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Face Recognition and Lip-reading in Autism

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Autistic children individually matched for mental age with normal subjects were tested on memory for unfamiliar faces and on lip-reading ability. The results show that autistic children are poorer than controls in memory for faces but comparable to controls in lip-reading. Autistic children show little influence on their auditory speech perception from visual speech. The results are discussed in relation to Bruce and Young's (1986) model of face recognition. The independence between facial speech and memory for faces is in accordance with this model but is only observed in autistic subjects.

INTRODUCTION

Faces play an important role in social interaction. There are least three aspects to the perception of faces that need to be considered. A very obvious aspect is that faces carry information about a person's identity. Equally important is the fact that face perception allows inferences about a person's states of mind. Finally, the face is a source of linguistic information. What we read on someone's lips contributes much more to decoding linguistic messages than has been suspected until recently.

Ever since Kanner's (1943) first description, it is widely agreed that autism is a deficit that affects subjects' social relations. Subsequent research has clearly underscored the original description which puts social deficits at the core of autism (Rutter, 1978; Volkmar, 1987). Intuitively, there would thus be good reason to suspect that autistic subjects have a

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problem in processing facial information. The issue of face processing ability in autistic children has only been addressed systematically over the last decade (Hobson, 1983; 1986; 1987; 1989; Langdell, 1978; 1980; 1981; Weeks & Hobson, 1987). Research on face perception in autistics is traditionally motivated by the notion of an affective disorder at the core of autism. Because of this concern, the emphasis has been on affective and communicative aspects of faces and on the recognition of facial expressions (Howlin, 1978; Richer, 1976; Rutter, 1978; Wing, 1976). In this sense, studies on face perception in autistics are close to approaches in social psychology where faces are studied in the context of social attributions (Argyle, 1983; Ekman, 1982).

Given that faces play a crucial role in communication, what representations and processes underlie the processing of facial information? An answer to this question is particularly important for understanding what underlies the social competence that normal subjects manifest in making social attributions on the basis of face perception. More to the point here, facial information processing must be understood in order to appreciate the impairments of social competence we witness in cases of autism.

From a logical point of view, the ability to recognise an expression of emotion imposes on the perceptual system a task different from that of recognising a person's identity (Bruce, 1988). At an empirical level, recognition of emotional expression in a face will draw on information sources other than those used in recognition of the identity of a face. Over the last few years, social, experimental and clinical studies have revealed how aspects other than emotion recognition are involved in face perception. Current models of face processing (e.g. Bruce, 1988; Bruce & Young, 1986; Ellis, 1986) are based on findings from those different sources. Models of this kind might have considerable heuristic value in clarifying face recognition in autistics. The present study makes a beginning with this. Bruce and Young (1986) distinguish three major aspects of face perception: recognition of facial identity, of facial expression and of facial speech. The present study examines two of these aspects, which have received little attention in the study of autism so far, i.e. recognition of facial identity and of facial speech.

The Recognition of Facial Expression

Kanner (1943) paraphrased the social impairments of autistics as "inborn disturbances of affective contact with others". Kanner himself noted that some autistic children never looked up at people's faces. Existing approaches have linked the absence of facial communication to a general social inadaptedness characteristic of autism. The notion of disturbed affective contact has motivated most students of face perception in autism to look at affective aspects of face processing, i.e. recognition of facial expression.

In an impressive series of studies, Hobson and associates have looked at the way autistic children perceive facial expressions of emotion (Hobson, 1983; 1986; 1987). It emerges from these studies that autistic children are relatively impaired in the recognition of facial expressions. In contrast with normal children, autistic children do not sort photographs by type of emotional expression but, for example, by type of hat worn or by sex. Autistic children have comparatively great difficulty combining facial expressions in photographs with the corresponding expressions in video-pictures, gestures, vocalisations and contexts. Hobson's results confirm earlier findings on the impaired recognition of facial expressions. Langdell (1980; 1981) presented a task where facial expressions had to be sorted into "sad" or "happy" ones. The subjects were presented with either the whole picture, the upper half or the lower half of the face. Autistic children were less good than normals at telling emotional expressions from the upper part of the face.

