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Reading the Mind in the Face: A Cross-cultural and Developmental Study

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Previous work suggests only a small set of facial expressions can be interpreted universally with any reliability. This set is confined to the six basic emotions. On the other hand, "cognitive" mental states (such as *distrust*, *recognize*, etc.) are held to be private, unobservable, and therefore not available from facial expression. In Experiment 1, we report a study that challenges the notion of the lack of expressive facial correlates to cognitive mental states and tests whether a larger range of mental states are not only detectable, but universally so.

Paintings and drawings of faces by one contemporary British artist (Hockney) and one seventeenth-century Spanish artist (Velazquez) were shown to subjects, who were given a forced choice of two semantic opposites as descriptors and asked to select the word that best described the character's mental state. Subjects from three different cultures (Britain, Spain, and Japan) showed good agreement in their judgement of 8 out of 11 mental states from facial information: *recognize*, *threaten*, *regret*, *astonished*, *worried*, *distrust*, *contempt*, and *revenge*. Cultural differences were only found on 3 out of the 11 mental states (*scheme*, *wary*, and *guilt*). The seventeenth-century faces were easily interpreted, though the contemporary faces were marginally easier. This suggests that a large range of subtle and complex mental states may be universally read in the face, highlighting the role that perception plays in our theory of mind.

In Experiment 2, we tested two possible confounding factors: (a) that subjects might have been using "basic emotion" categories to make their judgements about complex mental states, or (b) that they might simply have been making positive/negative judgements. Subjects (from the UK only) were therefore given the same stimuli as in Experiment 1, but this time their forced choice was between the target word and a distractor that was a term describing a basic emotion or a distractor that was another complex mental state term of the same valence (positive or negative) as the target term. The results remained virtually unchanged relative to Experiment 1, suggesting that these judgements are quite subtle.

In Experiment 3, we administered a modified version of this test to British children, aged 8–11, in order to see whether there was any development in the ability to recognize these same mental states. Results showed no developmental change during this period, in that even the 8-year-old British children were at the adult level at recognizing 10 out of 11 of these mental states from the facial expressions.

Emotion Recognition

There is a longstanding debate about whether emotion recognition is culture-specific or universal. Darwin (1872), for example, proposed that there were universal facial behaviours for each emotion. In taking this position, he was reiterating an ancient view: More than 2000 years ago, the Roman orator Cicero stated that: "The face is the image of the soul" (Baron & Byrne, 1991, p. 45). La Barre (1947), on the other hand, argued for the opposite, culture-specific position: "There is no 'natural' language of emotional gesture" (p. 55) Birdwhistell (1963) also concluded that ". . . there are probably no universal symbols of emotional state" (p. 126).

From the late 1960s, the evidence had swung back towards a modified universalist position. Thus, Ekman (1973, 1992) concluded that although not *all* emotional states are correlated with universally recognizable facial expressions, a limited set of *six* emotional facial expressions—*happiness*, *sadness*, *anger*, *disgust*, *fear*, and *surprise*—are universally recognizable. This conclusion is based on the cross-cultural studies carried out in societies as varied as the United States, Japan, Borneo, and New Guinea (Ekman & Friesen, 1969, 1975; Izard, 1971, 1977). Such data provide strong evidence for both the production and the recognition of universal emotions being "hard-wired" in the human brain. On balance, then, Darwin seems to have been right, at least for this small set of emotions.[1]

Zajonc (1985) elaborated the natural selection implications of this work. He suggested that this universal ability might have evolved because of its high survival value, in that communicating emotional signals would allow an individual to warn another organism of impending danger (e.g. via the "fear" face), of impending attack (e.g. via the "anger" face), and so on. On the basis of this evolutionary argument, Hansen and Hansen (1988) predicted that facial expressions that signal potential danger (e.g. angry faces) should be easier to recognize than those that do not (e.g. happy faces). Using an identification paradigm ("the face in the crowd" technique) these authors confirmed this prediction.

