CHILDREN’S AND ADULTS’ KNOWLEDGE OF THE DISTINCTION BETWEEN ENJOYMENT AND NONENJOYMENT SMILES

Pierre Gosselin, Mélanie Perron, Mélanie Legault, and Patrizia Campanella

ABSTRACT: Children’s and adults’ knowledge of the distinction between enjoyment and nonenjoyment smiles was investigated by presenting participants with short video excerpts of smiles prepared in accordance with the Facial Action Coding System (Ekman & Friesen, 1978). Enjoyment smiles differed from nonenjoyment smiles by greater symmetry and by appearance changes in the eye region produced by the orbicularis oculi action. The results indicate that 9- and 10-year-old children and adults were sensitive to the appearance changes produced in the eye region, but only when they could view the complete temporal dynamic of the smiles. No evidence of sensitivity was found for the level of asymmetry of the smiles, and no evidence of sensitivity for either of the markers was found in 6- and 7-year-old children.

KEY WORDS: emotion; facial expression; perception; development; enjoyment.

Emotional development is characterized by regulative processes which emerge very early in life. Clear evidence of control of emotional expression has been found in preschool children who smiled in order to mask their disappointment while receiving an unattractive gift (Cole, 1986; Josephs, 1994) or who were more likely to cry after injuring themselves if a caregiver was looking at them (Blurton-Jones, 1967). The control that children gradually gain over their emotional expression has important consequences for communication between children, as it makes this process much more complex. In order to know what other children really feel, a child has to...
pay attention not only to the emotion overtly expressed but also to the subtle clues indicating that an emotion is hidden or simulated.

The ability to judge the authenticity of emotional expression may have several benefits. At the individual level, it may help children to protect themselves better. For example, being able to judge the sincerity of an interest shown by other people in oneself may help to avoid harmful manipulations. At the group level, this ability may help children achieve a finer regulation of their relationships. For example, providing support or comfort to a friend may depend in some circumstances upon the ability to detect hidden sadness or fear. Being able to detect hidden anger in others may help to select appropriate actions preventing escalation of conflicts.

According to the theory of mind literature (Harris, 1990; Taylor, 1996), children begin to understand the distinction between real and apparent emotions during the preschool years. Using a concrete task, in which real emotions were symbolized with a feeling thermometer and apparent emotions with drawings of facial expressions, Josephs (1994) found that 4- and 5-year-olds were able to match correctly the face shown by characters with fictitious stories in which the characters overtly expressed or hid negative emotions. An even more precocious understanding of this distinction was reported by Banerjee (1997) with an interview protocol designed to reduce the verbal and memory load of the task. Children as young as 3 years of age were found to perform above chance level when asked to indicate the face shown by characters with fictitious stories in which the characters overtly expressed or hid emotions.

This precocious understanding in 3-year-olds is, however, rudimentary and largely implicit. Preschoolers have difficulty in verbally articulating their understanding of real and apparent emotions. Specifically, they are not proficient in providing examples of situations where they would dissimulate their emotions to other people (Saarni, 1989) and in providing justifications for dissimulating felt emotions (Harris, Donnelly, Guz & Pitt-Watson, 1986). In contrast, most 6-year-olds are able to report when and why they would dissimulate their emotions to other people (Saarni, 1989), and they understand the misleading effect that the control of expressive displays may have on other people (Gross & Harris, 1988). The knowledge of these topics continues to improve during later childhood, with older children (10–11 years) more able to take into account various factors susceptible to affect the likelihood of expressive control, such as the degree of affiliation with an interactant, status differences, and the intensity of felt emotions (Saarni, Mumme & Campos, 1998).

While a substantial body of evidence has been gathered about children’s knowledge of the contextual and motivational determinants of ex-
pressive control, relatively few studies have investigated children’s knowledge of the behavioral differences between real and apparent emotions. Expressions of genuine and simulated emotions have been found to differ according to several dimensions (Ekman, Hager & Friesen, 1981; Hess & Kleck, 1990; Weiss, Blum & Gleberman, 1987), but it is still unclear whether children and adults are sensitive to these differences. The examination of this question is also important because many social situations in everyday life are ambiguous and can therefore elicit different emotions in different people. It is difficult in such situations for people to infer the real emotion experienced by other people on the basis of the context alone. The information provided by the emotional behavior can potentially lead to better appraisal of the emotions felt by others (Ekman, 1982) and of the impression they intended to convey while controlling their expressive displays (Fridlund, 1994). In the two studies we present here, we examined children’s knowledge of the differences between enjoyment and nonenjoyment smiles. This kind of knowledge has been examined in adults to some extent (Frank, Ekman & Friesen, 1993; Hess & Kleck, 1994), but its developmental aspect has not yet been documented.

The facial expression of enjoyment was chosen for two reasons. First, the simulation of enjoyment appears to be the most common and most effective strategy to hide negative emotions (Ekman, 1985). Therefore, knowledge of the distinction between enjoyment and nonenjoyment smiles has clear relevance for the social adaptation of children. Second, the facial expression of enjoyment has been documented far more than the expression of other fundamental emotions, and consistent differences have been found between enjoyment and nonenjoyment smiles. Enjoyment smiles include muscular activity of the orbicularis oculi and of the zygomatic major. The former raises the cheeks, causing crow’s feet and bulges beneath the eyes, while the latter pulls lip corners up diagonally toward the cheekbones. Slight levels of asymmetry have been reported more often in nonenjoyment smiles than in enjoyment smiles (Ekman, Hager & Friesen, 1981; Hager & Ekman, 1985). Ekman, Friesen and O’Sullivan (1988) and Frank et al. (1993) also found that the Cheek Raiser, which raises the cheeks, causing bulges beneath the eyes, and sometimes crow’s feet on the side of the eyes, occurred less frequently in nonenjoyment than in enjoyment smiles. Finally, nonenjoyment smiles are characterized by a speed of muscular contraction that is more irregular than enjoyment smiles (Hess & Kleck, 1990; Weiss, Blum & Gleberman, 1987).

