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Facial expressions and Parkinson's disease

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Patients with Parkinson's disease (PD) and matched control subjects were photographed posing a range of facial expressions. The same subjects were later asked to identify the posed expressions of the other subjects. They were also asked to rate the quality of expressions posed by the control subjects after being told what each expression was. Expressions posed by healthy control subjects were more readily identifiable than expressions posed by Parkinson's patients, but the two groups did not differ in their ability to recognize facial expressions or in the goodness ratings they gave, and their error patterns were closely similar. There was no significant difference between the groups on other tests of face processing or on ratings of emotionality except for greater reported anxiety in the Parkinson's patients. We conclude that although patients with PD have reduced facial expressiveness, there is no apparent diminution in their comprehension of facial expressions or their day-to-day experience of emotion.

Keywords: Facial expressions – Parkinson's disease

INTRODUCTION

The ability to produce normal, spontaneous facial expressions is impaired in patients suffering from Parkinson's disease (PD). The unnatural immobility of their facial muscles may be a reflection of the tendency of the disorder to have its greatest effect on movements which are carried out by small muscles (*Brain's Clinical Neurology*, 6th edn). The result is the so-called "masked face syndrome" (Rinn, 1984). This feature is rated in one of the scales commonly used to measure PD (Webster, 1968) and has led to PD patients being rated from silent videotapes as more anxious, hostile, suspicious, unhappy, bored and tense; also as less intelligent, stable and tough-minded than matched patients with ischaemic heart disease (Pentland *et al.*, 1987). As well as being less prominent, facial expressions are reduced in frequency in PD subjects, and their smiles are felt by viewers to be "false" smiles (Pitcairn *et al.*, 1990).

As well as having practical importance for those dealing with PD patients, the reduced facial expressiveness of PD patients may have theoretical implications for our understanding of the mechanisms underlying the production and perception of facial expressions. An old idea recently revived within social psychology is that feedback from the production of facial expressions may contribute to the interpretation and felt intensity of emotions (Adelmann and Zajonc, 1989; Ekman, 1992). If this is the case, then PD patients may not only differ from normal, healthy subjects in their expression of emotion, but may also differ in their experience of emotion and in their perception and interpretation of the emotional expressions of others.

Using photographs in which PD patients and matched control subjects posed different facial expressions we sought to answer the following questions.

(1) Is the ability to pose a facial expression impaired in PD?
(2) If it is, are PD patients less sensitive to the facial expressions of others?
(3) If PD patients have an impaired ability to express emotion, do they also experience less emotion?
(4) If PD patients are less sensitive to the facial expressions of others, are other aspects of face recognition also impaired?

To answer this last question, the PD patients and controls were given tests assessing their ability to recognize famous faces and to match unfamiliar faces presented in different views and poses.

METHODS

Subjects

Nine male subjects with idiopathic PD participated in the study, along with nine healthy, age-matched male volunteers. The PD subjects were all taking part in an on-going study of cognition and mood which included regular psychiatric assessments (Boyd *et al.*, 1991; Biggins *et al.*, 1992). None had shown evidence of dementia or affective disorder. The mean age of the PD subjects was 59.7 years (95% C.I. = 51.4 to 67.9) while that of the control subjects was 62.9 years (95% C.I. = 55.8 to 70.0). The PD subjects were rated on Hoehn and Yahr's (1967) staging for PD, with one subject being stage I, three subjects stage II, four subjects stage III and one subject stage IV. When rated on Webster's (1968) scale for PD, the mean score was 10.7 (95% C.I. = 6.65 to 14.7, where a score below 10 represents mild severity of disease while a score of 11–20 represents moderately severe disease). When the "facies" rating from Webster's scale was performed, seven PD subjects were rated as scoring 1 ("Detectable immobility. Mouth remains closed. Beginnings of changes in features indicative of anxiety or depression") and two subjects were rated as scoring 2 ("Moderate immobility. Emotion breaks through at markedly increased threshold. Moderate appearance of anxiety or depression. Drooling may be present").

Procedures

Each subject from both the PD and control group was photographed twice posing the expressions happiness, sadness, disgust and anger, plus a "neutral" expression. No stimulus other than a request to pose a named expression was given. Each pair of photographs showing a subject posing a given expression were examined by an independent volunteer who was unaware of which group each poser belonged to, and was asked to select the "better" of the two for use in the experiment.

