Disgust implicated in obsessive–compulsive disorder

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SUMMARY

Psychiatric classificatory systems consider obsessions and compulsions as forms of anxiety disorder. However, the neurology of diseases associated with obsessive–compulsive symptoms suggests the involvement of fronto-striatal regions likely to be involved in the mediation of the emotion of disgust, suggesting that dysfunctions of disgust should be considered alongside anxiety in the pathogenesis of obsessive–compulsive behaviours. We therefore tested recognition of facial expressions of basic emotions (including disgust) by groups of participants with obsessive–compulsive disorder (OCD) and with Gilles de la Tourette's syndrome (GTS) with and without co-present obsessive–compulsive behaviours (GTS with OCB; GTS without OCB). A group of people suffering from panic disorder and generalized anxiety were also included in the study. Both groups with obsessive–compulsive symptoms (OCD; GTS with OCB) showed impaired recognition of facial expressions of disgust. Such problems were not evident in participants with panic disorder and generalized anxiety, or for participants with GTS without obsessions or compulsions, indicating that the deficit is closely related to the presence of obsessive–compulsive symptoms. Participants with OCD were able to assign words to emotion categories without difficulty, showing that their problem with disgust is linked to a failure to recognize this emotion in others and not a comprehension or response criterion effect. Impaired recognition of disgust is consistent with the neurology of OCD and with the idea that abnormal experience of disgust may be involved in the genesis of obsessions and compulsions.

1. INTRODUCTION

Obsessive–compulsive disorder (OCD) is characterized by intrusive thoughts and irrational urges to carry out ritualized actions, and all current psychiatric diagnostic and classificatory systems concur in seeing OCD as a form of anxiety disorder. However, neurophysiological and neuropsychological studies of OCD highlight abnormalities in fronto-striatal regions (Abbruzzese *et al*. 1997; McGuire 1995; Rapoport 1989). These regions may be involved in mediating the emotion of disgust on the basis of findings of impaired recognition of disgust in Huntington's disease (Gray *et al*. 1997; Sprengelmeyer *et al*. 1996, 1997), and functional imaging of neural responses to facial expressions of disgust (Phillips *et al*. 1997). A role for disgust in OCD is therefore plausible on neurological grounds. In addition, a recent theoretical proposal has suggested that OCD may involve a dysfunction of this emotion (Power & Dalgleish 1997).

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Given that the neurology of obsessions and compulsions compromises neural pathways involved in the mediation of disgust we reasoned as follows. The emotion of disgust is based on the appraisal of objects and events for their potential role in contamination and transmission of diseases (Rozin *et al*. 1993). If OCD involves a dysfunction of this appraisal process, then a poor correlation between the stimuli which evoke disgust in OCD sufferers and stimuli evoking disgust in other people will result. To the extent that recognition of facial expressions is learnt in a social context by mapping the appropriate expression displayed by others to one's own emotional experience, people with OCD will have little opportunity to learn to recognize facial expressions of disgust. For example, when a person with OCD experiences disgust other people may not, and hence they may show non-disgust expressions. The consequence will be to weaken any learned association between the emotional experience of disgust and the corresponding facial expression displayed by others.

To test this hypothesis two tasks of facial expression recognition were given to a group of participants with

obsessive–compulsive disorder (OCD), and with Gilles de la Tourette's syndrome (GTS; Robertson 1994) with and without co-present obsessive–compulsive behaviours (GTS with OCB; GTS without OCB). Since obsessions and compulsions are widely considered as forms of anxiety disorder, a group of people suffering from panic disorder and generalized anxiety was also included.

2. METHOD

Clinical participants included 12 people (seven female, five male) with a DSM-III-R diagnosis of OCD (DSM 300.30), and eight people (six female, two male) with anxiety disorders (six with panic disorder, DSM 300.01; two with generalized anxiety, DSM 300.02). In addition, 12 people with GTS took part. For five of these (GTS with OCB group; two female, three male), obsessive or compulsive behaviours were noted as well as motor and vocal tics, whereas the other seven (GTS without OCB group; five female, two male), had motor and vocal tics without obsessions or compulsions.

Testing was carried out in Germany and in England. To establish that participants were able to understand the meanings of verbal emotion terms used for responses, everyone was tested for their comprehension of these terms. They could all state what it means to say someone is happy, surprised, afraid, sad, disgusted, or angry, and give plausible examples of circumstances under which people might experience such emotions. All testing in Germany was done by a native speaker of German, using German equivalents of English emotion names.