Judgment studies concerned with the authenticity of emotional expressions have mainly focused on the ability to detect deception. In these studies, participants were shown short videos of other participants who
were instructed to express honestly felt emotions, to mask felt emotions or to simulate emotions (Ekman & Friesen, 1974; Ekman & O’Sullivan, 1991; Gosselin, Kirouac & Doré, 1995; Hess & Kleck, 1994). The results of these studies indicate that it is generally difficult, even for adults, to detect whether the facial displays were deceptive or not. Soppe (1988), using a similar method, examined the development of this ability and found than children between 6 and 12 years of age can detect the masking and inhibition of negative emotions, but not the simulation of negative emotions, and not the masking, inhibition and simulation of positive emotions. In contrast, adults were able to detect all kinds of deception, except the simulation of negative emotions.

One limitation of the aforementioned studies is that they did not provide information on which aspects of facial activity the decoders were sensitive to. In other words, they did not identify the specific type of knowledge that decoders had about the distinction between genuine and deceptive expressions. The examination of this issue would require a different method in which decoders are presented with expressive displays varying systematically for the physical parameters being studied, but being constant for the other parameters. To our knowledge, only two studies attempted to use this approach, although they did not control all the physical parameters.

Frank et al. (1993) investigated whether adults were sensitive to the activation of the Cheek Raiser and to the duration of smiles, two clues which have been hypothesized to distinguish enjoyment from nonenjoyment smiles. The participants in their study were presented with short video excerpts showing people smiling when talking about something pleasant or funny, and smiling when talking about something unpleasant. The material was selected so that enjoyment smiles involved the simultaneous activation of the Cheek Raiser and of the Lip Corner Puller and were of moderate duration (M = 4.75, SD = 4.47 sec.), while nonenjoyment smiles involved the activation of the Lip Corner Puller only and had very brief or very long durations. The results revealed that adults were sensitive only to the activation of the Cheek Raiser. Specifically, they were more prone to say that the stimulus persons were truly happy when the Cheek Raiser and the Lip Corner Puller were activated simultaneously than when only the Lip Corner Puller was activated.

Bugental, Kopeikin and Lazowski (1991) studied children’s visual responses to enjoyment and polite smiles while interacting with adults. Enjoyment smiles were defined as those that included the activation of the Cheek Raiser and Lip Corner Puller while polite smiles were those not accompanied by the Cheek Raiser, smiles accompanied by action units
associated with negative emotions, and smiles that included action units associated with conversation regulation. Children’s gaze behavior was found to vary according to their age and according to whether they were from abusive or nonabusive families. Below the age of 7, children from nonabusive families showed eye aversion in response to polite smiles, but not to enjoyment smiles. By age 10, they showed no significant deviation from base rates for polite smiles, but showed elevated levels of sustained gaze in response to enjoyment smiles. These developmental shifts were not found in children from abusive families who responded to polite smiles with eye aversion at all ages between 3 and 13.

Bugental et al. (1991) interpreted the developmental shifts found in children from nonabusive families as reflecting an increased understanding of the significance of the two types of smiles, with the polite smiles understood as a discrepant stimulus eliciting social withdrawal in young children and understood as a minor and common deception in older children. The pattern of gaze behavior they found in children between 3 and 6 years old indicates clearly that these children discriminated between enjoyment and polite smiles. However, the significance of their results in older children (10–13) is less clear, as the study did not assess whether children actually interpreted both types of smiles as enjoyment or polite. Therefore, it was not clear that older children had an explicit knowledge of the differences between enjoyment and polite smiles.

One problem with the method used by Frank et al. (1993) and Bugental et al. (1991) is that it was not possible for them to control all the physical parameters of the stimulus material, and, consequently, to identify the specific parameters the participants were sensitive to. For example, the temporal dynamics (regularity of the speed of the muscular action) was not controlled in either of these studies. Furthermore, the polite smiles in Bugental et al. differed from the enjoyment smiles on various dimensions simultaneously and the intensity of the facial actions was not controlled. An alternative approach that can be used to achieve better control of the physical parameters of the stimulus material is to instruct stimulus persons to produce very specific facial actions according to predetermined intensity, durations, and temporal dynamics. The stimulus material obtained in this way would be artificial, but this would not be a problem if the appropriate research design and index of sensitivity were chosen.

In the two studies reported here, we investigated children’s and adult’s knowledge of the distinction between enjoyment and nonenjoyment smiles. In the first study, we examined whether children and adults were sensitive to the activation of the Cheek Raiser (also known as the Duchenne marker) and to the asymmetry of smiles. In the second study, we investigated how
much dynamic information decoders needed to judge the authenticity of smiles. In order to control the physical parameters of the expressive displays as much as possible, we asked stimulus persons to produce very specific facial actions according to predetermined intensity, durations, and temporal dynamics. We reasoned that if children and adults have some knowledge of the two features distinguishing enjoyment and nonenjoyment smiles, they would be more likely to judge the stimulus persons as being really happy for smiles featuring the Duchenne marker and the symmetry marker than smiles not featuring these markers. Given the possibility that the artificiality of the stimulus material could affect the use of response categories, the participants’ knowledge of the significance of these two features was inferred on the basis of their relative tendency to judge the stimulus persons as really happy, and not on the basis of hit rates. The Facial Action Coding System (Ekman & Friesen, 1978) was used to ensure that the physical parameters of the stimuli were adequately manipulated.

Study 1

This study examined whether children and adults were sensitive to the Duchenne marker and to the symmetry marker. Based on the findings reported by Frank et al. (1993), we hypothesized that adults would demonstrate an implicit knowledge of the fact that enjoyment smiles are characterized by the activation of the Cheek Raiser. In the context of the present study, this knowledge would be manifested by a greater tendency to say that the stimulus person was really happy when the Cheek Raiser and the Lip Corner Puller were both activated than when only the Lip Corner Puller was activated.

The findings reported by Bugental et al. (1991) suggest that 10-year-olds may have some knowledge of the features distinguishing enjoyment from nonenjoyment smiles. However, their study was not designed to assess whether children actually perceived the two types of smiles as enjoyment and nonenjoyment. Furthermore, it was not clear what were the specific facial features characterizing polite smiles that children were sensitive to. Consequently, no specific hypothesis was made in relation to children’s knowledge of the facial clues.