Immediately prior to being photographed, the subjects completed the UWIST Mood Adjective Checklist questionnaire (UMACL) and the Hospital Anxiety and Depression scale (HAD). The UMACL is designed to measure how the person feels at a particular moment in time (i.e. the time when they fill in the form). The results are combined into three areas which are energetic arousal, tense arousal and hedonic tone (Matthews, 1985, 1987). The HAD is designed to measure clinical anxiety and clinical depression. The person is asked to relate the experience of how they have been feeling over the past week. Anxiety and depression are measured on two separate subscales (Zigmond and Snaith, 1983).

Between 8 and 20 weeks later each subject was shown the photographs of the other subjects in a random order. The subject was reminded what the different expressions were and was asked to identify which expression was being posed in each photograph. When this was completed, raters were shown the photographs again. This time they were told what the posed expression was, and were asked to rate how "good" each expression was using a 4-point scale from 1 = poor to 4 = good. Subjects were not required to judge any of their own expressions.

In addition, subjects carried out three face processing tests developed by Young and Flude at the University of Lancaster. In the Expression Recognition test, pairs of photographs are presented one above the other. The photographs are taken from the Ekman and Friesen (1976) series and show normal subjects posing the expressions happy, sad and angry. Sixteen of the 48 trials show a happy and a sad expression, 16 show a happy and an angry expression, and 16 show a sad and an angry expression. On each trial, the name of an expression is shown between the two photographs and the subject has to decide which photograph matches the named expression. In the Unfamiliar Face Matching test, 48 pairs of photographs of two different but similar-looking people are presented in 3/4 pose (i.e. half way between full face and profile), one above the other. A full face photograph of one of the two people is shown on one side of the display. The subject has to decide which of the two 3/4 photographs shows the same person as the full face photograph. Finally, in the Famous Face Recognition test, subjects are shown 48 pairs of photographs which show similar-looking people in similar poses, except that one of the two is a famous face while the other is unfamiliar. The subject is first asked to indicate which of the two is famous. Having selected one, the subject is asked to state the famous person's occupation and name.

RESULTS

Accuracy of recognizing posed expressions

Accuracy scores for each subject's own face and that of their matched patient or control were excluded for the analysis. The results are shown in Table I. The scores were analysed by means of a three-way analysis of variance, with rater group (PD or control) as a between-group factor, and poser group (PD or control) and expression type (neutral, happy, sad, disgusted and angry) as within-subjects factors.

TABLE I. Accuracy with which PD and control raters identify expressions posed by PD or control patients

	Posed by controls					Posed by PD patients				
	N	H	S	D	A	N	H	S	D	A
PD raters (mean)	4.2	7.2	2.1	2.2	1.9	2.8	6.0	2.1	2.9	1.6
Control raters (mean)	2.8	7.4	2.2	3.2	2.6	2.7	5.6	3.3	1.3	0.9

N, neutral; H, happy; S, sad; D, disgusted; A, angry. Max score per expression = 8.

TABLE II. Goodness ratings given by PD and control raters to expressions posed by control subjects

	Posed expression			
	Happy	Sad	Disgusted	Angry
PD group	3.57	3.00	2.95	2.61
Controls	3.54	3.11	2.79	2.68

The main effect of poser group was highly significant [$F(1,16) = 16.36$; $p < 0.001$], with expressions posed by control subjects (mean = 3.59) being more readily identifiable than expressions posed by PD patients (mean = 2.91). In contrast, the main effect of rater group was not significant ($F < 1$), with the overall mean for the PD raters (3.30) being very close to the mean for the control raters (3.20). The interaction between poser group and rater group was also non-significant [$F(1,16) = 1.59$; N.S.], indicating that the superior identification of expressions posed by controls was as evident for PD raters as it was for control raters.

There was a main effect of expression type [$F(4,64) = 54.22$; $p < 0.0001$], with happy being the easiest expression to identify and angry the most difficult. The interaction between rater group and expression type was not significant [$F(1,16) = 1.00$; N.S.], indicating that PD and control subjects found the same expressions relatively easy or difficult to identify. There was, however, a significant two-way interaction between poser group and expression type [$F(4,64) = 3.56$; $p = 0.01$] and a significant three-way interaction between rater group, poser group and expression type [$F(4,64) = 4.02$; $p < 0.01$]. Inspection of Table I suggests that identification of the more difficult expressions posed by PD patients tended towards chance level (1.5) more than identification of the same expressions posed by controls.

Errors in recognizing posed expressions

The PD raters made a total of 205 errors in identifying expressions posed by control subjects while control raters made a total of 195 errors. The errors were cast into confusion matrices for the two rater groups. The correlation between the two matrices is high ($r = 0.799$, $p < 0.001$) indicating that the pattern of misidentification errors was very similar for the two rater groups.