The studies just mentioned give no insight into the ability of autistic children to recognise facial identity independently of their ability to process emotional expression. In the absence of an accepted model of face perception, it is difficult to conclude that the observed results follow from a poor ability to recognise facial expression only and not, for example, from a poor ability to recognise facial identity or from both.

Facial Expression *vs* Facial Identity

There is increasing empirical and clinical evidence for the existence of separate processes corresponding to facial identity and facial expression. Experimental studies with normal subjects show that modes of presentation of stimuli (brightness, rotation, movement) influence differentially recognition of identity and of expression (see Bruce, 1988, for an overview). Clinical studies with prosopagnosic patients have documented the existence of a dissociation between recognition of identity and of expression (e.g. Bruyer, 1986). On the basis of such evidence, Bruce and Young (1986) and Bruce (1988) argue for an heterarchic organisation of face recognition abilities. They propose that recognition of identity and of expression and lip-reading may be achieved independently.

In their most recent study, Hobson, Ousten and Lee (1988) address this issue of the relation between recognition of personal identity and recognition of emotional expression. Their study shows that autistics present a divergent profile of face recognition abilities. When presented with full faces, autistics perform as well as controls both in judging identity and emotional expression of faces. When some of the cues to emotion and identity were reduced (e.g. blank mouth, blank forehead), the performance of the autistic subjects declined more for recognition of emotional expression than for recognition of identity.

Facial Speech

We mentioned above that in the view of Bruce and Young (1986) the face perception system might well have separate components for, among others, identity, expression and lip-reading. Studies of eye contact tend to show that autistic children avoid looking at faces and avoid eye contact behaviour (Richer, 1976; Rutter, 1978). No studies of facial speech ability in autistics have been reported so far.

The study by Langdell (1981) offers information that may or may not be relevant. Langdell starts from the fact that children aged 4–10 years find the upper part of the face more helpful for identification than the lower part (Goldstein & Mackenberg, 1966). His own study compares younger and older autistics and finds that, in contrast with normal children, young autistics find the lower features of the face more helpful for peer identification. Older autistic children show no such preference. When asked to identify faces by looking only at the lower part, they perform at the same level as the younger group, but their identification based on the upper part of the face is as good as that of normal children.

There are reasons to expect that recognition of facial speech in autistic children is within the normal range. Studies of discrimination learning and short-term memory show that autism is not associated with any particular deficits in those areas (see Sigman, Ungerer, Mundy & Sherman, 1987, for an overview). Of immediate relevance for the present issue are the findings that memory for auditory presented stimuli and for written material is adequate (Aurnhammer-Frith, 1969; Frith, 1970a; 1970b; Fyffe & Prior, 1978). We know that in normal subjects the ability to lip-read follows closely the ability for processing language in the auditory modality (Campbell, 1989; Massaro, 1987). Yet in subjects with reading disorders in the phonological domain, lip-reading is impaired and exercises less influence on the auditory categorisation of speech sounds (de Gelder & Vroomen, 1988). Those subjects also tend to have worse memory for visual speech information (de Gelder & Vroomen, 1989; 1990). For autistic subjects with no auditory impairment and with reading ability within the normal range, we should expect to observe normal facial speech recognition, and visual influence on auditory speech processing should be at the level predicted by visual speech recognition.

Available research does not allow us to exclude the possibility of an effect of impaired memory for faces on facial speech ability. There is evidence from both clinical and experimental studies that neural mechanisms involved in face recognition are predominantly located in the right hemisphere in contrast with a left hemisphere dominance for linguistic abilities. Neurological damage might selectively affect recognition of facial speech and identity recognition. Campbell, Landis and Regard (1986) have found a dissociation between face recognition and lip-reading in cases of acquired face recognition deficit. The observations fit in with a model as proposed by Bruce and Young (1986; see also Bruce, 1988).