The second aim of this study was to examine whether children and adults had an explicit knowledge of the differences between enjoyment and nonenjoyment smiles. After viewing the tape, participants were asked to identify the differences between enjoyment and nonenjoyment smiles.
Method

Participants

Thirty children, aged 6 and 7 years (M = 6.70, SD = 0.40), and 30 adults (M = 23.48, SD = 6.44) participated in this study, with roughly the same number of males and females in each group. The children were recruited from two middle-class elementary schools, located in the Ottawa-Hull region of Canada, and the adults were recruited from social sciences classes at the University of Ottawa. All participants were French Canadian and had French as their mother tongue. Only children with informed parental consent and adults with informed consent participated in the study.

Materials

Participants were shown videotapes of three different smiles, each smile being produced by eight stimulus persons: four adult males and four adult females. The physical parameters of the smiles were controlled with the Facial Action Coding system (FACS), developed by Ekman and Friesen (1978). The FACS is an anatomically based measurement method that distinguishes 44 facial action units. Facial behavior is described in terms of combinations of action units and the coding process requires repeated slow-motion as well as real-time inspection of the tape. FACS contains norms to code the intensity of action units and their temporal dynamics. Five intensity levels, from A (very slight) to E (extreme), and three temporal phases (onset, apex and offset) are distinguished.

Each stimulus person was met individually by a FACS expert and instructed to produce specific facial movements. First, the target facial configuration was verbally described by the FACS expert and illustrated with photographs. Second, the stimulus persons were instructed to practice the target configurations several times, looking into a mirror, and receiving feedback from the FACS expert. After a few successful attempts, the stimulus persons were videotaped while producing each of the three smiles 25 times, receiving a feedback after each attempt.

The first type of smile (symmetric Duchenne marked) involved the Cheek Raiser and the Lip Corner Puller. The former raises the cheeks, causing crow’s-feet and bulges beneath the eyes, while the latter pulls lip corners up diagonally toward the cheekbones. The stimulus persons were instructed to activate moderately (C level) and symmetrically these two action units for each side of the face, with each temporal phase (onset, apex and offset) lasting about one second. For the second type of smile
(asymmetric Duchenne marked), the instructions were the same, except that the action units had to be activated slightly more intensively (one intensity level difference) on one side of the face than on the other. The choice of the side to be activated more intensively was left to the stimulus persons. Finally, for the third type of smile (non-Duchenne marked), the stimulus persons were instructed to moderately (C level) and symmetrically activate the Lip Corner Puller, with each temporal phase lasting around one second.

The material was subsequently coded by three coders who had previously passed the FACS proficiency test. One coder reviewed all the material and identified 84 smiles (3 or 4 exemplars of each type of smile per stimulus person) which had the action units, intensities, and temporal dynamics we were looking for. Each of these 84 smiles were later coded by two other coders. The interrater agreement ranged from 93.5% to 94.4% for coding the presence of action units, from 85.0% to 86.2% for the presence of asymmetry, and from 51% to 57% for their intensity. Although these latter values might seem low, they were comparable to those reported by Ekman and Friesen (1982). Almost all of the disagreements were one-point disparities. Within a one-point margin of error, the agreement ranged from 96.5% to 97.9%. For the agreement on the duration of each temporal phase, we computed how often the two coders agreed inside a .25 sec. margin of error. The agreements ranged from 66.2% to 83.1%, 55.4% to 59.3% and 63.5% to 66.1% for the duration of the onset, apex and offset, respectively.

One exemplar of each of the three types of smiles produced by each stimulus person was selected from the 84 smiles. We chose those which contained the action units and intensities we were looking for and which had comparable temporal dynamics. The asymmetric smiles were selected from those having one intensity level difference between the two sides of the face. As shown in Table 1, the mean duration of onset, apex and offset ranged from 0.9 to 1.2 sec., 1.3 to 1.5 sec., and 1.1 to 1.3 sec., respectively. This table also indicates that the three types of smiles were also comparable with respect to the total duration and intensity of their action units. Illustrations of the three types of smiles are displayed in Figure 1.

Procedure

Children. Children were tested individually, in French, by a female experimenter in a quiet room located near their classroom. They were told that they would see 24 short video excerpts showing eight people smiling. They were informed that the person was really happy while smiling in
TABLE 1

Mean Duration (in s) and Intensity of the Smiles Shown to Participants in Study 1

<table>
<thead>
<tr>
<th>Duration</th>
<th>Onset</th>
<th>Apex</th>
<th>Offset</th>
<th>Total</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Symmetrical Duchenne marked smile</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheek Raiser</td>
<td>1.0</td>
<td>1.3</td>
<td>1.2</td>
<td>3.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Lip Corner Puller</td>
<td>1.2</td>
<td>1.4</td>
<td>1.3</td>
<td>3.9</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>Assymetrical Duchenne marked smile</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheek Raiser</td>
<td>0.9</td>
<td>1.4</td>
<td>1.1</td>
<td>3.4</td>
<td>2.3</td>
</tr>
<tr>
<td>Lip Corner Puller</td>
<td>1.1</td>
<td>1.4</td>
<td>1.2</td>
<td>3.7</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Symmetrical NonDuchenne marked smile</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lip corner Puller</td>
<td>1.2</td>
<td>1.5</td>
<td>1.2</td>
<td>3.9</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Note. In order to assess the equivalence of the intensity of the action units in the three smiles, we calculated the mean rank values, with rank 1 corresponding to very slight, rank 2 to low, rank 3 to medium, rank 4 to medium-high, and rank 5 to extreme.

some video excerpts whereas, in other video excerpts, he or she was not happy but smiled in order to look happy. Then, children were asked to describe a situation in which someone was really happy and smiled, and a situation in which someone was not happy but smiled in order to look happy. If the children were not successful in describing these two situations after three attempts, the experimenter provided them with appropriate situations. This part of the procedure was aimed at making clear the kind of judgment that the children would be expected to make while seeing the video excerpts. The children's responses were coded independently by two judges. The interrater agreement (kappa), calculated on the basis of the 60 descriptions coded by each judge, was .91. Almost all the children (93.3%) provided adequate descriptions of a situation in which someone was really happy and smiled and nineteen of them (63.3%) were able to describe a situation in which someone was not happy by smiled in order to look happy.