Recognition of Other Mental States

Emotions, of course, are only one subset of the range of mental states that people experience. Another, partially overlapping subset comprises *cognitive* mental states (such as thinking, deciding, intending, planning, remembering, etc.). Strangely, despite the importance of these cognitive mental states in the development of our everyday "theory of mind" (Premack & Woodruff, 1978; Wellman, 1990)—that is, in interpreting and predicting the actions of others—studies have largely ignored the question of whether these, too, might be reliably read from the face, and if so, whether universally so.

There are some exceptions to this. For example, some studies suggest that the mental state indicating *deception* can be recognized from "micro-expressions"—fleeting facial expressions that last only a few tenths of a second (Ekman & Friesen, 1975)—and from gaze-avoidance (Kleinke, 1986). In addition, Izard (1971) suggested the mental state of *interest* could also be universally recognized. Ekman & Oster (1987) acknowledge that interest may be detectable but suggest that "head position, not facial expression, may have provided the cues for recognizing" this (p. 149). In the present paper, we report three studies that explore whether information about a larger range of mental states is available

[1]Here we do not address the interesting and important issue of whether emotion recognition can be equated with emotion conceptualization (but see Russell, 1991).

during perception of the human head. Unlike Ekman and Oster (1987), we do not restrict our focus purely to *facial expression*. Our stimuli are illustrations of *heads*, and these naturally contain information about facial expression, head orientation, and in all likelihood other facial features.

The proposal that a large set of mental states (beyond the "basic" emotions) can be read in the face at first glance seems implausible, given the emphasis usually placed on the *privacy* of such mental states: "You can never know what someone is thinking." However, our recent work suggests that the privacy of mental states—even some cognitive mental states—turns out to be less than total. For example, from early childhood onwards, subjects can reliably detect when a person is *thinking*, from the direction of the person's eyes (Baron-Cohen & Cross, 1992).[2] Furthermore, children and adults appear to use eye-direction to judge not only which object a person is looking at, but also which object they *want*, or *plan to act upon*, or are *referring to* (Baldwin, 1991; Baron-Cohen, Campbell, Karmiloff-Smith, Grant, & Walker, 1995). In addition, it is of considerable interest that autistic children appear "blind" to the mental significance of the eyes (Baron-Cohen et al., 1995).

Given these recent studies, it is important to investigate whether adults are able to perceive a *range* of mental states—both cognitive and affective—in the face. We were interested in testing whether such an ability was not only stable across different individuals within one culture, but also across differing cultures. In Experiment 1 we therefore tested individuals from two European cultures—Britain and Spain—and one non-European culture—Japan. Finally, we wanted to test whether such an ability was stable across *time*. To investigate this, we used faces from portraits by two artists separated by about 300 years: the seventeenth-century Spanish painter Diego Da Velazquez (1599–1660 [3]), and the contemporary British artist David Hockney (whose illustrations were drawn between 1966 and 1984). Would subjects living in London, Madrid, and Tokyo find these equally easy to interpret? [4]

[2]This is not to say that we can diagnose the *content* of a person's thoughts —only the fact *that* the person is engaged in thinking.

[3]These are the dates of Velazquez' life; the paintings that we used in this study span a wide period of his working life.

[4]Here we cannot, of course, establish whether performance by the same subjects across time is stable, for obvious reasons. However, given the 300 years that have elapsed since Velazquez was painting, the question we investigate is whether his depiction of facial expressions is meaningful to viewers in the late 20th century.

EXPERIMENT 1

A Cross-cultural Study

Subjects. In each of three cultural groups—British (all English-speaking), Spanish (all Spanish-speaking), and Japanese (all Japanese-speaking)—20 subjects were tested. Subjects were adults from a range of social classes, age groups, and occupations; the sex ratio of the groups was also balanced.

Method and Materials. Each subject was tested individually in a quiet room. The subject was presented with six illustrations by Velazquez (see Figures 1–6, in order of appearance, taken from his work reproduced in Brown, 1986; most are fragments of the original scenes) and five illustrations by Hockney (see Figures 7–11, taken from his work reproduced in Hockney, 1988). With each picture, the subject was read a pair of words and asked to choose which of these best described what the person in the picture was feeling or thinking. Subjects who said they were unsure were asked to choose the word that was *closest* to describing the person's state of mind. This forced-choice procedure was designed to overcome any reluctance subjects might experience in judging the state of someone else's mind, given the prevailing assumption of privacy.