We used tasks intended to explore basic visual processing (spatial contrast sensitivity function) and the perception of social information other than emotion from the face, and two tasks to assess recognition of each of six basic emotions. Full descriptions of these procedures can be found elsewhere (Sprengelmeyer *et al.* 1996); only essential details are given here.

Basic visual processing was assessed using the Vistech VCTS 6000 contrast sensitivity chart. This measures the degree of contrast at which the orientations of stationary sinusoidal gratings can be detected at each of five spatial frequencies (1.5, 3.0, 6.0, 12.0, 18.0 cycles per degree).

Age perception and sex perception were tested with 40 faces, of which half were male, half female, and half were old people, half young. The task was to work through these faces one by one, classifying each as of 'young' or 'old' appearance in one block of trials, and as 'male' or 'female' in another block. Perception of unfamiliar face identity was assessed with the Benton Test of Facial Recognition (Benton *et al.* 1983). In this test, subjects have to choose which of six photographs of unfamiliar faces are pictures of the same person as a simultaneously presented target face photograph. The test of perception of gaze direction involved 18 pairs of face photographs; the task was to choose the face looking directly at the viewer from a second face looking slightly away.

Our principal test of facial expression recognition used an emotion hexagon. Facial expressions were ordered by placing each adjacent to the one it was most likely to be confused with in Ekman & Friesen's (1976) norms; this gave the sequence happiness–surprise–fear–sadness–disgust–anger. The ends of this sequence (anger and happiness) were then joined to create a hexagon, and computer-interpolated ('morphed') images were created for the six continua that lie around its perimeter. The resulting morphed faces are shown in figure 1. They were presented one at a time on a computer screen, for 5 s each, in pseudo-random order. The subject's task was to decide whether each image was most like happiness, surprise, fear, sadness, disgust, or anger. The names of the six emotions were printed on a card, which could be consulted throughout the test. There were six blocks of trials; in each of these blocks all of the 30 morphed faces were presented once. The first block was discounted as practice, and data from the remaining five blocks (150 trials) were used for analysis. Performance of clinical participants was compared to a group of 40 neurologically normal controls (20 male, 20 female), aged 20–60 years (mean = 43.21 years, s.d. = 13.37), using two-tailed Mann–Whitney U tests.

A second test of recognition of emotions in facial expressions used photographs of the faces of ten people from the Ekman & Friesen (1976) series. For each face, there were poses corresponding to each of six basic emotions (happiness, surprise, fear, sadness, disgust, and anger), giving a total of 60 photographs (ten for each emotion). These were shown one at a time in pseudo-random order, and the subject was asked to decide which of the six emotion names best described the facial expression shown. The names of the six emotions were printed on a card, and this was available throughout the test. Performance of clinical participants was compared to a group of 40 neurologically normal controls (19 male, 21 female), aged 20–60 years (mean = 42.88 years, s.d. = 14.32), using two-tailed Mann–Whitney U tests.

Although pre-testing of all participants had established that they understood the meaning of emotion words (see above), the pattern of results obtained for recognition of facial expressions of disgust by participants in the OCD group indicated that it was particularly important to know whether they were unwilling to choose the verbal label 'disgust' as a response. The entire group of participants with OCD were therefore retested with a task involving the classification of words as synonyms for happiness, surprise, sadness, fear, disgust, or anger. Ten synonyms for each emotion were used (see Appendix 1), presented in pseudo-random order; these were German words because all participants with OCD were tested in Germany. A further 18 German-speaking controls (mean age = 50.56 years, s.d. = 6.77) were tested for comparison.

3. RESULTS

Background data from the Vistech VCTS 6000, the Benton test, the gaze direction and age and gender perception tasks are presented in table 1. As table 1 shows, the OCD and anxiety groups, and the GTS with and without OCB groups were well-matched for age, intelligence, vision, and on non-emotional measures of face processing (perception of age, sex, unfamiliar face identity, and gaze direction). Comparisons of the OCD and anxiety groups showed no differences for any of these measures (two-tailed Mann–Whitney U tests; $p > 0.1$, in all cases), and comparisons of the GTS with OCB and GTS without OCB groups showed they differed only on the Benton test ($p < 0.05$; $p > 0.1$, for all other measures shown in table 1).

