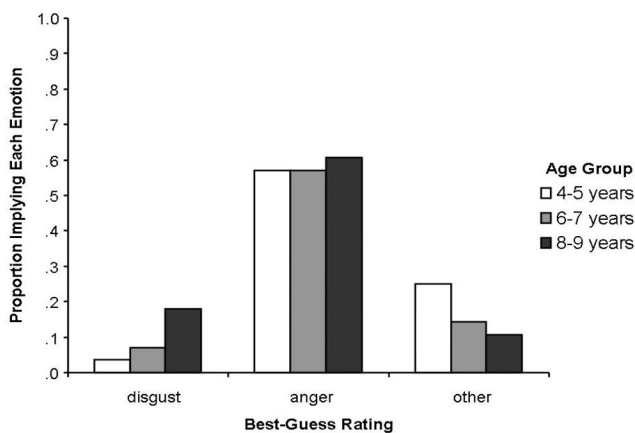
Table 4
Proportion of Participants' Responses to the Cause + Consequence Questions for "Happiness," "Anger," and "Disgust" Facial Expressions That Were Rated as an Emotion Category or as a Nonstory

	Facial expression					
	Children			Adults		
Best-guess rating	Happiness	Anger	Disgust	Happiness	Anger	Disgust
Cause stories						
Happiness	**0.96**	0.01	0.01	**0.77**	0.00	0.00
Anger	0.01	**0.67**	0.48	0.05	**0.64**	0.05
Disgust	0.00	0.00	**0.08**	0.00	0.00	**0.77**
Other emotions	0.01	0.31	0.33	0.05	0.27	0.00
Nonstories	0.02	0.00	0.10	0.14	0.09	0.18
Consequence stories						
Happiness	**0.90**	0.08	0.12	**0.91**	0.05	0.00
Anger	0.04	**0.61**	0.53	0.00	**0.95**	0.23
Disgust	0.00	0.01	**0.04**	0.00	0.00	**0.41**
Other emotions	0.04	0.19	0.24	0.00	0.00	0.23
Nonstories	0.02	0.11	0.07	0.09	0.00	0.14
Cause + consequence stories						
Happiness	**0.99**	0.01	0.02	**0.86**	0.00	0.00
Anger	0.00	**0.76**	0.58	0.00	**0.91**	0.05
Disgust	0.00	0.00	**0.10**	0.00	0.00	**0.82**
Other emotions	0.00	0.19	0.25	0.00	0.00	0.00
Nonstories	0.01	0.06	0.05	0.14	0.09	0.14

Note. Maximum possible for each cell = 1.00. Target responses are in bold. Each column for each response type totals to 1.00. Other emotions includes those stories that were best-guess rated as sad, scared, or surprised.

Predicting Correct Responses to the Cause and Consequence Questions for Disgust

Next, we asked what variables predict the ability to imagine a cause or a consequence for the disgust face that implies disgust. Age was the first candidate. Given the wide range of ages in the current sample (48 to 118 months), age seemed an obvious predictor of children's performance on the storytelling task. However, as stated above, age, although a significant predictor, did not have the strength one might have expected.

The second candidate predictor was accessibility of the word *disgust*, as indicated by a child's use of *disgust* on the free-labeling task. Children who used *disgust* on the free labeling task (correctly or incorrectly) clearly knew the label, could produce it, and associated it with a facial expression. Of the 84 children, 31 (36.9%) used the word *disgust* on free labeling, and, of these, 19 (61.2%) labeled at least one of the two disgust faces as *disgust*.[4] Use of *disgust* for the disgust face during free labeling correlated significantly but weakly with age, $r = .22$, $p = .04$, and so we expected that some of the same relationships that we observed between age and children's responses to the cause and consequence questions would also occur in the present analysis. Instead, use of *disgust* did not correlate significantly with correct responses (based on the best-guess ratings for the disgust face) to the cause question ($r = .13$, $p = .25$), the consequence question ($r = .12$, $p = .28$), or cause + consequence story ($r = .17$, $p = .12$).[5]

Consistency Across Tasks

Another important question concerns the consistency shown by the children on the various tasks they were given. We first asked

about the consistency of the children's free labeling responses to the two different disgust faces. Of 84 children, 68 used the same label for both faces (54 labeled both *anger*, 13 *disgust*, and one *sad*), and 16 used different labels (seven *angry* and *sad*, six *angry* and *disgust*, one *angry* and *scared*, one *angry* and an uncodable response, and one *surprised* and *sad*). A test of proportions indicated that the proportion of children who used the same label for both disgust faces (81.0%) was significantly higher ($p < .001$) than the proportion who used different labels (19.0%). This pattern was not affected by age (independent groups t tests, $ps > .49$) or by the order in which the sets of faces were presented (independent groups t tests), $t(82) = .34$, $p = .73$.