FIG. 1. *Portrait of Man*, by Velazquez (Brown, 1986, Plate 231).

FIG. 2. *Baltasar Carlos and a Dwarf*, by Velazquez (Brown, 1986, Plate 96).

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FIG. 3. *Surrender of Breda*, by Velazquez (Brown, 1986, Plate 136).

FIG. 4. *Mother of Jeronima de la Fuente*, by Velazquez (Brown, 1986, Plate 40).

FIG. 5. *St Paul*, by Velazquez (Brown, 1986, Plate 36).

FIG. 6. *Old Woman Cooking*, by Velazquez (Brown, 1986, Plate 13).

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FIG. 7. *Self-Portrait with Mouth Open* (1983) by Hockney (Hockney, 1988, Plate 32).

FIG. 8. *Gregory* (1978) by Hockney (Hockney, 1988, Plate 19).

FIG. 9. *Self-Portrait with Striped Shirt and Tie* (1983) by Hockney (Hockney, 1988, Plate 27).

FIG. 10. *Self-Portrait*, (26 September 1983) by Hockney (Hockney, 1988, Plate 45).

These figures are reprinted by kind permission of Cavin Butler and Tradhart (Berkshire).

FIG. 11. *Celia in Black Dress with Red Stockings* (1973) by Hockney (Hockney, 1988, Plate 47). Reprinted by kind permission of Cavin Butler and Tradhart (Berkshire).

The word pairs were originally drawn up by three of the authors (SBC, AR, & PC) using the following procedure: A suggestion was made by one of the authors as to which word might best describe the current mental state of the person in the picture. Then, if these three authors were unanimous on this being a plausible reading of the character's mental state from their face, a semantic opposite was generated to be the foil in the word pair for that picture. The word pairs for each picture are given in Table 1. Picture presentation was randomized, as was word order, to avoid order effects.

Results

Regarding cultural differences and similarities, the mean numbers of correct judgements are shown in Table 2. As can be seen, across all three nationalities, the mean number correct was above 8 (maximum possible = 11), which is above chance. These mean scores were compared across the three nationalities using a one-way ANOVA. This revealed a main effect of nationality, $F(2, 57) = 4.69$, $p = 0.013$. A Tukey's (HSD) test revealed that this was due to the British making fewer errors than the other two groups, $p < 0.05$. This apparent cultural difference is probably accounted for by the ratio of British to non-British raters who chose the original mental-state terms (2:1). Table 3 shows the number of subjects making a correct judgement on each figure, in each cultural group. We

TABLE 1
Word Pairs for Each Figure Used in Experiment 1

Fig.	*English*	*Spanish*	*Japanese*
1	contempt–admiration	*desprecio–admiracion*	*keibetsu–shosan*
2	wary–confident	*desconfiado–confiado*	*fuange–jishin*
3	recognize–ignore	*ignorar–reconocer*	*mushi–kizuku*[a]
4	threaten–trust	*amenaza–confianza*	*shinrai–odoshiteiru*
5	regret–satisfied	*apesadumbrado–satisfecho*	*kokai–manzoku*
6	guilt–innocence	*culpa–inocencia*	*zaiakukan ga aru–mujaki*
7	astonished–expect	*sorprendido–excitante*	*odoroite iru–kitai shieriru*
8	worried–confident	*copnfiado–procupado*	*kakushin o motteiru–shimpai shiteiru*
9	distrust–accept	*recelar–aceptar*	*fushinkan o motteiru–ukeirete iru*
10	revenge–forgive	*vengarse–perdonar*	*shiraseyo to shiteiru–[nanikao] takurande iru*
11	scheme–inform	*avisar–manquinar*	*fukushu [no kimochi]–yurusu [kimochi]*[b]

Note: The correct word is the first word of each word pair. In the actual experiment, word order was random.