The children were then shown the 24 video excerpts and asked after each excerpt the following question: “In your opinion, was the person
Figure 1. Photographs of one stimulus person showing the three types of smiles at the apex and the neutral face (upper left picture). In the Symmetrical Duchenne smile (lower left picture), the Cheek Raiser and the Lip Corner Puller are both activated symmetrically. In the assymetrical Duchenne smile (lower right picture), the Cheek Raiser and the Lip Corner Puller are both activated, but the activation is more intense on one side of the face than on the other. In the symmetrical Non-Duchenne smile (upper right picture), the Lip Corner Puller is activated symmetrically.

really happy or did she (or he) just pretend to be happy?” Their responses were written down by the experimenter. Two tapes were prepared, with different fixed randomized orders of the stimuli.

After the viewing of the tape, the children were asked: “In your opinion, what were the differences in the face when the people were really happy and when they pretended to be happy? This free-response question was followed by a binary response question: “Do you think that the (name of the facial region) looked different?” which was asked for each of the following five regions: mouth, brows, cheeks, nose and eyes. The order of
these regions was randomized across participants. Again, their responses were written down by the experimenter.

**Adults.** Adults were tested individually, in French, in a laboratory room at the University of Ottawa. After filling out the consent forms, they received written information describing the task they were expected to perform. This information was identical in content to the information the children received, but was phrased appropriately for adults. Unlike the children, the adults were not asked to provide examples of situations in which someone smiled when really happy and when not happy. The adults provided their responses by filling out an answer sheet.

### Results

**Judgment of the Authenticity of the Smiles**

Given that prior analyses did not indicate any significant main effect or interaction effect related to presentation order of the stimuli and participants' gender, the data were pooled together for the main analyses. The dependent variable was the proportion of responding that the stimulus person was really happy, and was calculated on the basis of eight trials per condition. As shown in Table 2, the adults' tendency to say that the stimulus persons were really happy increased as a function of the activation of the Cheek Raiser, but not as a function of the symmetry of the smiles. The children's tendency to say that stimulus persons were really happy did not seem affected by the symmetry of the smiles nor by the activation of the Cheek Raiser.

The data were treated with a $2 \times 3$ (Age $\times$ Type of smile) ANOVA, with repeated measures for the last factor. Given that the requirement of sphericity of orthogonal components was met, the univariate approach was used. The analysis revealed a main effect for the type of smile, $F(2, 116) = 15.09$, $p < .0001$, and for the interaction between the two factors, $F(2, 116) = 7.99$, $p < .001$.

The analysis of simple effects showed that the type of smile was significant in adults only, $F(2, 58) = 21.92$, $p < .0001$. The Tukey multiple comparison test indicated that adults were more likely to say that the stimulus persons were really happy for the symmetric and asymmetric Duchenne marked smiles than for the symmetric nonDuchenne marked smiles, indicating that adults were sensitive to the activation of the Cheek Raiser, but not to the asymmetry of smiles.

Given that only 19 of the 30 children were able to provide adequate
### TABLE 2

**Participants’ Tendency (mean proportions of responses) to Perceive the Stimulus Persons as Really Happy in Study 1**

<table>
<thead>
<tr>
<th>Type of smile</th>
<th>Symmetrical Duchenne marked</th>
<th>Assymetrical Duchenne marked</th>
<th>Symmetrical nonDuchenne marked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>.45</td>
<td>.47</td>
<td>.43</td>
</tr>
<tr>
<td>SD</td>
<td>.16</td>
<td>.18</td>
<td>.22</td>
</tr>
<tr>
<td>Adults</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>.53</td>
<td>.57</td>
<td>.31</td>
</tr>
<tr>
<td>SD</td>
<td>.20</td>
<td>.16</td>
<td>.15</td>
</tr>
</tbody>
</table>

Examples of a situation in which a person smiled when being happy and smiled when pretending to be happy, we reanalyzed the data according to this ability. The mean proportions of responding that the stimulus persons were really happy for the symmetric Duchenne marked smile, asymmetric Duchenne marked smile and symmetric nonDuchenne smile were .40 (SD = .11), .43 (SD = .10), and .44 (SD = .22), respectively, for the group of children who did not provide adequate descriptions of situations while the corresponding mean proportions were .47 (SD = .18), .49 (SD = .21) and .42 (SD = .23) for the other group. In order to assess whether the pattern of responses of the two groups was different, the data were treated with two separate ANOVAs, with the type of smiles as the within group factor. No significant effect was found in these analyses, indicating children were not sensitive to the asymmetry of the smiles nor to the activation of the Cheek Raiser.

**Differences Reported by the Participants**

The participants’ answers to the free-response question were examined independently by two judges to assess whether they explicitly referred to the two parameters examined in the study. An answer was coded as referring to asymmetry when the participants mentioned that the facial activity was more intense on one side of the face than on the other in nonen-
joyment smiles. An answer was coded as referring to the activation of the Cheek Raiser when participants reported that the enjoyment smiles differ from nonjoyment smiles in one of the following features: the eyes looked smaller, the eyes had something special, or the cheeks were raised. All the material was coded by each judge, and the interrater agreements (kappa) were 1.0 and .96 for the asymmetry and the activity of the Cheek Raiser, respectively. Only one adult and none of the children referred to the dimension symmetry/asymmetry. Important differences between children and adults were found for the other dimension. Only two children (6.7%) mentioned appearance changes associated with the Cheek Raiser, but 17 adults (56.7%) did.

