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Differences Between Children and Adults in the Recognition of Enjoyment Smiles

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Abstract

We investigated the differences between 8 years old children (N=80) and adults (N=80) in recognition of felt vs. fake enjoyment smiles using a newly developed, FACS-based picture set. We tested the effect of different facial Action Units (AUs) on judgements of smile authenticity. Multiple regression showed that children base their judgement on both mouth and eyes AU intensity, with relatively little distinction between the Duchenne marker (AU6 or ‘cheek raiser’) and a different voluntary muscle which has 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. We propose and discuss an initial developmental model of the smile recognition process.

Key Words

Smiles, Duchenne marker, emotion recognition, FACS, 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, wich consists of prototypical, intense displays of "basic" emotions (e.g. Pollak, Cicchetti, Hornung & Reed, 2000; Pollak & Sinha, 2002; Blair & Coles, 2000; Simonian et al., 2001). Other researchers used even more stylized stimuli, such as cartoon faces (e.g. Pons, Harris, & de Rosnay,2004; Cassidy, Parke, Butkovsky & Braungart, 1992); the number of emotions usually ranges from four (joy, sadness, anger and fear) to seven (adding disgust, contempt and surprise).

While recognition of prototypical facial displays can be an adequate test of young children's ability, we think it definitely falls short when evaluating children older than six years. Research has shown that, by the sixth 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 (Pons et al., 2004; Meerum Terwogt, Koops, Oosterhoff & Olthof, 1986; Saarni, 1989; Gross & Harris, 1988; Gosselin, Warren & Diotte, 2002c). 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 where 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 to "felt" enjoyment smiles, compared with faked or "social" smiles (Frank, Ekman & Friesen, 1993). Its effects on the face are: narrowing of the eye aperture, wrinkles or "crows 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 (Schimdt & 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: 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 non-altruists (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 6-12 months old infants with their mothers. Infants from 1 to 6 months produce more Duchene smiles when mother is smiling at them (Messinger, Fogel & Dickson, 2001), and by 10 months they direct Duchenne smiles at 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 pre-term newborns. On the recognition side, Bugental, Kopeikin and Lazowski (1991) found that children from 3 to 6 years old tended to divert gaze from non-Duchenne smiles, showing at least some implicit discrimination ability. Gosselin, Perron, Legault and Campanella (2002b), using standardized stimuli, found that 9-10 years old children responded differently on a judgement task to Duchenne and non-Duchenne smiles, while they found no significant difference in 6 and 7 years old children. 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 candidate as a cue of genuine expression of enjoyment. Both smile asymmetry (e.g. Gazzaniga & Smylie, 1990; Wylie and Goodale, 1988; Brown et al., 2003) and synchrony and speed of AU activation (e.g. Bugental, 1986; Hess & Kleck, 1990; Frank & al., 1993) have been found to vary between posed and spontaneous facial expressions. However, it is not clear whether people do actually use these cues to evaluate smile authenticity. Gosselin et al. (2002b), for example, found that both adults and 9 years old children used AU6 activation, but *not* degree of symmetry, to discriminate between true and fake 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 Soppe, 1988 and Gosselin, Beaupre & Boissonneault, 2002a). Here we will describe the construction of a picture set for smile recognition, designed to assess the use of 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 et al., 2002b); we want to cover a wider range of smile intensity in order to obtain items of variable difficulty. Another novel feature of our picture set is introduction of AU7 as a “simulated” AU6 activation. We expect 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 colour 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 1024x768 pixels for on-screen presentation; those with too much asymmetry or other defects were discarded. We retained 25 simile 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 side 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.

[insert table 1 here]
[insert figure 1 here]

Participants

80 children (42 males and 38 females; age: *M* = 7y11m, *SD* = 4m) and 80 adults (38 males and 42 females; age: *M* = 27.8y, *SD* = 7.4) took part in the research. The children sample was recruited from a local school. 8 years old children were chosen because a) previous research shows that they understand the difference between genuine and faked expressions and b) the study by Gosselin et al. (2002b) reported an improvement in detection of the Duchenne marker between age 7 and 9. In order to obtain an heterogeneous sample, adult participants included volunteer university students from different faculties, high-school teachers and other workers. Both samples belonged to a middle-level SES.

Material and procedure

All participants were tested individually by a trained experimenter. Each participant was shown the 25 smile items, plus two 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 seconds, and were separated by a 1 second fade-to-black transition. Then, instructions 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. *Note:* Original instructions were in Italian; "contento" was the synonim for "happy").

The 25 smile items were then shown, in one of two randomized orders; each item had a duration of 3 seconds and started with a neutral face (1s), followed by a fading transition (1s) and the smiling face (1s). The one-second duration of the slide was chosen to give a natural feeling to the smile. After 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/she was sure that the child had properly watched the picture. The presentation was carefully constructed in order 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 judgements on subtle differences in muscle contraction.

After 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 know" answers were coded as incorrect, since 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 is needed to evaluate whether smile recognition is a facet of a general emotion recognition ability, or rather involves some distinct processes.

