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BRIEF REPORTS

Differences Between Children and Adults in the Recognition of Enjoyment Smiles

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The authors investigated the differences between 8-year-olds ($n = 80$) and adults ($n = 80$) in recognition of felt versus faked enjoyment smiles by using a newly developed picture set that is based on the Facial Action Coding System. The authors tested the effect of different facial action units (AUs) on judgments of smile authenticity. Multiple regression showed that children base their judgment on AU intensity of both mouth and eyes, with relatively little distinction between the Duchenne marker (AU6 or "cheek raiser") and a different voluntary muscle that has a similar effect on eye aperture (AU7 or "lid tightener"). Adults discriminate well between AU6 and AU7 and seem to use eye-mouth discrepancy as a major cue of authenticity. Bared-teeth smiles (involving AU25) are particularly salient to both groups. The authors propose and discuss an initial developmental model of the smile recognition process.

Keywords: smiles, Duchenne marker, emotion recognition, Facial Action Coding System, bared-teeth smiles

What is emotion recognition ability made of? Developmental psychology has devoted great attention to the ability to recognize emotions in others, with special emphasis on facial expressions as a source of information. Most developmental studies concerned with facial expressions have used some adaptation of Matsumoto and Ekman's (1988) picture set, which consists of prototypical, intense displays of basic emotions (e.g., Blair & Coles, 2000; Pollak, Cicchetti, Hornung, & Reed, 2000; Pollak & Sinha, 2002; Simonian, Beidel, Turner, Berkes, & Long, 2001). Other researchers used even more stylized stimuli, such as cartoon faces (e.g., Cassidy, Parke, Butkovsky, & Braungart, 1992; Pons, Harris, & de Rosnay, 2004); the number of emotions usually ranged from four (joy, sadness, anger, and fear) to seven (adding disgust, contempt, and surprise).

Although recognition of prototypical facial displays can be an adequate test of young children's ability, we think it definitely falls short when children older than 6 years are evaluated. Research has shown that, by their 6th year, most children begin to understand more sophisticated aspects of emotional life: for example, that emotions can be faked or suppressed and that contrasting emotions can be felt simultaneously (Gosselin, Warren, & Diotte, 2002; Gross & Harris, 1988; Meerum Terwogt, Koops, Oosterhoff, & Olthof, 1986; Pons et al., 2004; Saarni, 1989). These important aspects of emotional functioning are reflected in facial expressions (see Ekman, 2003): We should expect that, among older children, the most socially skilled will be the ones who recognize not only basic emotions, but also faked, suppressed, or multiple emotional displays. For this reason, new sets of stimuli are needed in order to test advanced emotion recognition and to trace its developmental trajectory.

Enjoyment Smiles

One area of advanced emotion recognition in which we already have solid empirical knowledge is that of recognition of "felt" versus "faked" enjoyment smiles. Ekman and Friesen (1982) have pioneered the rediscovery of the so-called Duchenne marker, which is the contraction of the external strand of *orbicularis oculi* muscle. The Duchenne marker, named after Duchenne de Boulogne who first described it in 1862, corresponds to Action Unit 6 (AU6 or "cheek raiser") in Ekman, Friesen, and Hager's (2002) Facial Action Coding System (FACS). AU6 activation has been found to be reliably associated with felt enjoyment smiles, compared with faked or "social" smiles (Frank, Ekman, & Friesen, 1993). Its effects on the face are the narrowing of the eye aperture, appearance of wrinkles or "crow's feet" on the external side of the eye, raising of the cheek, and lowering of the eye cover fold.

The importance of AU6 and its evolutionary significance (Schmidt & Cohn, 2001) come from the fact that it is difficult to control deliberately: Ekman (2003) estimated that only 10% of people can contract AU6 voluntarily, thus being able to fake a credible enjoyment smile. The inner part of *orbicularis oculi*, labeled AU7 ("lid tightener"), is quite different in this respect:

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Most people can easily contract it voluntarily, and it only narrows the eye aperture without causing wrinkles or raising the cheek.