[a] As an alternative, "daredaka–wakaru" was also used (meaning "understand who someone is").

[b] Words in square brackets were used as a supplementary explanation. For example, "kimochi" for Figure 11 means "feeling".

first checked which figures were passed by at least 70% of subjects in each group (i.e. 14 or more out of 20), which we set as a generous criterion for good performance. Using this criterion, this showed that the British passed on all but one of the 11 figures (*guilt*), the Japanese also passed on all but one of the 11 figures (*contempt*), and the Spanish were above chance on all but two of the 11 figures (*wary*, and *guilt*).

Separate analyses were carried out for each figure in order to test which pictures were most indicative of cultural differences. Probability levels were adjusted, using the Bonferroni correction, to $p = 0.005$. This showed only three cultural differences: (a) *Wary* was recognized by 35% of the Spanish subjects, compared to 75% of the Japanese and 100% of the British subjects, Pearson's χ^2 (2, 60) = 20.5, $p = 0.0004$; (b) *guilt* was recognized by 60% of British subjects and 30% of Spanish subjects, as compared with 90% of Japanese subjects, Pearson's χ^2 (2, 60) = 15.37, $p = 0.0005$; (c) *scheme* was recognized by 70% of Japanese subjects, as compared to 100% of Spanish subjects and 100% of British subjects, Pearson's χ^2 (2, 60) = 13.33, $p = 0.0013$.

Regarding differences between artists, Table 2 shows the mean number of subjects making a correct judgement for the Velazquez and Hockney pictures. A repeated-measures ANOVA was performed across the three nationalities in

TABLE 2
Mean Number of Correct Responses by Nationality, Experiment 1

		Nationality							
		British		*Japanese*		*Spanish*		*Total*	
Artist	*Max.*	*x*	*SD*	*x*	*SD*	*x*	*SD*	*x*	*SD*
Velazquez	6	5.1	1.1	4.8	1.0	4.2	0.8	4.7	1.0
Hockney	5	4.6	0.8	3.8	1.2	4.4	0.6	4.2	0.9
Total	11	9.7*	1.6	8.6	1.5	8.5	0.9	8.9	1.5

* British vs. Japanese and Spanish, $p < 0.05$.

TABLE 3
Number of Subjects Making a Correct Judgement on Each Figure, by Nationality, in Experiment 1

Artist		*British*	*Japanese*	*Spanish*
Velazquez	1. contempt	15	13	14
	2. wary	20	15	07*
	3. recognize	16	17	16
	4. threaten	18	15	20
	5. regret	19	18	20
	6. guilt	13	18	06*
	x	16.8	16.0	13.8
	SD	(2.6)	(2.0)	(6.1)
Hockney	7. astonished	18	14	16
	8. worried	19	15	17
	9. distrust	17	18	20
	10. revenge	17	14	14
	11. scheme	20	14*	20
	x	18.2	15.0	17.4
	SD	(1.3)	(1.7)	(2.6)

Note: $n = 20$ for all nationalities.
* Bonferroni adjusted, $p < 0.005$.

order to identify any artist effect. The within-subject factor revealed a main effect of artist, $F(1, 57) = 4.64$, $p = 0.018$, and a Nationality × Artist interaction, $F(2, 57) = 6.01$, $p = 0.004$. Table 2 shows that, overall, Hockney's drawings were slightly easier to identify than were Velazquez' paintings (84% vs. 79%). However, in comparison to the British and Spanish subjects, the Japanese subjects recognized Velazquez' paintings marginally better than they recognized Hockney's drawings.