Eyes Test

The revised Eyes Test (Baron-Cohen et al., 2001a) is composed of 36 items, each showing the photograph of a person's eyes. The test taker is asked to choose, from 4 adjectives, the one which best describes the mental state of the pictured person; one point is given for each correct answer. While this test effectively discriminates between autistic and non-autistic people, there is also considerable variability in test scores among normal adults. In the children's sample, we used the 28-item children version of the Eyes Test (Baron-Cohen et al., 2001b).

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/she didn't 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 adults, we needed a more difficult task: the same 14 pictures of emotional expressions were embedded for a barely perceptible time ($1/5^{th}$ 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.

DATA ANALYSIS

In order to assess the influence of different AUs on smile judgement, we performed multiple linear regression analysis on the 25 items. Separately for each of the two samples, we tested 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 percent of times each item had been judged as "really happy" was the dependent (perceived autenthicity). For example, item 6I has the following intensities: AU6 = 2.0, AU7 = 0.0, AU12 = 3.5, AU25 = 2.0; its perceived authenticity is 56% for children (45 out of 80 children judged it to be authentic) and 58% for adults. Items were 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.

[Insert table 2 here]
[Insert table 3 here]
[Insert table 4 here]

The results revealed some interesting differences between children and adults in the use of facial cues. In the children sample, three AUs significantly and positively predicted perceived authenticity: AU6, AU7 and AU25 (model 3: 76% of variance explained). Thus, children actually use the information from the eyes but can be "fooled" by AU7, as was expected. While estimated regression coefficients are 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 (ranging 0-5), while it amounts to 6.7% for the *whole* activation range of AU7 (which is dichotomously scored). Thus, AU6 seems to exert a stronger overall influence on children's judgements than AU7. Bared teeth (AU25) are another important cue, while pure smile intensity (AU12) doesn't seem to predict authenticity when AU6 is taken into account (model 2; note that AU6 and AU12 show moderate collinearity, as shown in table 2).

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

[Insert figure 2 here]

To sum up, children's judgements seem to be strongly influenced by AU intensity, and in particular by the bared-teeth component: "strong" smiles tend to be perceived as sincere, irrespective of the eye AUs involved. On the contrary, adults seem to judge fake smiles more easily when they are 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, females performed slightly better than males in the Eyes Test, $t(78) = 2.711$, $p = .008$. In the children 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 et al. (2002b) found that adults correctily recognized AU6 (Duchenne) smiles of moderate intensity about 53-57% of times on average, while 7-year-old children's rates were about 45-47% (p. 94). For comparison, our AU6 smile pictures were recognized as felt, on average, by 66% of adults (ranging from 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 children group, 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 group, 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 fake 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 a very low correlation between the Eyes Test and smile recognition in the adult group.

DISCUSSION

A developmental model of smile recognition

In our study we described 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 (figure 3).

[insert figure 3 here]

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, one needs to pay *attention* to facial features. Since even very young children treat human faces as highly salient stimuli, big differences at this point are most likely to be 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 ety al., 2001c), 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 years old children 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 source. 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 "crows feet". Indeed, a visual scan study showed that adults make many gaze fixations to the crows feet area when looking to pictures of smiling faces (Williams et al., 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. While 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 judgement 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 itmay reflect a different trade-off in accuracy.

The significance of bared-teeth smiles

Data analysis revealed that bared teeth are 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, while 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 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 (for example, 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; human smile seems to be phylogenetically related to primate Silent Bared Teeth display (SBT), while laughter is thougth to derive from Relaxed Open Mouth displays (ROM). ROM 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, SBT seem to have an appeasement function, related to signaling of nonaggressive intentions (for reviews, see Schmidt & Cohn, 2001; Waller and 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 8 years and between 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 will confirm 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).

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

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Table 1. Complete FACS coding of the 25 smile pictures. AU intensity is scored separately for the right and left side of the face; intensity range goes from A (minimum) to E (maximum). Note that AU7 is not scored for intensity in the FACS system.

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

Table 2. Correlations between AU intensities in the 25 items (Pearson correlation for continuously scored AUs, point-biserial correlation for AU7). Note that correlations depend entirely on item constuction, and do not reflect the natural co-occurrence of AU activations. * = p < .05; ** = p < .01

	AU6	AU7	AU12	AU25
AU6	1.00			
AU7	-.51**	1.00		
AU12	.49*	-.31	1.00	
AU25	-.30	.24	.32	1.00

Table 3. Multiple regression analysis of how AU intensity predicts perceived authenticity of items in the children sample. Mouth AUs are entered first.

Model 1 (F-test: p= .004; R^2= .39)

	B	95% CI for B	β	t	p
AU12	5.44	2.08 to 8.79	.59	3.363	.003
AU25	.69	-1.92 to 3.30	.10	.548	.590

Model 2 (F-test: p< .001; R^2= .70)

	B	95% CI for B	β	t	p
AU12	.92	-2.26 to 4.09	.10	.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)

	B	95% CI for B	β	t	p
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	.77 to 12.63	.30	2.348	.029

Table 4. Multiple regression analysis of how AU intensity predicts perceived authenticity of items in the adult sample. Mouth AUs are entered first.