The Duchenne marker is then a useful cue for detection of simulated enjoyment expressions. There is even some experimental evidence that altruists produce more Duchenne-marked smiles than nonaltruists (Brown, Palameta, & Moore, 2003), suggesting a possible evolutionary function of AU6 as an innate signal of cooperative intentions. Yet another interesting feature of this signal is that children and even infants seem to produce and recognize it from a very young age.

Fogel, Nelson-Goens, and Hsu (2000) were able to describe different, contextually appropriate types of smiles, including Duchenne ones, during videotaped play of 6- to 12-month-olds with their mothers. Infants from ages 1 to 6 months produced more Duchenne smiles when their mother was smiling at them (Messinger, Fogel, & Dickson, 2001), and by 10 months of age they directed Duchenne smiles at their mother but not at strangers (Fox & Davidson, 1988). Preliminary data by Dondi et al. (2004) suggest that Duchenne smiles are spontaneously produced even by sleeping preterm newborns. On the recognition side, Bugental, Kopelkin, and Lazowski (1991) found that children from ages 3 to 6 years tended to divert gaze from non-Duchenne smiles, showing at least some implicit discrimination ability. Gosselin, Perron, Legault, and Campanella (2002) used standardized stimuli and found that 9- to 10-year-olds responded differently on a judgment task to Duchenne and non-Duchenne smiles, whereas they found no significant difference in 6- and 7-year-olds. However, their samples were small, and the study might have suffered from low statistical power.

Other Cues of Smile Authenticity

The Duchenne marker is not the only cue that could be used to identify spontaneous enjoyment smiles. Both smile asymmetry (e.g., Brown et al., 2003; Gazzaniga & Smylie, 1990; Wylie & Goodale, 1988) and synchrony and speed of AU activation (e.g., Bugental, 1986; Frank et al., 1993; Hess & Kleck, 1990) have been found to vary between posed and spontaneous facial expressions. However, it is not clear whether people actually use these cues to evaluate smile authenticity. Gosselin, Perron, et al. (2002), for example, found that both adults and 9-year-olds used AU6 activation, but *not* degree of symmetry, to discriminate between felt and faked enjoyment smiles, although in a more recent study Chartrand and Gosselin (2005) reported major effects of asymmetry. Support for the role of dynamic components comes from a study by Krumhuber and Kappas (2005).

An Advanced Picture Set for Smile Recognition

As we discussed above, there is growing interest in the ability to discriminate between genuine and simulated emotion expressions (for expressions other than smiles, see Gosselin, Beaupre, & Boissonneault, 2002; Soppe, 1988). In this article, we describe the construction of a picture set for smile recognition designed to assess the use of the Duchenne marker in discrimination between felt and unfelt enjoyment smiles. We will then use these pictures to investigate the effect of different facial cues on smile recognition and to describe possible differences between children and adults.

Previous research has typically employed smiles of constant intensity, varying only in AU6 involvement (e.g., Gosselin, Perron, et al., 2002); we wanted to cover a wider range of smile intensity in order to obtain items of variable difficulty. Another novel feature of our picture set is the introduction of AU7 as a simulated AU6 activation. We expected that some participants, especially children, could be misled by (voluntarily controllable) AU7 into believing that (involuntary) AU6 is displayed; precise detection of AU6 is needed for recognition of deliberately faked smiles.

Method

Construction of the Picture Set

To build the item pool, we took 37 color digital pictures of an actor's face; the actor was extensively trained with the FACS manual (Ekman et al., 2002) to selectively contract single facial AUs. Different AU combinations were obtained as follows. Each picture involved one eye-region AU (AU6, AU7, or none [AU0]) plus a smile of varying intensity with either closed lips (AU12) or bared teeth (AU12 + AU25). We thus obtained three picture sets, each corresponding to the activated eye-region AU and composed of pictures with varying smile intensities, from very slight (coded "A" in the FACS) to very strong ("E") and with open or closed lips. A picture of the neutral face was also taken, together with some pictures of various emotional expressions (e.g., surprised, disgusted). Pictures were resized to 1,024 × 768 pixels for on-screen presentation; those with too much asymmetry or other defects were discarded. We retained 25 smile pictures: 11 Duchenne smiles with AU6 activation and 14 non-Duchenne smiles, 7 with AU7 activation and 7 without eye activation (AU0).