Here also it is difficult to base predictions of developmental phenomena on models of face processing in adults and on cases of acquired disorders. On the basis of clinical data, we would expect to find that impairments in aspects of face processing do not necessarily have an influence on facial speech recognition. But no data from adults or from children are available.

Facial Identity and Facial Speech: The Present Study

The present study might shed light on recognition of facial identity and of facial speech in autistic children and on the possible link between the two processes. None of the studies reviewed above has investigated recognition of facial identity independently of the possible influence of aspects like familiarity, naming and recognition of facial expressions and recognition of degraded facial information. Hobson et al. (1988) studied facial identity using a task where the subjects had to match photographs with one of several simultaneous probes. The paradigm might encourage reliance on non-specific recognition strategies. To obtain insight into recognition of facial identity proper, we have adopted a memory paradigm involving matching different photographs of the same unfamiliar individuals. The difference in presentation guarantees that the extraction of personal identity is mandatory (Bertelson & van Haelen, 1978).

Evidence of a discrepancy between recognition of personal identity and of facial speech would suggest a partial independence between identity and facial speech recognition. Our study might allow us to appreciate the extent to which Bruce and Young's (1986) model, which is based on data from adults and acquired disorders, receives support from the observation of developmental disorders. At the same time, the study of face perception in autism might benefit from investigating a broadened range of hypotheses derived from current face perception models.

A major methodological issue for the study of autistic subjects is the choice of the appropriate control groups. Controls matched on verbal mental age (MA) offer the best chance of unbiased comparisons (Sigman et al., 1987). It guarantees that effects of general-intelligence differences between groups are cancelled out. As complementary measures of intelligence, we administered the RAVEN Progressive Matrices Test (coloured version). To obtain a more specific insight into possible group differences, a task of scene recognition was used as a control task for the face recognition tasks.

METHOD

Subjects

The autistic group consisted of 17 children (16 male, 1 female), aged between 6 years 6 months (6:6) and 16 years 4 months (16:4) (mean = 10:11 years). They had all been diagnosed following Rutter's criteria (Rutter, 1978). The normal group was individually matched with the autistics on the basis of sex and on the raw scores of the Peabody Picture Vocabulary Test (PPVT). Their ages ranged between 6:10 and 11:2 years (mean = 8:6 years). The matching was based on a difference of 5 or less items on the PPVT. The mean raw PPVT scores for autistic and normals was 78.9 and 79.5 respectively.

Raven's Progressive Matrices (coloured version) were also administered. Details of the groups are presented in Table 1. The subjects had no known sensory disorders.

Procedure

The autistic subjects were tested in their daily environment in the presence of a caretaker, whereas the normal subjects were tested in a quiet room in school. Testing lasted about 45 min. The following tests were administered in the order as presented below.

TABLE 1
Details of the Groups

Group	*N*		*Age*	*PVT Raw Scores*	*Raven Raw Scores*
Autistic	17	Mean	10:11	78.9	26.0
		S.D.	2:4	14.7	4.6
		Range	6:6–16:4	57–121	18–34
Normal	17	Mean	8:6	79.5	25.4
		S.D.	1:4	16.2	5.8
		Range	6:10–11:2	52–125	15–34

1. Kaufman face recognition test for children. This face recognition test was taken from a neuropsychological battery (Kaufman & Kaufman, 1983). It contains one example and 15 sets of test pictures. Each set consists of (1) a photograph of either one or more target faces and (2) the picture of a group of four or more people. The photographs are coloured, hair and clothes are shown, and facial expressions are neutral. The subjects are shown the sets one by one. The target picture(s) is presented for 5 sec, and then the group picture is shown and the subject is asked to point to the target person(s).