Discussion

In this study we tested whether there is universal recognition of a wide set of mental states, beyond the expressions of "basic emotions" usually reported. Specifically, we tested 11 different facial expressions (expressing, we suggest, 11 different mental states). Only 2 of these could be construed as falling into the category of "basic emotions" (*wary*, which comes within the category of "fear"; and *astonished*, which comes within the category of "surprise"). Despite this wider set including both cognitive and affective mental states, there was remarkable consistency in how subjects from the three different cultures (Britain, Spain, and Japan) recognized these. Using a generous criterion of agreement by more than 70% of each group, no cultural differences were found on 8 out of the 11 mental states: *contempt, recognize, threaten, regret, astonished, worried, distrust,* and *revenge*. The 3 mental states in which one or more of the three cultures performed significantly differently were *wary, guilt,* and *scheme*. The faces drawn by the contemporary artist David Hockney were marginally easier to recognize than were the paintings created by the seventeenth century artist Diego Da Velazquez (perhaps reflecting a "caricature effect"), though performance was above chance on the majority of the figures from both artists. These results suggest that adults have considerable aptitude for reading a wide range of mental states in the face, in a cross-culturally similar way.

One concern, however, is that subjects may have been using basic emotion categories to make these judgements, simply choosing the label that most closely matched the basic emotion. A second concern is that subjects may simply have been making a positive/negative judgement. These possible confounding factors were investigated in Experiment 2.

EXPERIMENT 2

Basic versus Complex Mental States

Experiment 2 sought to retest the finding from Experiment 1, from one culture (the UK), that subjects could recognize complex mental states from the face. This retest controlled for basic emotion judgements, or simple positive/negative judgements, by asking subjects to choose between a triad of words for each

picture: (a) a correct complex mental state term, (b) an incorrect complex mental state term of the same valence (positive or negative) as the correct term, and (c) a basic emotion term.

Subjects. Twenty English-speaking subjects were tested, comprising adults from a range of social classes, age groups, and occupations; the sex ratio of the group was also balanced.

Method and Materials. Each subject was tested individually in a quiet room. The subject was presented with the same figures (1–11) as were used in Experiment 1. With each picture, the subject was read a pair of words and asked to choose which of these best described what the person in the picture was feeling or thinking. As before, subjects who said they were unsure were asked to choose which word was *closest* to describing the person's state of mind. The word triads were read aloud with each figure, in a random order. Figure presentation was also randomized, to avoid order effects. The word triads are shown in Table 4.

TABLE 4
Word Triads for Each Figure.

	Word Triad		
Figure	*Correct*	*Basic Emotion*	*Distractor*
1	contempt	sad	distrust
2	weary	fear	threaten
3	recognize	surprise	astonished
4	threaten	angry	guilt
5	regret	sad	revenge
6	guilt	sad	threaten
7	astonished	surprised	recognize
8	worried	fear	scheme
9	distrust	angry	contempt
10	revenge	angry	regret
11	scheme	afraid	worried

Note: Within each triad, the first is the correct word, the second is the basic emotion term, and the third word a distractor of the same complexity and valence. In the actual experiment, word order was random.

Results and Discussion

The number of subjects passing on each figure is shown in Table 5. A comparison with scores from Experiment 1 (Table 3) shows that performance was remarkably similar across the two experiments when comparing the two English samples. A *t*-test showed no difference between the two sets of scores, $t(20) = 0.17, p = 0.86$, and chi-square comparisons for each figure across the two experiments revealed only one significant difference (Figure 7, $\chi^2 (1) = 4.5, p = 0.034$). On this item alone, performance was reduced to chance levels. This would be expected, given that the target (correct) mental state term is in fact a basic emotion term (*astonished*), and this is synonymous with the other basic emotion term used in the triad (*surprised*). Inspection of errors on this item showed that subjects were equally likely to choose either of these. Leaving this particular item to one side, the overall results from Experiment 2 show that the good performance in recognizing complex mental

TABLE 5
Number of Subjects Making a Correct Judgement on Each Figure, in Experiment 2

Artist		*No.*
	n	20
Velazquez	1. contempt	16
	2. wary	20
	3. recognize	17
	4. threaten	20
	5. regret	18
	6. guilt	15
	x	17.7
	SD	2.0
Hockney	7. astonished	11*
	8. worried	19
	9. distrust	18
	10. revenge	16
	11. scheme	20
	x	16.8
	SD	3.6

*Differs significantly from performance by UK sample in Experiment 1, $p < 0.034$

states from the face found in Experiment 1 was not an artefact of judging the faces in terms of either a basic emotion or in terms of a simple positive/negative dimension.