Results for the tests of facial expression recognition are presented in table 2, which shows means and standard deviations of performance for control subjects, and mean performance of the clinical participant groups.

First, we consider results for participants with OCD and with anxiety disorders. To evaluate performance of the emotion hexagon test, we divided the stimuli shown in figure 1 into sets which were consistently recognized as each emotion by controls, as has been done in previous studies (Calder *et al.* 1996; Sprengelmeyer *et*

Table 1. *Characteristics of clinical participant groups*

	anxiety		OCD		GTS with OCB		GTS without OCB	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
background information								
age	36.63	9.98	34.83	10.09	25.40	5.64	29.57	6.11
IQ	105.88	11.14	108.58	14.07	105.00	13.54	112.00	10.82
contrast sensitivity[c]								
1.5 cpd	5.38	0.52	5.58	1.08	5.25	0.50	5.43	0.53
3.0 cpd	6.00	0.53	6.17	0.94	6.00	0.00	6.14	0.38
6.0 cpd	5.75	0.46	5.58	1.62	6.00	0.82	5.86	0.38
12.0 cpd	5.38	1.06	5.17	1.99	6.25	0.50	6.29	0.49
18.0 cpd	5.00	1.20	4.25	2.20	5.75	0.50	5.86	0.38
face perception								
age perception (max = 40)	36.88	2.30	37.58	1.93	39.33	0.58	38.71	1.25
sex perception (max = 40)	39.13	0.83	39.17	0.58	38.00	2.65	39.00	1.75
Benton test (max = 54)	48.25	4.65	48.00	4.67	42.60	2.97	47.71	2.50
gaze direction (max = 18)	17.38	1.41	17.25	1.14	NT	—	NT	—

cpd—cycles per degree.
[c]—contrast sensitivity measured in arbitrary units based on intervals used in published test chart.

Table 2. *Mean performance of two tests of facial expression recognition by clinical participant groups, and means and standard deviations for 40 control subjects*

(Data for classification of emotion words by the OCD group and 18 control subjects are presented for comparison.)

	anxiety	OCD	GTS with OCB	GTS without OCB	controls mean	s.d.
emotion hexagon (max = 20 for each emotion)						
happiness	20.00	19.83	19.60	20.00	19.55	1.01
surprise	17.75	17.00	15.60	18.43	17.80	2.81
fear	19.38[aa]	16.75	16.80	18.00	16.25	3.91
sadness	19.88[ba]	18.83	19.80	19.86[ba]	18.33	3.03
disgust	19.63	5.17***	5.80***	19.43	18.25	3.74
anger	19.75[a]	15.67[b]	14.80**	18.43	18.15	2.56
Ekman & Friesen (1976) faces (max = 10 for each emotion)						
happiness	10.00	9.92	10.00	9.57	9.95	0.22
surprise	7.38[b]	8.08	8.40	8.43	8.33	1.31
fear	8.25	6.58	7.80	6.86	7.65	2.02
sadness	9.13	8.17	8.60	9.00	8.48	1.57
disgust	8.75	5.67**	4.40**	8.86	8.28	1.89
anger	9.00[ba]	8.50	7.40	8.57	7.68	1.85
word classification (max = 10 for each emotion)						
happiness	—	9.41	—	—	9.67	0.69
surprise	—	8.25	—	—	8.72	0.90
fear	—	8.92	—	—	8.78	1.17
sadness	—	9.17	—	—	9.17	1.10
disgust	—	8.42	—	—	8.50	1.25
anger	—	9.17	—	—	9.44	0.75

Marked scores differ from controls:
[b] borderline impairment, $0.1 > p > 0.05$; * impaired, $p < 0.05$; ** impaired, $p < 0.01$; *** impaired, $p < 0.001$.
[ba] borderline hypersensitivity $0.1 > p > 0.05$; [a] hyper-recognition, $p < 0.05$; [aa] hyper-recognition, $p < 0.01$.

al. 1996). Four such stimuli were identified for each emotion (each of which was presented five times in the main block of trials), leading to scores out of a maximum of 20 possible correct responses for each emotion. The performance of the OCD group fell significantly below that of a normal control group in the recognition of disgust ($p < 0.001$), and fell in a borderline region ($0.1 > p > 0.05$) for recognition of

anger, but was unimpaired for the other emotions. No impairment of recognition of any emotion was noted for participants with anxiety disorders; in fact, they showed significantly better recognition than controls of fear ($p < 0.01$) and anger ($p < 0.05$), and a borderline advantage for recognition of sadness ($0.1 > p > 0.05$). At an individual level, there was a perfect separation of disgust recognition scores on this test, with every person in the OCD group showing significantly impaired recognition of disgust and everyone in the anxiety group scoring in the normal range.