2. Face recognition (FACE). We constructed the FACE task from a large set of pictures used in an earlier study by Bertelson and co-workers (Bertelson & van Haelen, 1978). The stimuli consisted of: (a) 16 black-and-white passport size photographs presenting 8 male and 8 female young adults. They were presented full face with neutral facial expressions. Hair and clothing were hidden by a black bonnet and a white scarf. (b) Thirty-two photographs in ¾ profile; 16 persons of the (a) group and 16 distractors. In the first round, the subjects were shown the 16 pictures of the (a) set, one photograph after the other for 5 sec each. In the test phase, the subjects were shown two pictures from the (b) set, a ¾ profile picture of a person from the original set and a distractor. The subjects were asked to indicate which of the two persons they had seen before.

3. Facial speech test (FSP). In the facial speech test (FSP), the subjects watched a video-recording of a female speaker. They were asked to repeat what she said. The speaker had been recorded on U-matic tape while pronouncing a series of VCV syllables. Each syllable consisted of one of the four plosive stops /p, b, t, d/ or a nasal /m, n/ in between the vowel /a/ (e.g. /aba/ or /ana/). There were three presentation conditions: audio-visual, auditory-only and visual-only. In the audio-visual presentation, dubbing operations were performed on the recordings so as to produce a new video-film comprising six different auditory–visual combinations: auditory /p, b, t, d, m, n/ were combined with visual /t, d, p, b, n, m/, respectively. Thus, the visual place of articulation feature never matched the auditory place feature. The dubbing was carried out so as to ensure that there was auditory–visual coincidence of the release of the consonant in each utterance. For the auditory-only condition, the original auditory signal was dubbed onto a video signal from the speaker while sitting quietly. For the visual-only condition, the auditory channel was deleted from the recording, so the subject had to rely entirely on lip-reading. Each presentation condition comprised of three replications of the six possible stimuli. There was a 10-sec gap of blank film between the successive trials. To counterbalance presentation order, each condition was divided into two blocks of nine trials each. The presentation order of these blocks was always audio-visual, auditory-only, visual-only, visual-only, auditory-only, audio-visual. The stimuli were presented on a 19-inch TV screen. The subjects were instructed to watch the speaker and repeat what she had said. References to modality were strictly avoided. The subjects' responses were written down by the experimenter. During the presentation, the experimenter monitored the subjects in order to make sure that they were watching the screen.

4. *Luria picture recognition test.* In order to obtain a measure of scene and object recognition, a test designed by Luria was administered. The test consisted of a series of 24 black-and-white pictures of everyday scenes. The pictures were presented at a rate of one per 5 sec. Four pictures appeared twice. The subjects were asked to indicate which pictures were repetitions.

RESULTS

The results of two normal subjects on the Kaufman test and two autistic subjects on the FACE task were not entered into the data analysis because of experimenter error. Due to practical reasons, the FSP task was not presented to eight autistic subjects. The percentage of correct responses on the Kaufman test was 72 and 83% for autistic and normal subjects respectively (see Table 2). The difference is significant according to a two-tailed t-test for matched pairs [$t(14) = 2.86$, $P < 0.02$]. Individual analysis showed that for the 15 matched pairs, autistics performed worse than their controls in 12 cases, the subjects performed equally well in two cases, and one autistic subject performed better than his control. The observed difference is significant according to a non-parametric Wilcoxon matched-pairs signed-ranks test ($Z = 2.41$, $P < 0.02$).