We next asked whether the label that children used for the disgust faces during free labeling predicted the emotion children implied for the disgust face on the storytelling task. For this

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[4] In other studies (Widen & Russell, 2008a, 2008b), Labeling Level 6 in the differentiation model (those children who used all six target emotion labels including disgust) was used to predict performance on other emotion tasks. In the current study, use of disgust was chosen as the predictor instead to include all the children in the sample who had used disgust on free labeling. Results of analyses done with labeling level were parallel.

[5] A parallel analysis was done correlating correct use of disgust for at least one of the disgust faces with children's responses to the cause and consequence questions. Although only 19 children used disgust correctly on the free labeling task, the same pattern was observed: Correct use of disgust did not correlate significantly with correct responses to the cause question ($r = .15$, $p = .19$), or the consequence question ($r = .05$, $p = .66$), but the cause + consequence story approached significance ($r = .21$, $p = .052$).

Table 5

Frequencies of Responses to the Cause + Consequence Questions for Children Who Labeled the "Disgust Face" as Disgust or Anger

Story-telling response	Best-guess rating of response to disgust face					Plausibility rating of response to disgust face		
	Disgust	Anger	Other emotion	None	Total	Disgust	Not disgust	Total
	Labeled disgust face as *disgust*					Labeled disgust face as *disgust*		
Cause	3	9	5	2	19	5	14	19
Consequence	1	12	2	4	19	4	15	19
Cause + consequence story	4	10	4	1	19	6	13	19
	Labeled disgust face as *anger*					Labeled disgust face as *anger*		
Cause	4	29	24	6	63	8	55	63
Consequence	2	32	18	11	63	6	57	63
Cause + consequence story	4	37	12	10	63	5	58	63

Note. If a child labeled either of the two disgust faces as *disgust*, those responses were coded as disgust. Of the remaining responses, if at least one disgust face was labeled as *anger*, those responses were coded as anger. The remaining emotion responses were coded as other emotions.

analysis, children's responses on both tasks were recoded into four mutually exclusive groups: disgust, anger, other emotions, none. For the free labeling task, in which children labeled two sets of faces, if a child labeled either of the two disgust faces as *disgust*, those responses were coded as disgust. Of the remaining responses, if at least one disgust face was labeled as *anger*, those responses were coded as anger. The remaining emotion responses were coded as other emotions; there were no nonresponses to the disgust faces to be coded as none. Results are shown in Table 5. Nineteen children labeled at least one of the disgust faces as *disgust*. Only four of these 19 (21%) children gave a cause + consequence story that implied disgust by the best-guess rating; six of them (32%) by the plausibility rating. The majority of children who labeled the disgust face as *disgust* nevertheless gave a story that implied anger. These results suggest that free labeling may overestimate children's true understanding of the disgust face as disgust.

The 63 children who labeled the disgust face as *anger* (see Table 5) showed more consistency. More than half of these children's (58.7%) cause + consequence story that were rated as anger by the best-guess rating, and a large majority (92.1%) did so by the plausibility ratings. The same pattern was observed for children's responses to the cause and the consequence questions.

Finally, we asked about consistency between responses to the cause question and the consequence question: Is the emotion implied by one the same as the emotion implied by the other? The disgust face did not invoke a strongly consistent script. With the best-guess judgments, 49 of the 84 children produced responses to the disgust face that were inconsistent. Of the 35 children who produced responses that were consistent, there was variation as to which emotion was implied: one implied happiness, five sadness, 26 anger, and three disgust. In contrast, the happy face yielded more consistent responses (74 of 84 children were consistent); the angry face less so (38 of 84 were consistent). With the plausibility ratings, a similar conclusion obtained: Only 5 of the 84 children produced stories for the disgust face in which both cause and consequence plausibly implied disgust. The comparable figure for the happy face was 81, for the angry face 68.