In the final experiment reported here, we turned to the question of when children first become able to recognize this range of mental states from the face.

EXPERIMENT 3

A Developmental Study

Experiment 1 showed that on 8 out of the 11 mental states we tested, adults from three different cultures agreed with each other in recognizing mental states from faces, and Experiment 2 showed that the use of alternative strategies could not explain the results. We were naturally drawn to wonder when children acquire this adult competence. Gates (1923) appears to have been the first to carry out this sort of research with children, though his original study seems to have underestimated the competence of young children, claiming that this ability is not completely developed until the teenage years. Ekman and Friesen (1971) tested recognition of six emotions (*happy, sad, anger, surprise, fear,* and two of *disgust*) in 130 children from isolated peoples in New Guinea. They found a mean correct performance of 90%, with no developmental differences between the ages of 6 and 15 years.

Even more impressively, recent work suggests that children as young as 2 years old can recognise the facial expressions of *happiness*, and by 3–4 years of age can recognise *sadness, anger, surprise,* and *fear* (Bullock & Russell, 1984; Izard, 1971; Michalson & Lewis, 1985; Smiley & Huttenlocher, 1989).[5] Five-year-old normal children can also discriminate the facial expression of *disgust* (Bullock & Russell, 1986; Michalson & Lewis, 1985; Tremblay, Kirouac, & Dore, 1987). It is therefore clear that the basic emotions can be discriminated by the age of 5. What about recognition of the wider set of mental states tested in Experiment 1?

To investigate this, in Experiment 3 we tested British children using the same set of figures as had been investigated in Experiments 1 and 2. However, to ensure that we were testing mental state recognition rather than language comprehension, we simplified the choice of terms used and presented them in a more interesting form, which was more appropriate for younger subjects.

Subjects. Subjects comprised 80 children, aged between 8 and 11 years, and divided into four age groups (8-, 9-, 10- and 11-year-olds) of 20 subjects each. They were all attending a state school in the South-East of England.

[5]It is of interest to note that that Baron-Cohen, Spitz, and Cross (1993) found that on a test of sorting photographs of *happy, sad,* and *surprise*, children with autism were significantly worse in their recognition of *surprise*, but were unimpaired in their recognition of the other two emotions.

Method. The materials were presented in the same way as in Experiment 1, except that the choice words were given in a sentence format. These are shown in Table 6. In addition, if a subject failed a test question, a comprehension control question was then asked, in order to ensure that the subject had failed because of a mental-state recognition problem, rather than a verbal comprehension problem. This comprised asking the child to explain what the target word in each of the wrong items meant, using a question that related to their own expe-

TABLE 6
Comparisons of Word Pairs Used for Adults in Experiment 1 and Children in Experiment 3

	Word Pair		
Artist	*Adult*	*Child*	*Question*
Velazquez	1. contempt–admiration	bad–good	Imagine he's just seen somebody do something. Does he think that person did something *bad* or *good*?
	2. wary–confident	scared–brave	Do you think the girl is feeling *scared* or *brave*?
	3. recognize–ignore	know–ignore	Has this man seen someone he *knows*, or is he trying to *ignore* someone?
	4. threaten–trust	nasty–friendly	Is she thinking of doing something *friendly*, or is she thinking of doing something *nasty*?
	5. regret–satisfied	sorry–pleased	Is he feeling *sorry* about something, or is he feeling *pleased* about something?
	6. guilt–innocence	guilty–proud	Is he feeling *guilty* about what he has done or is he feeling *proud* about what he has done?
Hockney	7. astonished–expect	surprised–expected	Has something *surprised* him, or was it something he *expected* to happen?
	8. worried–confident	worried–sure	Is this person *worried* about something, or are they *sure* about something?
	9. distrust–accept	suspicious–trust	Is she *suspicious* of someone, or does he *trust* them?
	10. revenge–forgive	own back–forgive	Imagine someone has *hurt* him. Is he going to get his *own back*, or is he going to *forgive* them?
	11. scheme–inform	plan–honest	Is she *planning to trick* someone, or will she be *honest* with them?