The performances on the FACE test are presented in Table 3. The autistics scored 51% correct on the FACE test, whereas the normal subjects scored 62% correct [$t(14) = 2.94$, $P < 0.01$]. A total of 10 autistics performed worse than their controls, three performed equally well, and two autistics performed better than their controls (Wilcoxon: $Z = 2.43$, P

TABLE 2
Percentage of Correct Responses on the Kaufman Face Recognition Test

Group	*Mean*	*S.D.*
Autistic	72%	19.7
Normal	83%	9.7

TABLE 3
Percentage of Correct Responses on the FACE Test

Group	*Mean*	*S.D.*
Autistic	51%	15.7
Normal	62%	9.4

< 0.02). There was a positive correlation between the Kaufman and the FACE test for the autistic group ($r = 0.66$, $P < 0.005$) and the normal group ($r = 0.26$, $P = 0.18$). Thus, the results suggest that autistics performed worse than normal subjects on face recognition tasks.

The results on the two face identity tests were compared with scores on the Luria test in order to have a control on the possible influence of some general visual memory factor. There was no difference between the groups on the Luria test [mean = 77 and 83% correct for autistics and normals respectively: $t(15) = 0.75$, $P = 0.468$]. Individual comparisons showed that four autistics were better than their controls, five pairs performed equally well, and seven autistics performed worse (Wilcoxon: $Z = 0.62$, N.S.). This suggests that the observed results are due to a specific impairment in facial identity recognition and not to a general visual memory deficit.

The results for the facial speech test are presented in Tables 4 and 5. In the audio-visual condition, there were two possible scorings: either lip-reading influenced auditory speech perception or it did not. The influence was measured by calculating the percentage of "fused" and "blended" responses. A fused response is one where visual information of the place of articulation is combined with the auditory information into a single syllable (e.g. ma-auditory/na-lips into a /na/ response), and a blend is a response where the visual place information is added to the auditory information into a two-phonemes composite (e.g. na-auditory/ma-lips into /mna/ response). The mean incidence of fusions and blends in the autistic group was 19% compared to 51% for the normals [$t(8) = 4.60$, $P < 0.005$

TABLE 4
Mean Percentage of Fusions and Blends in the Audio-visual Condition on the Facial Speech Task (FSP)

Group	*Mean*	*S.D.*
Autistic	19%	11
Normal	51%	20

TABLE 5
Mean Percentage of Correct Responses in the Auditory and Visual Conditions on the Facial Speech Task (FSP)

	Auditory		*Visual*	
Group	*Mean*	*S.D.*	*Mean*	*S.D.*
Autistic	97	3	74	24
Normal	91	16	84	16

according to a two-tailed t-test for matched pairs]. A subject analysis showed that, in the audio-visual condition, all nine autistic subjects were less influenced by visual speech than their matched controls (Wilcoxon: $Z = 2.66$, $P < 0.001$).

In the auditory-only condition, a correct response was an accurate repetition of the stimulus. Accuracy in this condition was high for both groups (97 and 90% for autistic and normal subjects respectively) and there was no significant group difference [$t(8) = 1.21$, $P = 0.261$]. For the nine pairs, the autistics performed better than their controls in five cases, equally well in two, and worse in three cases (Wilcoxon: $Z = 1.15$, N.S.). A correct response in the visual-only condition was defined as one that fell in the same category of visually discriminable phonemes as the stimulus. Thus, there were two visually distinct phoneme categories: the bilabials /p, b, m/ and the linguals /t, d, n/ (Binnie, Montgomery & Jackson, 1974; Woodward & Barber, 1960). The percentage of correct responses in the visual-only condition did not differ significantly between the two groups [mean = 74 and 84% for autistic and normal subjects respectively: $t(8) = 0.87$, N.S.]. Five autistics performed better than their controls and four performed worse (Wilcoxon: $Z = 0.29$, N.S.).

The Pearson correlations between visual influence in the audio-visual condition and lip-reading were 0.51 ($P < 0.02$) for the normals and 0.25 ($P > 0.10$) for the autistics. Thus, the hypothesis that better lip-readers would be more influenced by visual information in the audio-visual condition is only significant for normal subjects.