The 25 pictures were coded by a certified FACS coder (Dr. Susan Schmidt, University of Turin). We obtained separate codings for the left and right sides of the face. FACS coding confirmed that only the intended AUs (AU6, AU7, AU12, and AU25) were present; asymmetry was never greater than one intensity step. FACS coding of the 25 items is reported in Table 1. The first digit in the item label stands for the activated eye-region AU: 0 for no eye movement, 7 for AU7, and 6 for AU6. Examples are shown in Figure 1.

Participants

The participants were 80 children (42 males, 38 females) with a mean age of 7 years, 11 months (SD = 4 months) and 80 adults (38 males, 42 females) with a mean age of 27.8 years (SD = 7.4). The children were recruited from a local school. Eight-year-olds were chosen because (a) previous research has shown that they understand the difference between genuine and faked expressions and (b) the study by Gosselin, Perron, et al. (2002) reported an improvement in detection of the Duchenne marker between the ages of 7 and 9 years. We obtained a heterogeneous sample of adult participants by including volunteer university students from different faculties, high-school teachers, and other workers. Participants in both samples were of a middle-level socioeconomic status and were native-born Italians.

Materials and Procedure

All participants were tested individually by a trained experimenter. Each participant was shown the 25 smile items plus two

Table 1
Complete FACS Coding of the 25 Smile Pictures

Item	Coding (AUs) Right	Coding (AUs) Left
0A	12A	12A
0B	12B	12C
0C	12B + 25B	12C + 25C
0D	12D + 25C	12E + 25D
0E	12A	12B
0F	12A + 25B	12B + 25C
0G	12D + 25C	12E + 25D
7A	7 + 12B + 25C	7 + 12C + 25C
7B	7 + 12A	7 + 12A
7C	7 + 12C	7 + 12C
7D	7 + 12A + 25B	7 + 12B + 25B
7E	7 + 12B + 25C	7 + 12C + 25C
7F	7 + 12C + 25C	7 + 12C + 25C
7G	7 + 12B + 5B	7 + 2B + 25B
6A	6A + 12A	6A + 12B
6B	6C + 12A	6C + 12B
6C	6B + 12C	6B + 12D
6D	6D + 12D	6D + 12E
6E	6C + 12D + 25C	6C + 12D + 25C
6F	6C + 12D	6C + 12D
6G	6A + 12B	6B + 12C
6H	6C + 12D + 25C	6C + 12D + 25C
6I	6B + 12C + 25B	6B + 12D + 25B
6J	6B + 12C	6B + 12C
6K	6C + 12C	6C + 12D

Note. FACS = Facial Action Coding System; AU = action units. AU intensity is scored separately for the right and left sides of the face; intensity range goes from A (minimum) to E (maximum). AU7 is not scored for intensity in the FACS system.

standardized tests involving recognition of facial expressions. The three tasks were presented on a computer and took about 20 minutes to complete.

Smile items. We prepared a computer presentation of the 25 smile items. The presentation started with a preliminary phase: The neutral face was shown, followed by four slides of different expressions (anger, sadness, surprise, and disgust) and then by the neutral face again. All slides lasted 3 s and were separated by a 1-s fade-to-black transition. The following instructions then appeared on the screen and were read and clarified by the experimenter: "Now you are going to see this person smiling. Each time, you will see a smile and then will be asked to tell if this person is *really happy* or is *just pretending to be happy*. If you can't decide, you may answer '*I don't know*'" (adult version; the children's version was slightly rephrased). Original instructions were in Italian; *contento* was the synonym for *happy*.

The 25 smile items were then shown in one of two randomized orders; each item had a duration of 3 s and started with a neutral face (1 s), followed by a fading transition (1 s) and the smiling face (1 s). The 1-s duration of the slide was chosen to give a natural feeling to the smile. Following the smiling face, a screen appeared with the question: "Do you think this person is really happy, or is he pretending to be happy?" Participants answered verbally, and the experimenter took note. If a child got distracted, the experimenter showed the item again until he or she was sure that the child had properly watched the picture. We carefully constructed the presentation to give participants the possibility to get accustomed to the actor's face; this happened both in the preliminary phase and within each item, where comparison with the neutral face was possible. In this way, we tried to give all the information needed to make judgments on subtle differences in muscle contraction.