Note: The correct word is the first word of each word pair. In the actual experiments, word order was random.

rience. For example, if they gave a wrong answer to the *suspicious–trust* item (Figure 9), the experimenter asked, "What makes you suspicious?" Any child who failed this comprehension control test was given a second chance at that item using an easier pair of words.

Results

Results regarding age differences are shown in Table 7. As can be seen, this shows that for all four age groups, the mean number of correct judgements exceeded 9 (out of a maximum of 11), which again is above chance. ANOVA revealed that there were no age differences, $F(3, 76) = 1.76, p \geq 0.05$. Table 8 shows the number of children in each age-group making correct judgements on each figure; using the same criterion as in Experiment 1 (equal to or more than 70% agreement), *all* the 8-, 9-, and 11-year-olds passed on 10 out of the 11 figures. The exception for these age groups was Figure 1 (*contempt* in the adult test). The 10-year-olds passed on 9 out of the 11 figures, the exceptions for them also being Figure 1, and Figure 3 (*recognize* in the adult test). Finally, regarding artist differences, as in Experiment 1, performance on the Hockney task was marginally but significantly better than performance on the Velazquez task, $F(3, 76) = 10.30, p < 0.001$. No child failed a language control question.

Discussion

In Experiment 3, we expected to find some development between the ages of 8 and 11 in the ability to recognize the same set of mental states as had been tested in adults in Experiments 1 and 2, using facial expressive information alone. Contrary to this prediction, we found that all four age groups performed significantly above chance on this task, and that no age differences were found. This suggests that by the age of 8, children are already very competent at reading the mind in the face, and this ability extends beyond recognition of the narrow set of basic emotions previously demonstrated. (Our set included *wary* and *astonished*, which were the only two mental states to overlap with previous studies.)

TABLE 7
Mean Number of Correct Responses by Each Age Group in Experiment 3

		Age							
		8		9		10		11	
Artist	*Max.*	*x*	*SD*	*x*	*SD*	*x*	*SD*	*x*	*SD*
Velazquez	6	4.9	0.7	5.2	0.8	4.8	0.8	5.0	0.4
Hockney	5	4.3	0.9	4.6	0.7	4.6	0.7	4.7	0.5
Total	11	9.2	1.0	9.8	1.0	9.4	1.0	9.7	0.7

Moreover, it appears that children are adept at making these mental state judgements even when they have only facial information available, disembedded from a larger social context. Although earlier work suggests that context may facilitate emotion recognition (Reichenbach & Masters, 1983), it is clear that children of this age do not depend on such contextual cues. We consider the significance of these experiments in the final section of the paper.

GENERAL DISCUSSION

Experiment 1 investigated whether a larger set of mental states than is traditionally recognized could be read in the face. Using drawings by David Hockney and paintings by Diego Da Velazquez as stimuli of human heads, we found that adult subjects from three cultures (Britain, Spain, and Japan) showed good agreement on 8 out of the 11 mental states depicted in the faces. The few cultural differences we found were for *scheme* (the Japanese were different to the other two

TABLE 8
Number of Children Making a Correct Judgement on Each Figure in Each Age Group in Experiment 3

		Age			
Artist		*8*	*9*	*10*	*11*
	n	20	20	20	20
Velazquez	1. bad	04	08	07	03
	2. scared	16	20	18	18
	3. know	17	15	13	18
	4. nasty	20	20	18	20
	5. sorry	20	20	20	20
	6. guilty	20	20	20	20
	x	16.2	17.2	16.0	16.5
	SD	6.2	4.9	5.1	6.9
Hockney	7. surprised	17	18	19	19
	8. worried	18	20	20	18
	9. suspicious	18	19	20	20
	10. own back	18	19	16	19
	11. plan	15	16	16	18
	x	17.2	18.4	18.2	18.8
	SD	1.6	1.5	2.1	0.8