Goodness ratings

Given the difficulty both groups of raters had identifying expressions posed by PD patients, only the goodness ratings given to expressions posed by controls were analysed. Ratings given to neutral expressions were also omitted. The results are shown in Table II. The data were analysed by means of a two-way analysis of variance, with rater group (PD or control) as a between-groups factor and expression type (happy, sad, disgusted and angry) as a within-subjects factor. The main effect of expression type was highly significant [$F(3,48) = 27.60$; $p < 0.0001$], with happy expressions being given the highest ratings, followed by sad, disgusted and angry. There was no significant difference between the ratings given by the PD and control raters; indeed the overall means for the two groups were identical (both 3.41). The interaction between rater group and expression type also did not approach significance ($F < 1$), indicating that the two groups of raters showed much the same pattern across the four expressions when it came to rating their goodness.

Other face-processing tasks

The results of the Expression Recognition, Unfamiliar Face Matching and Famous Face Recognition tests are shown in Table III. No significant difference was found between the two groups on any of the measures using Mann–Whitney U-tests.

Emotionality

No significant differences were found when the scores of the two groups on the energetic arousal, hedonic tone or general arousal scales of the UMACL were compared using Mann–Whitney U-tests. No significant difference was observed on the depression subscale of the HAD, but the PD subjects showed greater anxiety scores than the controls ($p < 0.01$).

TABLE III. Performance of the PD and control subjects on the Expression Recognition, Unfamiliar Face Matching and Famous Face Recognition tests

	Expression Matching	Unfamiliar Face Matching	Famous Face Recognition		
			Which is famous?	Occupation	Naming
PD group					
Mean	47.2	43.3	45.1	42.2	33.4
Range	46–48	41–45	40–48	33–48	14–42
Controls					
Mean	46.9	44.3	45.0	43.6	34.6
Range	45–48	41–47	33–48	31–48	18–41

Maximum score on each measure = 48.

DISCUSSION

Facial expressions posed by PD patients were less readily identifiable than facial expressions posed by controls, even though the subjects identifying the expressions knew what the small set of expressions being posed was. This illustrates once again the inexpressiveness of the faces of PD patients. Importantly, however, there was no difference between PD patients and controls in the accuracy with which they identified expressions posed by patients or controls, and their error patterns were very similar. The two groups also did not differ in the goodness ratings they gave to expressions posed by the control subjects.

The finding that PD patients and controls were equally good at selecting which of two posed expressions matches the written name of an emotional state lends further support to the suggestion that PD patients are not impaired in their perception and interpretation of facial expressions. The PD patients in our study were also unimpaired at unfamiliar face matching and at identifying famous faces. Dewick *et al.* (1991) did find a difference between PD patients and controls on unfamiliar face matching and identifying famous faces. (In fact, the tests of expression matching and unfamiliar face matching used by Dewick *et al.* were the same as were used in the present study.) We would note, however, that the patients in the Dewick *et al.* study were older, had probably been suffering from PD for longer, and included more patients in an advanced stage of the disease than the present study: it may be that problems with unfamiliar face matching and the identification of famous faces only emerge when the disease is relatively advanced. More important for present concerns is the fact that, despite the greater age and severity of their patients, Dewick *et al.* also found no difference between PD patients and controls on the recognition of facial expressions.

As stated in the Introduction, recent social psychological theories of emotion have revived the notion that feedback from the facial musculature to the brain enhances perceived emotion, and may also assist in the interpretation of emotional expressions (Adelmann and Zajonc, 1989; Ekman, 1992). PD patients show reduced facial expressivity, which might be predicted to lead to a general reduction in the experience of emotion. Our data suggest that this is not the case: no difference was found between PD patients and controls on any of the three scales of the UMACL (energetic arousal, hedonic tone and general arousal) or on the depression subscale of the HAD. The hedonic tone of the UMACL and the depression subscale of the HAD relate in a fairly transparent way to the happy–sad dimension. Although PD patients generate happy and sad expressions that are less intense than those of controls, there appears to be no reduction in either their capacity to recognize those expressions on the faces of others or their experience of the corresponding emotions. It is true that our self-report scales do not relate closely to the experience of anger and disgust, and we have not measured moment-to-moment fluctuations in felt emotion associated with changing facial expressions, but our data nevertheless call into question the hypothesis that feedback from facial musculature plays a significant role in either the interpretation of expressions or the experience of emotions.

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