Three of the five facial regions enumerated by the experimenter presented differences related to asymmetry or activation of the Cheek Raiser: the eye, cheek, and mouth regions. The symmetric Duchenne marked smile differed from the asymmetric Duchenne marked smile in the mouth, eye and cheek regions, and from the symmetric nonDuchenne marked smile in the eye and cheek regions. Participants were credited correct points for identifying each of these regions and for rejecting the nose and the brow regions. For the main analysis of the data, we used the unbiased hit rate, proposed by Wagner (1993), as the dependent variable. In the context of this study, this measure represented the joint probability that a difference in the facial regions was correctly detected, given that it occurred at all, and that a response was correctly used, given that it was used at all. The advantage of this measure, compared to other measures, is that it took into account both the probability of an event, in this case a difference in the face, and response bias. The unbiased hit rate could range from 0 (null accuracy) to 1 (perfect accuracy). The overall accuracy was .63 (SD = .25) for the children and .72 (SD = .20) for the adults, and was above chance levels in each case, $t(29) = 5.23$ and $8.54$, $p < .001$, respectively. A one way ANOVA, with age as the between group factor, did not reveal a significant difference between the children and the adults, $F(1, 58) = 1.47$, $p < .23$.

To check for possible judgment bias in detecting distinctive features, we computed the probability of saying yes for each participant. The mean probability of saying yes for the children ($M = .67$, $SD = .22$) was very close to that of the adults ($M = .69$, $SD = .16$). Potential judgment bias was evaluated by verifying whether the mean probability of saying yes differed from the real probability of the distinctive features in the task (.60). This analysis revealed that both the children, $t(29) = 2.24$, $p < .04$, and the adults, $t(29) = 3.08$, $p < .01$, slightly overestimated the differences in
TABLE 3

Percentage of Participants Who Indicated Differences in Particular Facial Regions in Study 1

<table>
<thead>
<tr>
<th>Age group</th>
<th>Mouth</th>
<th>Brows</th>
<th>Cheeks</th>
<th>Nose</th>
<th>Eyes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children</td>
<td>86.6</td>
<td>53.3</td>
<td>76.7</td>
<td>36.7</td>
<td>83.3</td>
</tr>
<tr>
<td>Adults</td>
<td>90.0</td>
<td>66.7</td>
<td>83.3</td>
<td>10.0</td>
<td>96.7</td>
</tr>
</tbody>
</table>

Note. The symmetrical Duchenne marked Smile differed from the two other smiles in the mouth, cheek and eye regions, but not in the nose and brow regions.

the face. As can be seen in Table 3, some participants were likely to find differences in the brow and nose regions, although these regions were not modified by the two parameters manipulated in the study.

Discussion

On the basis of the findings of Frank et al. (1993), we hypothesized that adults would be more likely to say that the stimulus persons were really happy when the Cheek Raiser was activated than when it was not. This prediction was confirmed by the results we obtained, indicating that adults had an implicit knowledge of this distinction between enjoyment and non-enjoyment smiles. The answers provided by adults to the free-response question, after the presentation of the stimuli, indicated that many of them demonstrated an explicit knowledge of this distinction. More than half of the adults referred spontaneously to some distinctions in the eye region, and many of them explicitly said that the eyes looked smaller when the stimulus persons were really happy.

We did not find evidence that adults would be more likely to say that the stimulus persons were really happy when the smiles were symmetric than when they were asymmetric. Given that the smiles only differed by a small amount of asymmetry, it is possible that the variation of this parameter was so subtle that it was not even noticed by the participants. This interpretation is supported by the answers provided by the adults to the free-response question. Of the 30 adults, only one spontaneously referred to the asymmetry of the smiles, and said that the enjoyment smiles were more symmetric than nonenjoyment smiles. Would we have obtained dif-
different results with a more powerful manipulation of this parameter? Although possible, these results would not be very meaningful given that previous research only reported a small amount of asymmetry in nonenjoyment smiles (Ekman et al., 1981; Hager & Ekman, 1985).

The results of this study indicate that 6- and 7-year-old children have a very limited knowledge of the differences between enjoyment and nonenjoyment smiles. Children’s tendencies to say that the stimulus persons were really happy did not increase as a function of the activation of the Cheek Raiser nor as a function of the symmetry of the smiles. In addition, very few of them correctly identified the differences between enjoyment and nonenjoyment smiles when they were asked the free-response question after the presentation of the stimuli. However, the children were able to locate the regions of the face in which enjoyment and nonenjoyment smiles differed when their attention was directed to specific facial regions, with a performance comparable to that of the adults. We think that this capability might be the manifestation of a rudimentary form of knowledge preceding the emergence of a more explicit knowledge. According to this interpretation, children might first learn that enjoyment and nonenjoyment smiles differ in some regions of the face without knowing the meaning of these differences. It is only later, during childhood or during adolescence, that they might be able to give the appropriate meaning to these differences.

This interpretation is in agreement with the proposal made by Bugental et al. (1991) that preschool children have the perceptual ability to discriminate between enjoyment and polite smiles, but have not yet learned the meaning of enjoyment and polite smiles. These authors suggested that children younger than 7 years of age respond to polite smiles with eye aversion because they perceive them as discrepant stimulus, not as a minor deception commonly used in social situations.

In the procedure used in this study, we asked children to provide examples of a situation in which someone was really happy and smiled, and of a situation in which someone was not happy but smiled to look happy. This part of the procedure was aimed to ensure that the children had an appropriate understanding of the task. While almost all the children provided adequate examples of the first type of situation, only 63.3% of them provided adequate examples of a situation in which someone smiled in order to look happy.

According to the theory of mind literature, children begin to understand the distinction between real and apparent emotions in the preschool years. For this reason, we think that the failure of several children in this study to give an appropriate example of a situation involving simulation resulted more from their difficulty in accessing this type of episodic knowl-
edge or their reluctance to share this information with the experimenter than from their lack of understanding. The fact that the children were successful in locating the regions of the face in which enjoyment and nonenjoyment smiles differed indicates that they understood the task. Furthermore, we reanalyzed the data to determine whether the children who gave an appropriate example of a situation involving simulation differed from those who did not, and we did not find any difference between the two groups.