Following administration, each response was coded as correct or incorrect. A correct response was scored for a "really happy" answer on items with AU6 activation and for a "pretending to be happy" answer for AU7 or no eye-region AU items (AU0). "Don't

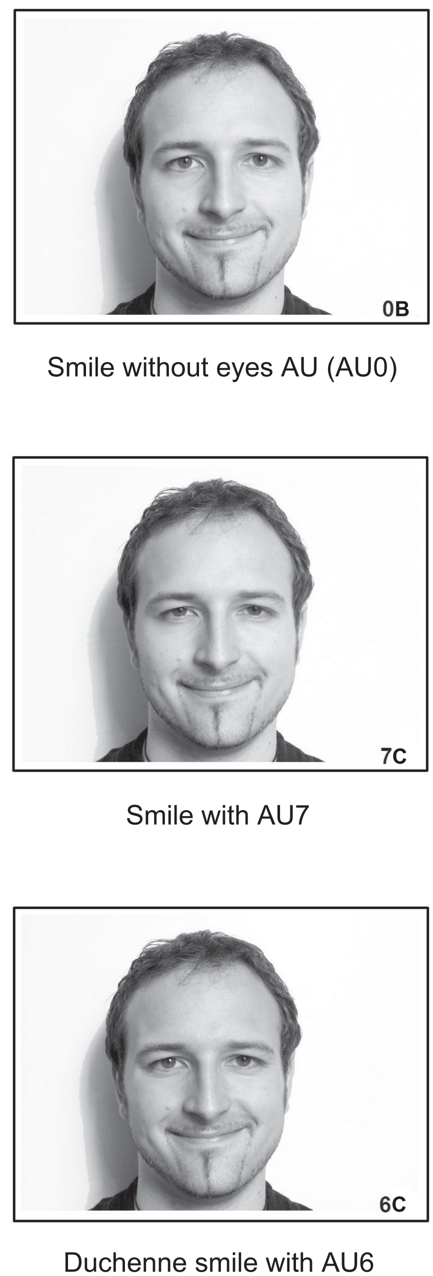

Figure 1. Examples of the three smile types in the picture set. To ease comparison, the three items shown all involve closed-lips smiles of similar intensity (see Table 1 for complete Facial Action Coding System coding).

know" answers were coded as incorrect because they were only intended to reduce guessing. The number of correct answers was used as a measure of smile recognition ability, to be correlated with two other tasks of emotion recognition. Correlation with other tasks was needed to evaluate whether smile recognition is a facet of general emotion recognition ability or whether it involves some distinct processes.

Eyes Test. The revised Eyes Test (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) is composed of 36 items, each showing the photograph of a person's eyes. The test taker is asked to choose one of four adjectives that best describes the mental state of the pictured person; one point is given for each correct answer. Although this test effectively discriminates between autistic and nonautistic people, there is considerable variability in test scores among normal adults. For the children, we used the 28-item children's version of the Eyes Test (Baron-Cohen, Wheelwright, Scahill, Lawson, & Spong, 2001).

Emotion recognition: JACFEE and JACBART. For children, we selected 14 pictures from the Japanese and Caucasian Faces of Emotion Expression (JACFEE; Matsumoto & Ekman, 1988), two for each emotion (happiness, sadness, anger, fear, surprise, disgust, and contempt). During administration, the child was probed for knowledge of the meaning of each emotional label and prompted with examples about the ones he or she did not understand. Then the experimenter showed each picture on a computer screen followed by the seven labels; the child had to choose the appropriate label. One point was awarded for each correct answer.

For the adults, we needed a more difficult task: The same 14 pictures of emotional expressions were embedded for a barely perceptible time (one fifth of a second) in the middle of short movie clips of the neutral face. This is the same procedure used to develop the Japanese and Caucasian Brief Affect Recognition Test (JACBART; Matsumoto et al., 2000). The JACBART items were shown on a computer screen and were followed by the same labels used for the JACFEE.