The last aspect of the results concerns the relation between face recognition and lip-reading ability. Pearson correlations between the face recognition tests and the lip-reading tests were calculated to check whether a common factor underlies the observed group differences (see Tables 6 and 7). In the autistic group, correlations between face recognition and lip-reading were low and negative. None of the correlations reached significance (all $P > 0.10$). In the normal group, there were positive correlations between the influence of lip-reading in the audio-visual condition and

TABLE 6
Correlations Between the Face Recognition Tasks, the Facial Speech Task (FSP) and the Luria for the Autistic Group

			FSP		
	Kaufman	*FACE*	*Auditory*	*Visual*	*Audio-visual*
FACE	0.65[a]				
Auditory	−0.06	−0.50			
Visual	−0.13	−0.07	−0.07		
Audio-visual	−0.21	−0.51	−0.51	0.25	
Luria	−0.01	−0.14	0.00	0.56	0.37

[a] $P < 0.05$.

the Kaufman test ($r = 0.442$, $P < 0.05$), between the influence of lip-reading in the audio-visual condition and the FACE test ($r = 0.442$, $P < 0.05$), and a marginally significant correlation between the percentage correct in the visual/only condition and the Kaufman test ($r = 0.39$, $P < 0.08$).

Multiple regression was used in order to test whether lip-reading could explain the variance of face recognition (measured as the mean proportion of correct responses on the Kaufman test and the FACE test). The classifying variables sex, chronological age, PVT, Raven and Luria were used in addition with the scores on the FSP (auditory, visual and audio-visual). For the autistic group, neither variable contributed significantly to explaining the variance of face recognition (all $P > 0.10$). For the control group, chronological age was entered first in the multiple regression explaining 48% of the variance, followed by the Luria test which contributed another 24% for a total of 72% explained variance. No other variable contributed significantly. Thus, the multiple regressions show that

TABLE 7
Correlations Between the Face Recognition Tasks, the Facial Speech Task (FSP) and the Luria for the Control Group

			FSP		
	Kaufman	*FACE*	*Auditory*	*Visual*	*Audio-visual*
FACE	0.26				
Auditory	0.05	−0.14			
Visual	0.39	0.20	0.30		
Audio-visual	0.44[a]	0.44[a]	−0.26	0.51[a]	
Luria	0.59[a]	0.49[a]	−0.26	0.34	0.45[a]

[a] $P < 0.05$.

neither lip-reading ability nor the influence of visual input in the audio-visual condition contribute to explaining the variance of face recognition performances. Discriminant analysis was used in order to examine how well each test predicts the autistic/control group division. The visual influence in the audio-visual condition accounted for 47% of the variance. The FACE task added another 5% to the explained variance. None of the other variables contributed significantly. On the basis of the visual influence measure and the performance in the FACE test, 83% of the subjects could correctly be allocated to one of the groups.

DISCUSSION

The present study was conducted to investigate (1) whether autistic children are impaired in their recognition of facial identity and facial speech and (2) whether there might be a link between these. The results suggest that autistic children are impaired in face identity recognition and that no impairment is found as far as the lip-reading ability of autistic children is concerned. Taken together, our results suggest the existence of a dissociation between facial identity and facial speech in autistic children.

To date, defective face processing for identity has not been reported for autistic children. Except for Hobson et al.'s (1988) study, previous studies have all looked for defective understanding of emotion and social cues for faces. Hobson has compared identity recognition across facial expression and vice versa. He found that recognition of facial expression declines in autistic subjects with deterioration of the stimuli. No such tendency was found in the normal group or in the condition of facial identity recognition. Autistic subjects perform as well as normal controls when given full face pictures and asked to judge identity. The fact that no difference is found between the two subject groups might be due to the difference in paradigms. As we noted above, our study uses a memory paradigm, whereas Hobson et al. (1988) used a matching task. Moreover, the subjects tested by Hobson et al. (1988) were much older (mean age 19:4, range 13:4–25:10) than those studied by us.