The results obtained in this study raise two questions. First, the developmental pattern of children’s knowledge of the differences between enjoyment and nonenjoyment smiles has to be examined more closely in order to determine at which moment children become able to associate the activation of the Cheek Raiser with genuine enjoyment. Second, it would be interesting to know how much dynamics information decoders need in order to be able to relate the activation of the Cheek Raiser to genuine enjoyment. The examination of this question could provide valuable information on the perceptual processes underlying the judgment of the authenticity of expressive displays.

**Study 2**

In this study, we examined more closely the developmental pattern of the judgment of the authenticity of smiles. The sample of participants included three age groups: 6 to 7 years, 9 to 10 years and 19 to 20 years. Given the results obtained in the first study, the investigation focused only on the sensitivity to the activation of the Cheek Raiser. It was hypothesized that adults would be more likely to judge the smiles as enjoyment when the Cheek Raiser was activated than when it was not. Secondly, we examined how much dynamics information decoders needed to judge the authenticity of the smiles. Participants were presented with video excerpts showing the complete smile in one condition, the onset followed by the apex in a second condition, and only the apex in the third condition.

**Method**

*Participants*

Fifty-five children (27 females and 28 males) enrolled in two middle-class, urban, elementary schools, located in Hull, Canada, and 30 young adults, enrolled in one college, located in the same city, participated in this
study. They were distributed into three age groups: 6 to 7, 9 to 10, and 19 to 20, with about the same number of males and females in each group. All the participants were French Canadian and had French as their mother tongue. Only children with informed parental consent and young adults with informed consent participated in the study. No remuneration was given for participation.

**Materials**

Participants were presented with videotapes of two types of smiles, the symmetric Duchenne marked smile and the symmetric non-Duchenne marked smile, chosen from those used in Study 1. Each type of smile was produced by four stimulus persons, two females and two males, and presented three times: one time from the onset to the offset (complete smile), one time from the onset to the end of the apex, and one time from the beginning to the end of the apex. The mean duration of the video excerpts associated with these three conditions were 3.7, 2.7, and 1.6 sec., respectively, for the symmetric Duchenne marked smile, and 3.8, 2.6 and 1.5 sec., respectively, for the symmetric non-Duchenne marked smile. The order of presentation of the 24 video excepts was randomized but fixed across participants.

**Procedure**

The procedure was identical to that used in Study 1, except that the participants were informed that they would be presented with complete and incomplete sequences of smiles. In addition, participants were not questioned, at the end of the experiment, about the facial differences they perceived between the smiles.

**Results**

As one can see from Table 4, the mean proportion of responding that the stimulus persons were really happy was slightly higher for the symmetric Duchenne marked smile than for the symmetric non-Duchenne marked smile in all of the conditions, except when the younger children were just shown the apex of the smiles. As expected, the greatest differences were found in the adults when they were shown the three temporal phases of the smiles. Substantial differences were also found in older children when they were shown the three temporal phases of the smiles, suggesting that older children were sensitive to the activation of the Cheek Raiser.
TABLE 4

Participants’ Tendency (mean probability of responses) to Perceive the Stimulus Persons as Really Happy in Study 2

<table>
<thead>
<tr>
<th>Age</th>
<th>Amount of dynamic information</th>
<th>Complete</th>
<th>Onset and apex</th>
<th>Apex</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Duchenne marked smile</td>
<td>NonDuchenne marked smile</td>
<td>Duchenne marked smile</td>
<td>NonDuchenne marked smile</td>
</tr>
<tr>
<td>6–7 years</td>
<td>M .49</td>
<td>.36</td>
<td>.55</td>
<td>.41</td>
</tr>
<tr>
<td></td>
<td>SD .34</td>
<td>.24</td>
<td>.30</td>
<td>.32</td>
</tr>
<tr>
<td>9–10 years</td>
<td>M .33</td>
<td>.13</td>
<td>.63</td>
<td>.46</td>
</tr>
<tr>
<td></td>
<td>SD .25</td>
<td>.19</td>
<td>.21</td>
<td>.24</td>
</tr>
<tr>
<td>19–20 years</td>
<td>M .56</td>
<td>.13</td>
<td>.57</td>
<td>.46</td>
</tr>
<tr>
<td></td>
<td>SD .30</td>
<td>.18</td>
<td>.18</td>
<td>.23</td>
</tr>
</tbody>
</table>

Note. Both smiles were symmetrical.
Participants' sensitivity to the activation of the Cheek Raiser was indexed by calculating the difference between the two types of smiles for the proportion of times the stimulus persons were perceived as really happy. This variable was used as the dependent variable in the analyses aimed to assess whether the performance was above chance level and in analyses aimed to assess the effect of age and experimental conditions.

The t test revealed that the stimulus persons were perceived more often as being really happy with the symmetric Duchenne marked smile than with the symmetric non-Duchenne marked smile only by adults and older children when they were shown the three phases of the smiles, \( t(29) = 5.90, p < .01 \), and \( t(27) = 4.60, p < .01 \), respectively.

The data were analyzed with a 3 × 3 (Age × Temporal phases) ANOVA, with repeated measures on the latter. Given that the requirement of sphericity of orthogonal components was met, the univariate approach was used. The analysis indicated a main effect for age, \( F(2, 82) = 3.58, p < .03 \), for the temporal phase, \( F(2, 164) = 7.28, p < .001 \), and for the interaction between these two factors, \( F(2, 164) = 2.89, p < .03 \). Further analyses of the effect of the temporal phase revealed a significant linear trend, \( F(1, 82) = 17.67, p < .0001 \), with sensitivity increasing as a function of the number of temporal phases.

The analyses of the simple effects showed that there were differences between age groups only when participants were shown the three phases of the smiles, \( F(2, 82) = 7.17, p < .002 \). The Tukey multiple comparison test indicated that the adults were more sensitive to the activation of the Cheek Raiser than the two groups of children. The analysis of the simple effects also revealed that there were differences between the three experimental conditions only in adults, \( F(2, 58) = 9.20, p < .0003 \). The Tukey multiple comparison test showed that adults' sensitivity to the Cheek Raiser was higher when they were presented with the three temporal phases of the smiles than when they were presented only with the apex or with the combined onset and apex of the smiles.