Results

Effect of AUs on Smile Recognition

In order to assess the influence of different AUs on smile judgment, we performed multiple linear regression analyses on the 25 items. For each of the two samples, we tested separately how each AU intensity was related to smile authenticity as perceived by participants. AU intensities of each item were coded from FACS intensity scores (A→1, B→2, . . . E→5), averaged across the two sides of the face and treated as independent variables; the percentage of times each item had been judged as "really happy" was the dependent variable (perceived authenticity). For example, item 6I has the following intensities: AU6 = 2.0, AU7 = 0.0, AU12 = 3.5, AU25 = 2.0; its perceived authenticity was 56% for children (45 out of 80 children judged it to be authentic) and 58% for adults. Items were treated as the unit of analysis (N = 25). Pearson correlations between intensities of different AUs are reported in Table 2; regression results are shown in Tables 3 and 4.

The results revealed some interesting differences between children and adults in the use of facial cues. In the child sample, three AUs significantly and positively predicted perceived authenticity: AU6, AU7, and AU25 (Model 3; 76% of variance explained).

Table 2
Correlations Between AU Intensities in the 25 Items

Intensity	1	2	3	4
1. AU6	—			
2. AU7	$-.51^{**}$	—		
3. AU12	$.49^{*}$	−.31	—	
4. AU25	−.30	.24	.32	—

Note. AU = Action Units. Pearson correlation for continuously scored AUs, point-biserial correlation for AU7. Correlations depend entirely on item construction and do not reflect the ecological co-occurrence of AU activations.
$^{*}p < .05$. $^{**}p < .01$.

Thus, children actually used the information from the eyes but were not "fooled" by AU7, as was expected. Although estimated regression coefficients were similar for AU6 (7.2) and AU7 (6.7), it should be noted that the 7.2% increment in perceived authenticity refers to just one step in AU6 intensity (range = 0–5), whereas it amounts to 6.7% for the whole activation range of AU7 (which is dichotomously scored). Thus, AU6 seemed to exert a stronger overall influence on children's judgments than did AU7. Bared teeth (AU25) were another important cue, whereas pure smile intensity (AU12) did not seem to predict authenticity when AU6 was taken into account (Model 2; note that AU6 and AU12 showed moderate collinearity as indicated in Table 2).

In the adult sample, the picture was more complex: AU6 was the only positive predictor of perceived authenticity, whereas both AU25 and (especially) AU7 were significantly and negatively associated with authenticity (Model 3; 77% of variance explained). Adults, then, were not fooled by AU7 and also seemed to judge negatively the bared-teeth smiles. Inspection of regression plots shows that the effect was mainly due to bared-teeth faked smiles (see Figure 2); when AU6 was present, there was no apparent negative effect of AU25 (test of the interaction term AU25 × AU6 in Model 4 is nearly significant, p = .056). As in the child sample, AU12 was no longer a significant predictor when AU6 was considered (Model 2).

To sum up, children's judgments seemed to be strongly influenced by AU intensity and in particular by the bared-teeth component: "Strong" smiles tended to be perceived as sincere, irrespective of the eye AUs involved. On the contrary, adults seemed to judge faked smiles more easily when they were strong and bared-teeth; it could be that adults are more sensitive than children to the *coherence* of different cues coming from eyes and mouth.

Gender Differences and Correlation With Other Tasks

Descriptive statistics for the three recognition scores are reported in Table 5. In the adult sample, women performed slightly better than men in the Eyes Test, $t(78) = 2.711$, p = .008. In the child sample, we found no significant gender differences, although the results are in the same direction. Participants' scores in smile recognition are similar to those reported in previous research: Gosselin, Perron, et al. (2002) found that adults correctly recognized AU6 (Duchenne) smiles of moderate intensity about 53% to 57% of times on average, whereas 7-year-olds' rates were about 45% to 47% (p. 94). For comparison, our AU6 smile pictures were recognized as felt, on average, by 66% of adults (ranging from

Table 3
Multiple Regression Analysis of How AU Intensity Predicts Perceived Authenticity of Items in the Sample With Children