Our other test of emotion recognition involved 60 photographs from the Ekman & Friesen (1976) series, with scores out of ten for recognizing each of six basic emotions. Again, recognition of disgust was significantly impaired in the OCD group ($p < 0.01$). The anxiety disorders group showed a borderline advantage for recognizing anger ($0.1 > p > 0.05$), and a borderline deficit for surprise ($0.1 > p > 0.05$).

Second, we consider participants with GTS, who allow us to examine how closely obsessions and compulsions are linked to impaired recognition of disgust. As table 2 shows, recognition of disgust was impaired for both facial expression recognition tests in the GTS with OCB group ($p < 0.001$ for emotion hexagon, $p < 0.01$ for Ekman & Friesen faces), and unimpaired in the GTS without OCB group. There was also a significant impairment of anger recognition on the emotion hexagon. At an individual level, there was again a perfect separation of disgust recognition scores on the emotion hexagon test, with every person in the GTS with OCB group showing significantly impaired recognition of disgust, and everyone in the GTS without OCB group scoring in the normal range.

Finally, full details of performance of the emotion hexagon are plotted in figure 2, which shows the rates at which each of the images was identified as each basic emotion. The abnormalities in the OCD and GTS with OCB groups are strikingly similar, with closely comparable severe misrecognitions of disgust as anger, and some tendency also to misclassify anger stimuli. In Ekman & Friesen's (1976) norms, anger is the emotion most often confused with disgust by normal subjects (at an overall rate of 6.4%), so it is reasonable that people who fail to recognize disgust should misidentify it as anger.

Although the results from the tests of facial expression recognition show a clear relation between obsessions or compulsions and impaired recognition of disgust, the data presented thus far do not distinguish two possible interpretations of this finding. The interpretation arising from our hypothesis is that the configuration of facial features which signals the emotion of disgust is not recognized, but an alternative possibility would be that people with obsessive or compulsive symptoms actually recognize the emotion but are unwilling to choose 'disgust' as a response, perhaps to avoid the anxiety it might engender for them. To investigate this latter possibility, participants from the OCD group were tested with a task which required deciding whether words were synonyms for happiness, surprise, sadness, fear, disgust, or anger. Results are presented in table 2, alongside those of a further 18 neurologically normal controls. In marked contrast to their performance of the facial expression recognition tasks, people with OCD classified these words (including the disgust words) as well as controls (two-tailed Mann–Whitney U tests; $p > 0.1$, in all cases), showing that their problems in recognizing facial expressions of disgust do not arise from any disposition to avoid using this label as a response.

4. DISCUSSION

Our findings showed impaired recognition of disgust on both tests for people with OCD and GTS with OCB, but not for the other groups. There was thus a close link between impaired recognition of disgust and the presence of obsessive–compulsive behaviours. This is consistent with the neurology of OCD and with the idea that abnormal experience of disgust may be involved in the genesis of obsessions and compulsions (Power & Dalgleish 1997). No such problem was noted for people with panic disorder and generalized anxiety, showing a clear difference between OCD and other forms of anxiety disorder. The tightness of the link between obsessive–compulsive behaviours and impaired recognition of disgust was further demonstrated by our data on participants with GTS, where only those people with clinically evident obsessions or compulsions showed impaired recognition of disgust.

In principle, findings of impaired performance on tests of recognition of facial expressions of disgust might derive either from impaired recognition of the configuration of facial features which signals the emotion of disgust or from an unwillingness to use 'disgust' as a response category. To test this latter possibility, participants with OCD were also asked to assign words to basic emotion categories; they proved as well able to do this as controls, indicating both that they understood the verbal meaning of disgust and that they were willing to use it as a response category. Consistent with our hypothesis, their problem does therefore seem to be linked to a failure to recognize this emotion in others.