In order to assess the generalization of these findings, we examined the pattern of responses for each of the stimulus persons. As can be seen from Table 5, the percentage of participants who perceived the stimulus person as being really happy was higher with the symmetric Duchenne marked smile than with the symmetric non-Duchenne marked smile. The difference in the perception of the two smiles was greater in the adults than in the children in the case of each stimulus person. The significance of the difference between the two types of smiles was examined with the McNemar test and, when the expected frequencies were smaller than 5, with the binomial test. Significant differences were found for each of the
TABLE 5

Percentage of Participants Responding that the Stimulus Person Was Really Happy When Presented with Complete Smiles in Study 2

<table>
<thead>
<tr>
<th>Age/type of smile</th>
<th>6–7 years</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>Duchenne marked smile</td>
<td>53.6</td>
<td>60.7</td>
<td>32.1*</td>
<td>50.0</td>
</tr>
<tr>
<td>NonDuchenne marked smile</td>
<td>46.4</td>
<td>46.4</td>
<td>14.3</td>
<td>35.7</td>
</tr>
<tr>
<td>9–10 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duchenne marked smile</td>
<td>29.6</td>
<td>25.9</td>
<td>33.3*</td>
<td>44.4***</td>
</tr>
<tr>
<td>NonDuchenne marked smile</td>
<td>11.1</td>
<td>22.2</td>
<td>7.4</td>
<td>11.1</td>
</tr>
<tr>
<td>19–20 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duchenne marked smile</td>
<td>46.7**</td>
<td>53.3**</td>
<td>73.3***</td>
<td>50.0**</td>
</tr>
<tr>
<td>NonDuchenne marked smile</td>
<td>13.3</td>
<td>13.3</td>
<td>10.0</td>
<td>13.3</td>
</tr>
</tbody>
</table>

*p < .10, **p < .01, ***p < .005.

four stimulus persons in adults, and for one stimulus person in older children. The difference between the proportions approached significance for one other stimulus person in older children and for one stimulus person in younger children.

Discussion

The first aim of this study was to gather more information on the developmental pattern of children’s knowledge of the differences between enjoyment and nonenjoyment smiles. The results showed that 9- and 10-year-old children were sensitive to the activation of the Cheek Raiser when viewing the three temporal phases of the smiles. The results obtained in the first study were also replicated in this study: when viewing the three temporal phases of the smiles, adults were sensitive to the activation of the Cheek Raiser while 6- and 7-year-old children were not.

The inclusion of a group of older children in the design of the study permits an interesting comparison between our results and those of Bugental et al. (1991). These authors observed that children less than 7 years of age respond with eye aversion to polite smiles but not to enjoyment smiles whereas by age 10 they respond with base-rate levels of visual behavior to
polite smiles and with elevated levels of sustained gaze to enjoyment smiles. Bugental et al. speculated that this developmental shift reflects an increased understanding of the significance of the two types of smiles and proposed that it is only at age 10 that children understand the enjoyment smile as a positive overture and the polite smile as a minor form of deception. The results of our study are entirely consistent with the developmental pattern they proposed.

The examination of the participants’ responses for each stimulus person revealed two interesting facts. First, the same general pattern of results was found for each stimulus person: a greater proportion of participants responded that the stimulus person was really happy when the Cheek Raiser was activated than when it was not. This difference was not always statistically significant, but was in the same direction for each stimulus person and each age group.

Second, the difference between the two proportions was significant for each stimulus person in adults while it was significant for only one stimulus person in older children and not at all in younger children. This increase in generalization across stimulus persons according to age suggests that physiognomic characteristics interfered with the extraction of the distinctive features of enjoyment and nonenjoyment smiles in children. This trend can be interpreted in terms of the differentiation principle proposed in Gibsonian theory (Gibson & Spelke, 1983). According to this principle, the ability of the perceptual systems to extract invariants or structures in physical stimulations improves over the course of life, with fine structures being discriminated later than highly contrasted structures. The theory posits that this improvement is related to various developmental changes, including physical maturation, more complete visual exploration, and more flexibility in attention processes. The appearance changes produced by the Cheek Raiser are quite subtle when this action unit is moderately activated, as was the case in the present study. For this reason, it can be difficult for young children to extract the distinctive features of enjoyment and nonenjoyment smiles from the multiple features of the face.

The comparison between the results of this study and those of the first study indicates that the patterns of responding were generally very similar, however, with one exception. The adult participants were more likely to judge the stimulus persons as being really happy while presented with the symmetric nonDuchenne marked smile in Study 1 (M = .31, SD = .15) than in this study (M = .13, SD = .18). This difference may result from sampling errors, but the fact that the patterns of responding were otherwise very similar do not support this possibility. A more plausible explanation would be that eliminating the asymmetric smiles from the set of stimulus
material made the activation of the Cheek Raiser more detectable. Given
that the two types of smiles in the present study differed from each other
only by the Cheek Raiser, it might have been easier for the participants to
focus their attention on the appropriate region of the face in order to locate
the difference.

The second objective of this study was to determine how much dy-
namics information observers needed to judge the authenticity of the
smiles. Adults and older children were sensitive to the activation of
the Cheek Raiser only when they viewed the three temporal phases of the
smiles. Participants were not able to judge authenticity correctly when they
were presented only with the apex of the smiles. They needed to compare
the appearance changes resulting from the activation of the Cheek Raiser
with the neutral face. However, they were not able to perform an adequate
perceptual analysis on the basis of a unique comparison between the neu-
tral face and the apex, as indicated by their performance when they
viewed the combined onset and apex. They were able to judge authenticity
only when they had the opportunity to make this comparison twice, as was
possible when the three phases of the smiles were presented. Overall, our
results indicate that the subtle appearance changes resulting from the acti-
vation of the Cheek Raiser are not easily detectable, and that their detec-
tion only emerges late in childhood, after an extensive period of experi-
ence and development of the visual system.