Intensity	B	95% CI for B	β	t	p
		Model 1, F test: $p = .004$; $R^2 = .39$			
AU12	5.44	2.08 to 8.79	.59	3.363	.003
AU25	0.69	−1.92 to 3.30	.10	0.548	.590
		Model 2, F test: $p < .001$; $R^2 = .70$			
AU12	0.92	−2.26 to 4.09	.10	0.600	.555
AU25	3.41	1.16 to 5.67	.48	3.147	.005
AU6	5.69	3.12 to 8.26	.76	4.600	<.001
		Model 3, F test: $p < .001$; $R^2 = .76$			
AU25	3.58	1.88 to 5.27	.50	4.388	<.001
AU6	7.22	5.22 to 9.22	.96	7.513	<.001
AU7	6.70	0.77 to 12.63	.30	2.348	.029

Note. AU = action units; CI = confidence interval. Mouth AUs are entered first.

58% to 81%) and 54% of children (ranging from 39% to 58%). These results support the notion that the absolute difference in performance between children and adults is noticeable but not of great magnitude.

In the child sample, smile recognition was moderately correlated with the Eyes Test, $r(78) = .44$, $p < .001$, but not with the JACFEE items, $r(78) = .21$. In the adult sample, correlation with the Eyes Test was lower and nonsignificant, $r(78) = .12$, and again there was no significant correlation with the JACBART, $r(78) = .21$.

These results suggest that recognition of faked smiles is quite distinct from the general dimension of emotional recognition, as assessed with the Ekman pictures. The importance of "reading the eyes" is reflected by the correlation between our task and the Eyes Test found in children. As we have shown above, children as a group seem not to distinguish well between AU6 and AU7 activation; individual differences in children, then, could be partly due to differences in eye-reading ability. In adults, discrimination between AU6 and AU7 seems to be less critical; indeed, we found

Table 4
Multiple Regression Analysis of How AU Intensity Predicts Perceived Authenticity of Items in the Sample With Adults

Intensity	B	95% CI for B	β	t	p
		Model 1, F test: $p < .001$; $R^2 = .58$			
AU12	6.92	2.72 to 11.11	.50	3.422	.002
AU25	−8.23	−11.49 to −4.97	−.76	−5.231	<.001
		Model 2, F test: $p < .001$; $R^2 = .68$			
AU12	3.19	−1.79 to 8.16	.23	1.333	.197
AU25	−5.98	−9.51 to −2.45	−.55	−3.520	.002
AU6	4.69	0.67 to 8.72	.41	2.423	.025
		Model 3, F test: $p < .001$; $R^2 = .77$			
AU25	−4.32	−6.83 to −1.81	−.40	−3.574	.002
AU6	4.18	1.22 to 7.14	.37	2.932	.008
AU7	−13.74	−22.54 to −4.94	−.40	−3.248	.004
		Model 4, F test: $p < .001$; $R^2 = .81$			
AU25	−4.12	−6.48 to −1.76	−.38	−3.639	.002
AU6	4.59	1.79 to 7.40	.40	3.414	.003
AU7	−13.21	−21.46 to −4.96	−.39	−3.340	.003
AU6 × AU25	3.39	−0.09 to 6.86	.20	2.031	.056

Note. AU = action units; CI = confidence interval. Mouth AUs are entered first.