Of course, we do not seek to claim that anxiety is an irrelevant aspect of OCD; our point is that additional factors involving disgust deserve further exploration. At present, successful treatment for OCD can prove difficult. The potential role of disgust in the genesis of the disorder may therefore have important practical implications.

Before such implications can become clear, further work will be needed to clarify whether problems in recognizing disgust are linked to some particular pattern of obsessive–compulsive behaviours. Clinically, obsessive–compulsive behaviours can be divided into washing or checking rituals. In their daily lives, all of our participants showed checking compulsions. Since there is a stronger *prima facie* case for involvement of disgust in washing than in checking, it would therefore be of interest to contrast groups of participants who engage in these forms of behaviour. In addition, there is scope for examining which forms of disgust expressions are misrecognized (Rozin *et al.* 1994), and which facial features may lead to their being misclassified as anger.

Figure 1. Expression continua used in emotion hexagon task. Going from left to right, the columns show 90%, 70%, 50%, 30% and 10% morphs along each continuum. From top to bottom, the continua shown in each row are happiness–surprise (top row), surprise–fear (second row), fear–sadness (third row), sadness–disgust (fourth row), disgust–anger (fifth row), anger–happiness (bottom row).

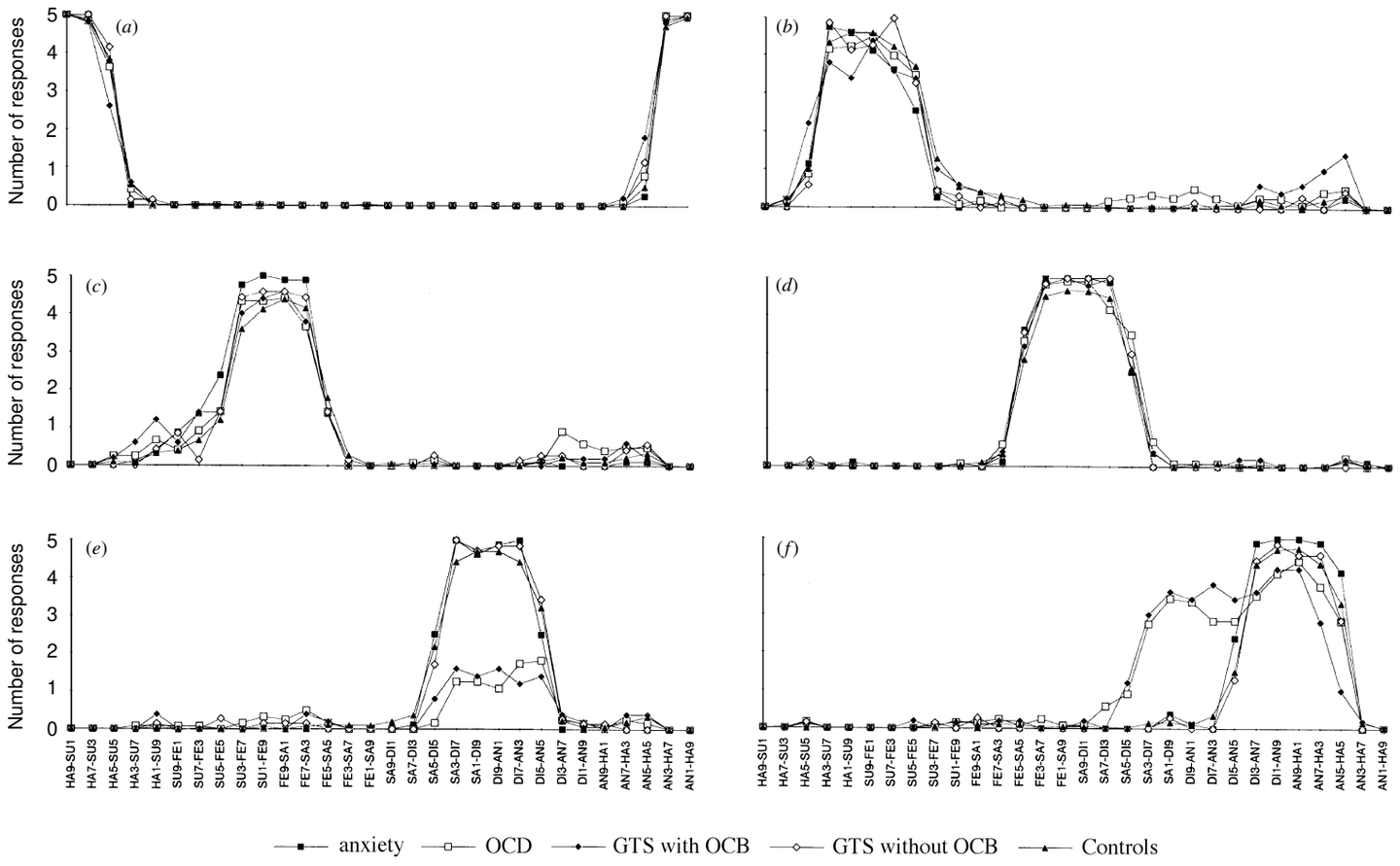

Figure 2. Identification of stimuli in the emotion hexagon by different groups of participants. The images from figure 1 are positioned along the *x*-axis, with the *y*-axis representing the rate at which each stimulus was identified as a particular emotion; seen as (*a*) happiness, (*b*) surprise, (*c*) fear, (*d*) sadness, (*e*) disgust, and (*f*) anger. There is a strikingly similar abnormality in the recognition of disgust for the OCD and GTS with OCB groups.

Since we have shown how impaired ability to recognize disgust could derive from the involvement of this emotion in people with OCD, one might have expected a parallel impairment of fear recognition in participants with panic disorder and generalized anxiety. Yet, if anything, there were hints in the data that those people outperformed controls on recognition of fear and anger, being in effect hypersensitive to displays of these emotions. This potential hypersensitivity deserves further study. For now, we need only note that there are a number of potential reasons for