General Discussion

Previous research in the theory of mind literature has shown that the under-
standing of the distinction between real and apparent emotions emerges in
a tacit form during the preschool years, and becomes more verbally articu-
lated between the ages of 5 to 10 years. Research in this area has provided
a substantial body of evidence with respect to children’s knowledge of the
contextual and motivational determinants of expressive control, but has not
devoted as much attention to children’s knowledge of the behavioral differ-
ences between real and apparent emotions. Preschoolers’ success in the
appearance-reality task indicates that they are aware of the discrepancy
between the facial patterns of felt emotions and of those produced in order
to hide felt emotions (neutral and masking faces). However, virtually no
evidence has been gathered about children’s knowledge of the behavioral
differences between felt and simulated emotions. The two studies reported
in this paper indicate that children’s understanding of real and apparent
emotions is enriched, in late childhood, by a better knowledge of their
PIERRE GOSSELIN, MÉLANIE PERRON, MÉLANIE LEGAULT, PATRIZIA CAMPANELLA

facial characteristics. Our results show that children develop around the ages of 9 and 10 years a sensitivity to the activation of the Cheek Raiser, a distinctive component of enjoyment smiles, allowing them to better judge the authenticity of the smiles.

We think that the acquisition of this knowledge represents a significant step in children’s understanding of emotion because it means that children can integrate various sources of information in order to infer real emotion in other people. Previous studies have shown that young children can infer real emotion in others on the basis of the description of the situations experienced by others. Our results indicate that older children can also use the information provided by the face to judge whether or not the emotions displayed by other people are genuine.

We believe that the late emergence of the ability to judge the authenticity of enjoyment from the face might be related to the fact that the differences between enjoyment and nonenjoyment smiles are very subtle, and that their detection requires more advanced perceptual development. This interpretation is supported by four findings. First, as participants get older, their sensitivity to the activation of the Cheek Raiser generalizes across stimulus persons. This increase in generalization strongly suggests that young children have difficulty in distinguishing the facial clues related to the authenticity of the smiles from physiognomic characteristics of the stimulus persons.

Second, we found that older children and adults were sensitive to the activation of the Cheek Raiser when they could see the three temporal phases of the smiles, but not when they were presented with the combined onset and apex of the smiles. The fact that participants needed to see the appearance changes produced by the Cheek Raiser twice, as was possible in the former condition, clearly indicates that these appearance changes are not easily detectable.

Third, a recent study by Bartlett, Hager, Ekman and Sejnowski (1999) examined adults’ ability to categorize action units and found that the Cheek Raiser was the most difficult action unit to categorize among those examined in the upper face. The participants in their study were provided with a guide sheet, containing an example image and a written description of six action units, and asked to categorize the test items showing the face of other stimulus persons. While the participants performed the task quite well overall (M = 73.4%), the results showed that they had much more difficulty in categorizing the Cheek Raiser than the other action units, with a mean accuracy of 55.0%.

Fourth, an important improvement in face processing has been reported in other areas for the same age range (Carey, 1996). When 6-year-
old children are asked to recognize the face of different people, they per-
form poorly when the face differs in expression, angle of view, direction of 
lighting, hair style or size. It is only at about the age of 10 years that chil-
dren perform in the adult range, indicating that this perceptual ability re-
quires the acquisition of an extensive expertise concerning faces.

The late emergence of the ability to judge the authenticity of smiles 
could also be explained from the learning perspective. In order to learn 
what markers distinguish enjoyment from nonenjoyment smiles, children 
need to be exposed to situations in which there are clear contingencies 
between these markers and other sources of information indicating that 
other people are really happy or that they are not. One factor that could 
potentially slow down this learning is the fact that these contingencies 
might not be very clear in everyday life. This possibility is suggested by a 
close inspection of the results reported in the literature. For example, only 
24% of the nonenjoyment smiles in Ekman et al. study (1981) were asym-
metrical, meaning that, most of the time, nonenjoyment smiles were sym-
metic. Ekman et al. (1988) found that the Cheek Raiser was activated more 
often in enjoyment smiles than in nonenjoyment smiles. However, this differ-
ence was observed for only one third of the nonenjoyment smiles.

The two studies reported here were designed to assess whether chil-
dren and adults had some knowledge of the distinctive features of enjoy-
ment and nonenjoyment smiles. Our research strategy was to control as 
much as possible the physical parameters of the smiles, varying some pa-
rameters while keeping other parameters constant. Given that all the smiles 
were artificial, in the sense that the stimulus persons were requested to 
perform specific facial movements, sensitivity was not assessed on the 
basis of hit rates but rather on the basis of the participants’ tendency to 
judge some smiles as being more representative of enjoyment smiles than 
others. This index of sensitivity was chosen because it was independent of 
the response category base rates, as long as both response categories were 
used by the participants. As one can see from Table 2 and Table 4, both 
response categories were used with roughly the same frequency, indicating 
there was no floor or ceiling effects in the use of response categories.

However, the use of artificial smiles raises the question of the ecologi-
cal validity of our findings, and one wonders if different results would have 
been obtained by using spontaneous smiles as a basis of comparison. Al-
though we cannot exclude this possibility completely, available evidence 
suggests that this is not the case. Frank et al. (1993), using spontaneous 
smiles as a basis of comparison, also reported that adults were more likely 
to judge the stimulus persons as being really happy when they display the 
Duchenne marked smile than the nonDuchenne marked smile.
The finding that 6- and 7-year-old children were able to locate the regions of the face in which enjoyment and nonenjoyment smiles differed suggests an interesting direction of inquiry for future research. It means that young children have a rudimentary knowledge of the distinctive features of enjoyment and nonenjoyment smiles even though they are not yet able to judge the authenticity of the smiles. In future studies, it would be worthwhile to investigate more closely this rudimentary knowledge by asking young children more precise questions about the nature of the differences between enjoyment and nonenjoyment smiles. More attention should also be devoted to explicit knowledge of the differences between enjoyment and nonenjoyment smiles in older children, as we did not investigate this issue in Study 2.

Notes

2. According to the FACS manual (Ekman & Friesen, 1978), the Cheek Raiser can slightly lower the brows in some people. However, a careful inspection of the stimulus material revealed that this was not the case for any of the stimulus people.
3. Prior analyses did not indicate any significant main effect nor interaction effect related to participants’ gender.

References