groups), and *wariness* and *guilt* (the Spanish were different to the other two groups). There were no group differences in the ability to identify *contempt*, *recognize*, *regret*, *astonished*, *worry*, *distrust*, *threaten*, and *revenge*. Although it could be argued that Britain and Spain are "closer" to each other in both being European, Japan is non-European, and yet Japanese subjects performed in a very similar manner to subjects from the other two cultures. Experiment 2 demonstrated that the labels subjects chose for these facial expressions were distinct from those used for the basic emotions, and that a simple positive/negative judgement cannot explain these differences. This provides preliminary support for a universalist position for the expression of a larger set of mental states.

Experiment 3 investigated when children aged 8–11 gradually acquire this capacity for reading mental states in the face. Contrary to predictions, we found that by 8 years of age children are already at the adult level of competence on this task (with the exception of Figure 1–*contempt*), and that no developmental changes were therefore found. We conclude that whatever development there is in this ability, it must occur before the age of 8, and that future developmental studies would need to test these younger children.

Naturally, some provisos are necessary. In the first place, we have not tested people from a non-industrial culture, and it could be argued that Japan, though non-Western, is still highly industrialized and therefore very much in contact with European–Western traditions. Further data from a society that is relatively untouched by Western culture would therefore be necessary before concluding that detection of this larger set of mental states from the face is universal. It is worth noting, however, that preliminary data from Riviere (the second author), using the Velazquez–Hockney Test with the Zapotecs—a rural community in Mexico—show very similar results to those reported here.

The second proviso is that the set of mental states tested in this study, though larger than that of the basic emotional states traditionally held to be the only ones universally detectable, is still only a subset of all possible mental states. We cannot therefore make claims about the *proportion* of mental states that are detectable from the face—only that a larger number are identifiable than had previously been thought. Determining the size of this set remains a task for future studies. We are currently carrying out an extension to this study, testing 30 mental states from the face (Baron-Cohen, Aranasalam, Patel, & Sharma, 1995). There is no doubt that some facial expressions are culture-specific in their relation to mental states. For example, Ekman and Friesen (1975) discuss "display rules" in culture-specific terms (such as *smiling* in some cultures being an expression of *shame*), Heelas (1986) discusses culture-specific nuances of emotion terms, and in Experiment 1, we, too, found that on 3 of the 11 mental states cultural differences emerged.

The third proviso is that in our Experiments subjects were asked to distinguish a target word to describe the expression of a mental state from a distractor (its semantic opposite, or a basic emotion term, or a related complex mental-state term of the same valence). We have therefore shown that on this task subjects can distinguish not only "black" from "white" remarkably consistently, but also shades of grey. However, we readily concede that without a forced-choice paradigm, subjects would be far less constrained in their judgement, and it is likely that far less consistency would be found.

Despite these provisos, these experiments also demonstrate that although one of the sets of stimuli we used are faces painted some three centuries ago, these are almost as readily interpreted in mental-state terms as are faces drawn in the late twentieth-century. Thus, neither cultural nor temporal separation seems to act as any great barrier to mental-state detection, at least as far as the majority of the set of mental states tested in this study are concerned.

It remains to be investigated whether performance on this mental-state detection task would improve even further if real faces, rather than paintings or drawings, were used as stimuli, or if photographs or videofilms of real faces were used. Our extension to this work is employing photographs. We assume that increasing the ecological validity of the stimuli should lead to improved performance. It is nevertheless important to remember that even with the relatively degraded input of Hockney's line drawings, there is apparently sufficient information available to make reliable judgements about the mind from the face. Furthermore, these sparse line drawings were actually easier to identify than the informationally rich Velazquez paintings, though both produced excellent performance. A related question for future research is to investigate whether recognition of the broad range of mental states in the face is categorical, as appears to be the case for the basic emotions (Etcoff & Magee, 1992). We hope that this study stimulates further research into the interesting interface between face processing and the everyday use of our theory of mind (Baron-Cohen, 1994, 1995a, 1995b).

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