the difference in findings. We consider the most likely of these to be the origin of OCD in early childhood, when facial expression recognition is being learnt. People with OCD often do not seek help until many years after the onset of symptoms (Marks 1992), and all of our OCD participants had shown evidence of such behaviours in childhood. In contrast, panic disorder and generalized anxiety often begin later in life (this was the case for participants in our anxiety group), when recognition of basic emotions is well-established. This later onset of weakened mapping of self-experienced emotion to the facial expressions of others may then serve to heighten (instead of reduce) sensitivity to appropriate cues.

The impairment of disgust recognition demonstrated here for people with OCD forms a double dissociation with evidence of specialized involvement of the amygdala in recognition of facial expressions of fear deriving from neuropsychological (Adolphs *et al*. 1994, 1995; Calder *et al*. 1996) and functional imaging studies (Breiter *et al*. 1996; Morris *et al*. 1996). The basic emotions of fear and disgust probably evolved for different purposes—fear as part of the appraisal of danger and threat (LeDoux 1995), and disgust to deal with the risk of contamination and disease (Rozin *et al*. 1993). The separation of effects associated with each emotion in psychopathological conditions may have important implications for understanding and managing these disorders.

We are grateful to Professor Paul Ekman for giving us permission to use and reproduce images derived from the Ekman & Friesen (1976) 'Pictures of facial affect' series.

APPENDIX 1. SYNONYMS USED IN EMOTION WORD CLASSIFICATION TASK

(*a*) Happiness (Freude): zufrieden, heiter, Spaß, Wohlgefallen, beschwingt, munter, angenehm, Vergnügen, Glück, Fröhlichkeit.
(*b*) Surprise (Überraschung): platt, verdattert, baff, Erstaunen, von den Socken, Verwunderung, Schock, Verwirrung, entgeistert.
(*c*) Fear (Angst): Entsetzen, eingeschüchtert, Muffe, Panik, Schiß, verschreckt, unsicher, Furcht, bange, scheu.
(*d*) Sadness (Trauer): untröstlich, trübsinnig, Wehmut, Leid, bedrückt, Kummer, schmerzerfüllt, niedergeschlagen, freudlos, Düsterkeit.
(*e*) Disgust (Ekel): Brechreiz, Abneigung, abgestoßen, scheußlich, angewidert, Übelkeit, abscheulich, zum Kotzen, Überdruß, Widerwillen.
(*f*) Anger (Wut): Entrüstung, gereizt, aggressiv, Ärger, Zorn, böse, Empörung, erbittert, Raserei, sauer.

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Received 15 September 1997; accepted 13 October1997