Does the observed face identity impairment suggest a deficit of a relatively isolated sub-process of the face processing system or might it have links with some other sub-process? Impairments in various aspects of face perception (e.g. recognition of familiar faces, difficulties in judging sex and age) and recognition of facial expression have all been found to exist to some degree in autistics. This convergence of face processing deficits would suggest that some other components of the face perception system are impaired. As we noted, the present picture still needs to be completed and this task is complicated by the fact that available data from autistics suggest developmental changes occurring in the sub-process. For example, some of the processing deficits are much less pronounced in older than in young autistics. No developmental data from normal subjects are available that would give insight into the developmental course of the different aspects of face processing. As to explaining this convergence of face processing deficits, different possibilities must be considered. One might opt for an additive picture of local impairments or one might propose the hypothesis of a common underlying cause. For example, our results about an impairment in face identity as well as earlier results on deficits in recognition of facial expression might have a common origin in a generalised face perception disorder. One possibility might be that there exists a basic disturbance in coding of facedness due to an abnormal development in early infanthood. Findings about preference for face over non-face stimuli in infants (Johnson & Morton, 1989) and about the existence of visual neurones responsive to faces (Perrett et al., 1988) suggest the existence of such a face-specific mechanism (Yin, 1969). This might, for example, result from a disorder in the early development of face processing ability (de Schonen & Mathivet, 1989). The two propositions are compatible with a modular conception of face processing ability. In either case, we are in the presence of a specific face processing deficit which, as indeed our data show, is not due to some general factor responsible for overall poor performance of the autistic group. If so, data on impaired face processing do not by themselves support either a cognitive or an emotion-based explanation of autism.

Our results on the good lip-reading ability of autistics are in agreement with earlier findings on the auditory speech ability of autistics. It has repeatedly been observed that autistic children show good performance in tasks of recalling unstructured material presented auditorially. Lip-reading is a skill that is part of normal speech processing ability. This leads us to expect that the lip-reading ability would also be within the normal range. The results support this prediction.

A surprising finding is that, contrary to earlier findings with normal subjects, in bimodal presentations autistic subjects are much less influenced by visual information than normal subjects. For normal subjects, it is known that the influence of visual information (lip-reading) on auditory information increases with lip-reading ability (Massaro, Thompson, Barron & Laren, 1986). We observed the same link in our normal subjects, because there was a positive correlation between visual influence and lip-reading. For the autistic group, there is considerably less influence from visual speech although there is no difference in lip-reading with normal subjects. This finding contrasts with existing models of audio-visual perception. Massaro's fuzzy logic model predicts that the visual influence in audio-visual speech perception will be the same for both groups, because the informativeness of the auditory-only and visual-only sources are the same for both groups (Massaro, 1987). A model of interactive activation of visual and auditory input predicts also that integration will occur the moment processing in each input modality is normal (Campbell et al., 1988). We have observed other cases where lack of integration does also occur. We found that retarded readers presented with an ambiguous auditory input take less advantage (than is to be expected on the basis of their visual speech capacities alone) from the visual information provided (de Gelder & Vroomen, 1988). Evidence from our facial speech task does not allow us to tell whether this failure to integrate information is a characteristic of audio-visual speech perception in autistic subjects or whether it is limited to the integration of phonemic information from lips outside a speech comprehension context. In the latter restricted case, given the good performance on the silent lip-reading task, the possibility of normal bimodal speech comprehension in autistics remains open (Campbell et al., 1988).

Campbell et al. (1986) have observed a case of developmental prosopagnosia showing some similarities with the results obtained here. Their patient, AB, had a good auditory speech ability and was unimpaired on silent lip-reading tasks but was not susceptible to fusions. The fact that there is no indication of autism is no reason to underestimate the importance of this convergence between different kinds of *developmental* disorders.