Conclusions

In the current study, children's association of the disgust face with the emotion of disgust was restricted to a minority. Of the 84 children shown the two disgust faces, 19 labeled at least one of them as *disgust*, but only four of the 19 also told a cause + consequence story for which the adult judges' best guess was disgust. Another four children labeled the disgust faces as *anger* and told a story judged as disgust. So, by the strict criterion of both free labeling and storytelling, only four children associated the disgust face with disgust. By the less strict criterion of either measure, 23 children did. Conversely, 61 of the 84 children showed no sign of associating the disgust face with disgust in either measure.[6]

Many more children labeled the disgust faces as *anger*. Of the 84 children, 63 labeled at least one of them as *anger*. Further, of the 63, 37 also told a cause + consequence story for which the adult judges' best guess was anger. Another 10 children labeled the disgust faces as *disgust*, but told a story judged as anger. So, by the strict criterion of both free labeling and story, 37 children associated the disgust face with anger. By the less strict criterion of either measure, 73 children did. Conversely, only 11 children showed no sign of associating the disgust face with anger in either measure.

A majority of adults associated the disgust face with disgust. Of the 22 adults shown the disgust face, 20 labeled it as *disgust*, and 17 of the 20 also told a cause + consequence story for which the judges' best guess was disgust. By the strict criterion of both free labeling and storytelling, 17 adults associated the disgust face with disgust. By the less strict criterion of either measure, 21 adults did. However the adults also showed some hints of associating the disgust face with anger: 11 of 22 labeled one of the disgust faces as anger and five of their consequence stories for the disgust face were judged as implying anger.

We find it interesting that the emotion that children associated with the disgust face did not change much over the almost 6-year

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[6] Lest we leave the impression that disgust is the second most likely interpretation of the disgust face for children, let us point out that sadness (15.5%) was a slightly more likely interpretation than was disgust (9.5%).

age range (4,0–9,10) studied here. Over this range, age correlated weakly and nonsignificantly with children's ability to generate stories for the face that implied disgust to adult judges. The youngest child to generate a recognizable cause + consequence story for disgust was 4 years and 9 months old. Few (only 17.9%) among the 8- and 9-year-olds' were able to do so.

The emotion that children did associate with the disgust face was anger. Indeed, as illustrated by Figure 3, the proportion of children who did so did not diminish between the ages of 4 and 9 years. Instead, the increase in interpretation of that face as disgust came at the expense of its interpretation as some emotion other than anger.

Of course, change does come eventually. The adults were much more likely than the children to associate the disgust face with disgust. We do not know if the change is due simply to age or to some more specific factor. For example, Wolfgang and Cohen (1988) found that education level had a dramatic effect on recognition of the conventional label for facial expressions: 81% with university level, 66% with high school level, and 43% with primary school level. Unfortunately, disgust was omitted from the list of emotions in their study.

Another possibility is that associating the disgust face with disgust might be more an individual difference than a developmental change during the first decade of life. We have insufficient data in the present study to explore this hypothesis, but future research should consider it. There was again some hint of individual differences among adults aged 18 to 23. Fifty percent of them labeled at least one of the disgust faces as anger, and almost one fifth (18.2%) of the cause + consequence stories generated for the disgust face were not recognized (by adult judges) as disgust (see also Widen & Russell, in press).

The possibility of individual differences widens the scope of inquiry. Much research examines the facial expression alone in determining the emotion that is attributed to that face. Other research, including the present study, considers two factors, the face and the observer's development. That is, children at different developmental levels attribute different emotions to the same face (Widen & Russell, 2003, 2009). The results of the current study and other studies of the disgust facial expression (e.g., Camras & Allison, 1985; Gosselin & Laroque, 2000; Gosselin, Roberge, & Lavallée, 1995; Harrigan, 1984; Markham & Adams, 1992; Russell & Widen, 2002; Widen & Russell, 2003, 2004, 2008a, 2008b) suggest that, beyond the face itself or the child's developmental level, a third factor contributes to children's interpretation of at least this facial expression—something to do with the child's individual experience. Another line of research supports the possibility that individual experience influences the interpretation of facial expressions: children who have been abused are more likely to interpret nonangry facial expressions as angry (e.g., Camras et al., 1983; Pollack, Cicchetti, Hornung, & Reed, 2000). In the current study, there are no data on what the third factor might be for the children in our sample, but we do raise the question.