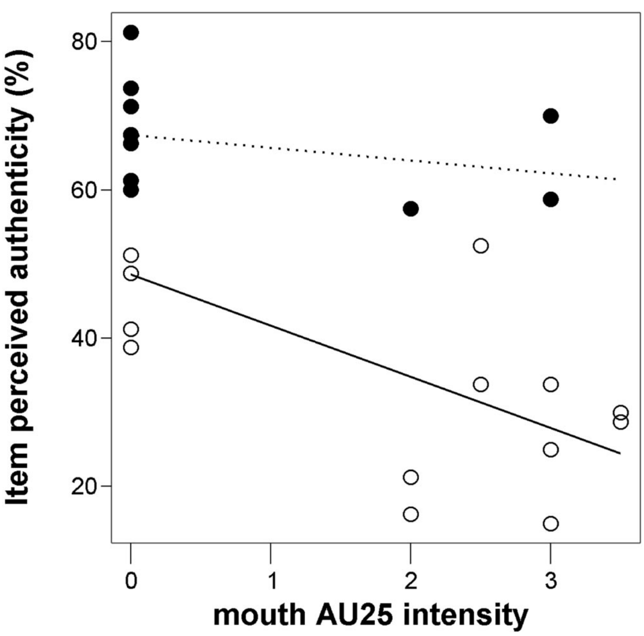

Figure 2. Regression plot showing interaction between AU25 (lips opening) and AU6 on the perceived authenticity of items in the adult sample. Separate regression lines are shown for items in which AU6 is present (black dots, dotted line) and items in which AU6 is absent (white dots, solid line). AU = action units.

a very low correlation between the Eyes Test and smile recognition in the adult group.

Discussion

A Developmental Model of Smile Recognition

In this article we describe some previously unreported differences in smile recognition between children and adults. Response analysis in the two groups showed that facial cues are assessed, and utilized, in quite different ways at different ages. Here we propose a basic developmental model of the smile recognition process, in which we synthesize our findings with those from previous literature (see Figure 3).

Sources of Developmental and Individual Differences

Where do developmental and individual differences in smile recognition come from? We identified three critical points in the recognition process where such differences could arise. First, attention should be paid to facial features. Because even very young children treat human faces as highly salient stimuli, big differences at this point are most likely due to pathological factors. Autistic people, for example, pay more attention than controls to noninformative regions of the face and especially little attention to the eyes (Pelphrey et al., 2002). If we consider autistic traits as a continuum to be found also in the nonclinical population (e.g., Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001), we may then expect to find smaller individual differences in smile recognition related to differences in attention to facial cues.

The second source of differences is the ability to operate fine discriminations between different AUs, especially in the eye region. Here we found a major developmental shift, with AU6 and AU7 showing a similar effect in 8-year-olds but sharply different effects in adults. This can be puzzling, given the characteristics of AU6 display: It has an early developmental onset, is exchanged between mothers and infants, and is likely to have an innate basis. However, AU6 and AU7 share their most easily visible effect, which is reduction of eye aperture. We propose that infants and children probably use the eye narrowing cue to detect enjoyment in smiles; later, this relatively coarse cue could be complemented with subtler but informative changes, such as cheek raising and crow's feet. Indeed, a visual scan study showed that adults make many gaze fixations to the crow's-feet area when looking at pictures of smiling faces (Williams, Senior, David, Loughland, & Gordon, 2001); to date, there has been no comparable research on children.

The third critical point we identified is the ability to detect discrepancies between eyes and mouth when judging smiles. Although children seem to "add" AU intensities from eyes and mouth, adults are very sensitive to discrepancy between a smiling mouth and neutral (AU0) or inconsistently activated (AU7) eyes. We propose that this apparent change in judgment criteria is useful to explain the relative small magnitude of the differences in performance usually found between children and adults. If criteria used by children and adults are qualitatively different, they will also suffer from different sources of error; adults' performance is not simply an improvement over that of children, but in a sense it may reflect a different trade-off in accuracy.

The Significance of Bared-Teeth Smiles

Data analysis revealed that bared teeth is an unexpectedly strong cue, affecting the response of both children and adults. It is interesting to note that we found no significant effect of pure smile intensity (AU12) on perceived authenticity, whereas AU25 was a significant predictor of authenticity, positive in children and negative (when coupled with AU0 or AU7) in adults. Although it is possible that a study with more statistical power might find a

Table 5
Descriptive Statistics for the Recognition Tasks in the Two Samples

Task	Overall *M*	Overall *SD*	Females *M*	Females *SD*	Males *M*	Males *SD*
Children						
Smile recognition	14.0	3.4	14.1	3.8	13.8	3.0
Eyes Task-C	14.1	4.6	14.7	4.8	13.6	4.4
JACFEE	9.4	2.5	9.3	2.4	9.5	2.7
Adults						
Smile recognition	16.2	3.7	16.9	3.7	15.4	3.5
Eyes Task-A	25.8	3.4	26.8	2.9	24.8	3.6
JACBART	9.4	2.3	9.5	2.0	9.2	2.6

Note. JACFEE = Japanese and Caucasian Faces of Emotion Expression; JACBART = Japanese and Caucasian Brief Affect Recognition Test.