The reduced visual influence in the autistic group might signal a lack of integration between linguistic information coming from different modalities. We are not offering this as an explanation of audio-visual speech perception in autism, only as a puzzling fact that theories of bimodal speech perception will need to account for. For that reason, it is unhelpful to link this absence of intramodular integration to the theory that autism is to be characterised as an absence of cohesive force at the level of the central processes (Frith, 1989). There is sufficient evidence of the fact that fusions and blendings of the kind presented in our facial speech task – as is the case for speech perception in general – are not under central control.

We now turn to the more hazardous issue of the relation between observed facial recognition impairment and good facial speech performance. At first sight, facial speech occupies a pivotal position at the intersection of two presumably highly modular domains, competence for language and competence for faces. Very intuitively, a reduced effect of visual speech might be an indication of a processing deficit inside the domain of language – limited to phoneme discrimination or extended to real lipreading – it might be a symptom of a horizontal interaction, an influence of a face-processing problem on facial speech perception, or facial speech and facial identity recognition might both be impaired due to a common cause.

Some suggestions about interactions have been made in earlier developmental studies. The finding of an upper face superiority in normal children might be related to the fact that young children are poor lip-readers. Langdell (1978, p. 265) explains the preference of young children for the lower part of the face by proposing that those children look at the mouth in an effort to compensate for an "inability to extract the full meaning of the auditory component of speech". A similar suggestion is made by Hermelin and O'Connor (1985). Proposals such as these represent an appeal to general factors like meaning and understanding or overall coherence. Given that autistics strike one as often not grasping the full meaning of a situation, one can understand researchers being biased in favour of high-level "cognitive" explanations. But the very fact that autistics as a group do have widely divergent intelligence would seem to rule out central factor theories. Moreover, it has frequently been observed that autistic subjects have very divergent scores on different sub-tests of intelligence batteries. For example, Kaiser (1988) found children with a verbal I.Q. of 70, a social I.Q. of 50 and a visual-spatial I.Q. of 120. The distinction between capacities implemented in modules like face or language processing and central intellectual abilities like concepts, reasoning and problem solving seems crucial for the study of a neurologically based developmental disorder like autism. For that reason, the strategy of trying to look at the effects of autism *per se* and select a population of high-ability autistic children may carry a risk. High-ability and older autistic children are likely to have come up with compensation strategies for their original deficits. For example, notwithstanding the autistic deficit and impaired social skills in everyday life, they perform remarkably well on experimental tasks requiring reasoning about social situations (de Gelder, 1990). Performance on face memory and lip-reading tasks of the kind used in the present experiment are less open to influences from central processes. They are more likely to give insight into specific impairments underlying autistic behaviour. In tasks such as we used here, there is little room for a possible influence from attentional strategies, e.g. ignoring lip-read cues as a way to avoid conflict.

Taken together, the various aspects of our results suggest that facial speech recognition and facial identity recognition might be relatively autonomous. The picture suggested is that of a dissociation between visual speech recognition and facial identity recognition in autistics. The dissociation we observe here in autistic subjects has been observed in a case of an acquired facial identity disorder (Campbell et al., 1986). If so, the findings lend support to a heterarchical model of the functional architecture of face perception as defended by Bruce and Young (1986), where the coding of facial information and recognition of identity proceed in parallel. In our view, this model represents a most welcome framework for further research on face perception disorders in autistics and on the development of face perception in general. The model does commit one to a dissociative picture of the primitive face processing components and to separate modules for face processing and language processing. We do not exclude, though, secondary influences from impairments of face processing to language perception and vice versa. For example, our results of defective integration of auditory and visual information suggest that autistics might have impairments in audio-visual speech perception. This might stimulate the development of attentional strategies like focusing on the lower part of the face. It is important not to mistake such compensatory mechanisms for evidence of interaction occurring at the level of face processing components.

Finally, on the basis of our data, we see no reason to lend support to current competing theories about autism. It is difficult to see how data on face recognition could lend support to an integrative approach to autism, whether formulated as a cognitive theory (Frith, 1989) or as an emotional theory (Hobson, 1989).

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