The present study did not test the theory of basic emotions or its evolutionary account (Ekman, 1972; Izard, 1971). Nevertheless, our results join with prior research (e.g., Bullock & Russell, 1984; Camras & Allison, 1985; Gosselin & Laroque, 2000; Gosselin et al., 1995; Harrigan, 1984; Izard, 1971; Markham & Adams, 1992; Russell & Widen, 2002; Widen & Russell, 2003, 2004, 2008a, 2008b, 2009, in press) in raising questions about the account of

disgust suggested by basic emotions theory (e.g., Ekman, 1994; Izard, 1971, 1994). If children approaching their tenth birthday do not readily associate the disgust face with disgust, then how can basic emotions theory be augmented to account for the current data? Furthermore, the frequent association of the disgust face with anger presents another kind of problem for basic emotions theory. This sort of error is not often studied, but seeing anger where, according to that theory, it does not exist, is just as much an error as not seeing anger where it does exist.

Of course, the measures used in the present study were all verbal reports, and it might be possible to find other nonverbal responses to the disgust face that would indicate that a child can read disgust specifically from the disgust face even if their explicit verbal understanding is absent. One possibility would be a behavioral response, similar to that intended by Repacholi and Gopnick (1997), although, as we said earlier, the behavior they studied might not be specific to disgust but rather general to negative expressions. To our knowledge, no evidence is available with a behavioral measure that is unique to disgust. Another possibility would be to approach this question with neurophysiological measures. Neuroimaging studies with adults have started to isolate brain structures activated differentially by the disgust face (e.g., Calder, Keane, Manes, Antoun, & Young, 2000; Phillips et al., 1997). Neuroimaging studies with children are less clear, but have so far suggested a slow developmental course in the response to facial expressions of emotion, with adult-like neural patterns not seen until adolescence (Batty & Taylor, 2006; Herba & Phillips, 2004; Kolb, Wilson, & Taylor, 1992; Lobaugh, Gibson, & Taylor, 2006).

Let us offer an interpretation of the available findings in terms of children's acquisition of scripts for emotion. Children begin with very broad categories and very simple scripts (Bullock & Russell, 1986). The initial scripts may be as simple as something good happens and you feel good about it versus something bad happens and you feel bad about it. These two broad categories cover all emotions in an undifferentiated manner. Over the preschool years, children differentiate within these broad categories to form more and finer-grained categories (Widen & Russell, 2003). However the process does not move from these broad categories to adult-like ones in one step. Rather, this process involves adding new elements to the script one at a time. One of children's earliest scripts is labeled *anger*, although to the young child the concept of anger is much broader than it is for the adult. Initially, for young children, the word *angry* covers any negative emotion. As differentiation proceeds, first sadness and then fear/surprise are differentiated from anger. At this point, anger and disgust remain one category, at least when the categories are cued by facial expressions. By this, we mean that when children are shown an angry or disgust face, not only is the same label used but, as the present data suggest, the same concept or script is used to understand the expresser's emotion. Other studies have shown that when disgust is cued by other aspects of the script (e.g., label, story), children's performance for disgust is stronger (e.g., Russell, 1990; Russell & Widen, 2002; Widen & Russell, 2004, in press; Wiggers & van Lieshout, 1985). Taken together, the evidence suggests that the disgust face is a weak cue to disgust for children, though it may be a strong cue to anger and thus a part of the anger script.

The present study focused exclusively on the child's interpretation of the disgust face. We must not assume that the disgust face

is integral to the concept/script for disgust. Other evidence suggests that preschoolers have formed a disgust script, but one that does not include the disgust face. For example, given the word *disgust* and asked to generate a cause, preschoolers' (3 to 4 years) generated stories that were recognizable (to adult judges) as disgust; indeed, their disgust stories were as recognizable as those for fear and anger (Widen & Russell, 2009, Study 1).

A recent study presented adults with the disgust face paired with the emotional posture of anger (Aviezer et al., 2008). Almost 90% of adults labeled the combination as *angry*. Such findings join current results in raising questions about the assumption that facial expressions (at least the disgust face) signal to children and adults a single discrete emotion. One possibility is that facial expressions mainly provide cues to valence (feeling good vs. feeling bad) and that, in typical circumstances, other aspects of the script such as causes (context) and consequences (behavior) provide information as to the specific emotion category.

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