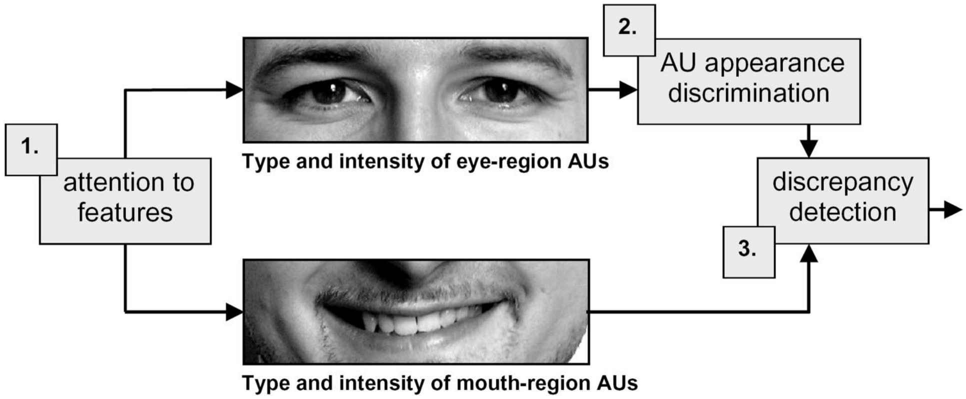

Figure 3. Three critical points in the process of smile recognition. Differences in these components may result from developmental changes, individual variation, and/or pathology. Note that the model is meant to represent the process of recognition, without assumptions about the neural structures involved and their sequential or parallel functioning. AU = action units.

smaller significant effect of AU12 alone, bared-teeth smiles do represent a distinct category; it is not clear yet whether they are perceived as a qualitatively different kind of smile (e.g., less controlled) or as a step along a continuum of emotional intensity (e.g., adults perceive open-mouth smiles as involving more arousal; see Bolzani-Dinehart et al., 2005).

This result is particularly interesting in the context of evolutionary theory: The human smile seems to be phylogenetically related to primate Silent Bared Teeth display, whereas laughter is thought to derive from Relaxed Open Mouth displays. Relaxed Open Mouth displays have a play-signal function in monkeys and can be found in certain phases of infants' play with mothers (Fogel et al., 2000); in contrast, Silent Bared Teeth displays seem to have an appeasement function related to signaling of nonaggressive intentions (for reviews, see Schmidt & Cohn, 2001; Waller & Dunbar, 2005). The bared-teeth component of smiles is usually overlooked in human facial expression studies, but our results suggest that it may have an important role.

Limitations and Future Directions

In this study, we began to assess age-related differences in the process of smile recognition. Of course, we still lack information about the age intervals before age 8 years and between age 8 years and adulthood, where developmental change is expected. Further research is also needed to confirm our hypothesis that children use eye narrowing as a primary cue to AU6 activation. Other limitations of our study come from the use of still pictures and from the absence of asymmetry cues. If, as seems likely, future research confirms the role of smile asymmetry and dynamics, these dimensions will need to be integrated in our basic recognition model. Moreover, individual differences in smile recognition may also come from differences in emotion knowledge, beyond perception alone (Chartrand & Gosselin, 2005).

Because most studies, including our own, make use of artificial FACS-synthesized stimuli, there is also need for ecological research on the recognition of naturally occurring facial expressions. Open-mouth smiles should also be included in future studies, in order to assess the relationship between the open-mouth and bared-teeth components.

Finally, we believe that future research could investigate the relationship between explicit judgment and implicit or physiological measures. For example, children in our study showed no influence of eyes-mouth discrepancies on their explicit judgments of smile authenticity: It would be interesting to investigate whether they showed some differences in physiological indices (e.g., pupillary size, brain activation) when looking at discrepant smiles.

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