Model 1 (F-test: $p < .001$; $R^2 = .58$)

	B	95% CI for B	β	t	p
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: $p < .001$; $R^2 = .68$)

	B	95% CI for B	β	t	p
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	.67 to 8.72	.41	2.423	.025

Model 3 (F-test: $p < .001$; $R^2 = .77$)

	B	95% CI for B	β	t	p
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: $p < .001$; $R^2 = .81$)

	B	95% CI for B	β	t	p
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	-.09 to 6.86	.20	2.031	.056

Table 5. Descriptive statistics for the recognition tasks in the two samples.

Children

			Females		Males	
Task	*M*	*SD*	*M*	*SD*	*M*	*SD*
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

			Females		Males	
Task	*M*	*SD*	*M*	*SD*	*M*	*SD*
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

Figure Captions

Figure 1. Examples of the three smile types in the picture set. To facilitate comparison, the three items shown here all involve closed-lips smiles of similar intensity (see table 1 for complete FACS coding).

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 where AU6 is present (black dots, dotted line) and items where AU6 is absent (white dots, solid line).

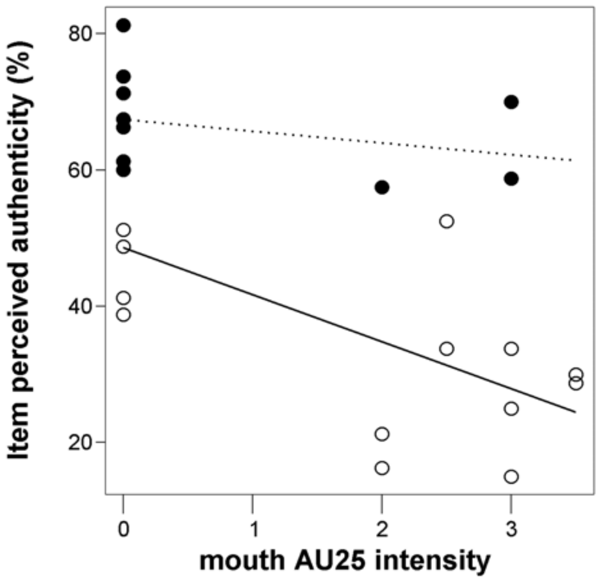
Figure 3. Three critical points in the process of smile recognition. Differences in these components can be due to developmental changes, individual variation and / or pathology. Note that the model is meant to represent the *process* of recognition, without assumptions about the neural structures involved and their sequential or parallel functioning.

Smile without eyes AU (AU0)

Smile with AU7

Duchenne smile with AU6

Figure 1



Item perceived authenticity (%)
80
60
40
20
0
1
2
3
mouth AU25 intensity

Figure 2

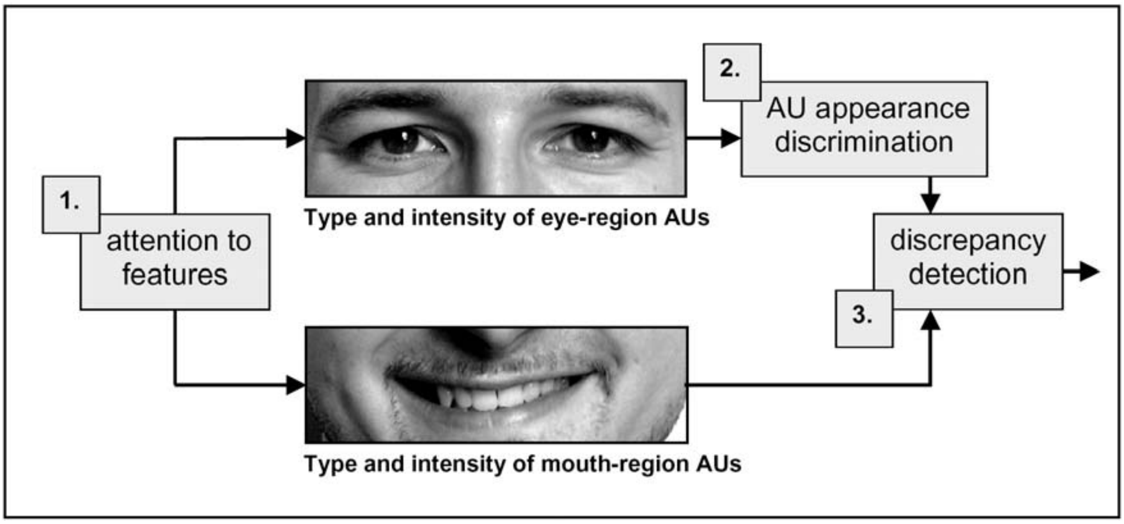

1.
attention to features
Type and intensity of eye-region AUs
2.
AU appearance discrimination
discrepancy detection
3.
Type and intensity of mouth-region AUs

Figure 3