Psychiatry Research 209 (2013) 40–49

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Recognition of emotion from body language among patients with unipolar depression

Felice Loi [a], Jatin G. Vaidya [b], Sergio Paradiso [c,d,e,*]

[a] Millharbour PICU, Tower Hamlets Centre for Mental Health, Mile End Hospital, London, UK
[b] Department of Psychiatry, Carver College of Medicine, University of Iowa, Iowa City, IA, USA
[c] Una Mano per la Vita, Association of Families and their Doctors, via Cristoforo Colombo n. 13, San Giovanni La Punta (CT) 95030, Italy
[d] Psychology & Neuroscience, Division of Humanities & Social Sciences, California Institute of Technology, Pasadena, CA, USA
[e] Universidad Diego Portales, Santiago, Chile

ARTICLE INFO

Article history:
Received 12 March 2012
Received in revised form
20 February 2013
Accepted 2 March 2013

Keywords:
Emotion
Body language
Unipolar depression
Psychosocial adjustment
Social cognition

ABSTRACT

Major depression may be associated with abnormal perception of emotions and impairment in social adaptation. Emotion recognition from body language and its possible implications to social adjustment have not been examined in patients with depression. Three groups of participants (51 with depression; 68 with history of depression in remission; and 69 never depressed healthy volunteers) were compared on static and dynamic tasks of emotion recognition from body language. Psychosocial adjustment was assessed using the Social Adjustment Scale Self-Report (SAS-SR). Participants with current depression showed reduced recognition accuracy for happy stimuli across tasks relative to remission and comparison participants. Participants with depression tended to show poorer psychosocial adaptation relative to remission and comparison groups. Correlations between perception accuracy of happiness and scores on the SAS-SR were largely not significant. These results indicate that depression is associated with reduced ability to appraise positive stimuli of emotional body language but emotion recognition performance is not tied to social adjustment. These alterations do not appear to be present in participants in remission suggesting state-like qualities.

1. Introduction

Major depressive disorder represents a significant and common cause of disability and social impairment (Kessler et al., 2003; Richards, 2011). Its frequency and burden are expected to increase in years to come (Monroe and Harkness, 2011). Individuals affected by unipolar depression continue to exhibit diminished psychosocial adjustment in multiple domains of functioning during the remission phase of the illness (Wells et al., 1989; Coryell et al., 1993; Hays et al., 1995; Shapira et al., 1999). Psychosocial adaptation reflects an individual's functioning and satisfaction in multiple social roles (e.g., family, work environment, friends) and is the result of a complex interplay of personal needs/wants and social demands (for further insights see Figueira and Brissos (2011)). The reasons behind psychosocial impairment in depression are not well understood (Hammen et al., 2009). One hypothesis suggests that a significant underpinning is abnormal emotion recognition from socially relevant stimuli (Ridout et al., 2007; Bourke et al., 2010; Bistricky et al., 2011).

As a whole, results of emotion recognition in depression have not been entirely consistent. Some investigators have shown that persons with depression exhibit impaired recognition of happy stimuli (Walker, 1981; Mandal and Bhattacharya, 1985; Surguladze et al., 2004; Csulkly et al., 2009) while others have not (Cooley and Nowicki 1989; Gur et al., 1992; Rubinow and Post, 1992; Persad and Polivy, 1993; Leppanen and Hietanen, 2004; Kan et al., 2004; Csulkly et al., 2009). Adding further complexity to the issue, in some studies, depression was associated with impaired recognition of *negative* emotions (e.g., angry, fearful and sad stimuli) (Feinberg et al., 1986; Rubinow and Post, 1992; Persad and Polivy, 1993; Asthana et al., 1998). Whereas impairment in recognition of happiness is mood congruent, reduced recognition of negative emotions is arguably a less mood congruent feature.

The studies discussed above were based on emotions portrayed by facial expressions, and in fact, emotion perception research in depression has primarily used human face stimuli neglecting the universe of emotional body language (Coulson, 2004). Findings attained using facial expressions are often extrapolated as indicators of the category of socially relevant stimuli as a whole. Novel and complementary insights may emerge when expanding the study of emotion perception to emotional body language (EBL, de Gelder, 2006; Hinzman and Kelly, 2012). In addition, the study of

* Corresponding author at: Una Mano per la Vita, Association of Families and their Doctors, via Cristoforo Colombo n. 13, San Giovanni La Punta (CT) 95030, Italy.
E-mail address: paradiso.sp@gmail.com (S. Paradiso).

0165-1781/$ - see front matter © 2013 Elsevier Ireland Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.psychres.2013.03.001

perception of EBL in depression fills a critical niche because the brain circuits processing EBL stimuli are only partially overlapping with the brain circuits processing facial expressions (de Gelder, 2006) and may be differentially affected by the depressive illness.

Body language may be defined as the collection of signs (e.g., posture, speed of movement, meaningful coordination of actions) expressed by the human body (Watzlawick et al., 1967; de Gelder, 2006; Schindler et al., 2008). Body language conveys a significant amount of emotionally and socially relevant information (Adolphs and Tranel, 2003; Heberlein et al., 2004; Bigelow et al., 2006; Atkinson et al., 2007). Perception of body language has been estimated to constitute up to 60–70% of human social communication (Burgoon, 1985). People who are able to correctly perceive body language signals tend to experience more meaningful relationships, greater social approval (Hodgins and Zuckerman, 1990) and competence (Seay and Altekruse, 1979; Noller, 1980; Trower, 1980). This is not surprising considering that facial expressions and body postures signal relevant information about emotional behaviors and intentions (Ekman, 1993; de Gelder, 2006) and that they are continuously appraised during social interactions (Bouhuys et al., 1999). Whereas EBL has been the subject of several studies in healthy participants (Coulson, 2004), schizophrenia (Bigelow et al., 2006), alcohol use disorder (Maurage et al., 2009), and focal brain damage (Heberlein and Saxe, 2005; Atkinson et al., 2007), to date, EBL has never been studied in depression (Coulson, 2004; Meeren et al., 2005; Calvo-Merino et al., 2008; Van den Stock et al., 2009).

Emotion perception in general and perception of EBL in particular may relate to social adaptation, a critical outcome measure in depression studies (Paradiso et al., 2011). A relationship between change in perception of socially relevant stimuli and poorer social adaptation in depression has been often posited but not empirically tested (Hodgins and Zuckerman, 1990; Ridout et al., 2003; Yoon et al., 2009; Gollan et al., 2010). One partial exception is a study that examined the association between emotion perception and psychological aggression towards sentimental partners as a function of depressive tendencies (Marshall et al., 2011). This study did not include individuals diagnosed with major depression (Marshall et al., 2011).

The present study examined perception of emotions across different body language stimuli in patients with unipolar major depression. Stimuli were included to examine perceptual responses to distinct facets of EBL including single body stimuli, stimuli depicting social interaction and socially relevant stimuli in motion. This approach was planned with the intent to capture the complexity of emotion perception and allowed assessment of consistency and differences of responses for differing types of stimuli. Dynamic stimuli were chosen based on the evidence that static and dynamic stimuli are processed by partially differing brain structures (Downing et al., 2001; Adolphs et al., 2003). Dynamic stimuli were added also because emotions in real-life are often conveyed by stimuli in motion (Kan et al., 2004; Hoffmann et al., 2006). Analyses were planned to study the effects of static and dynamic tasks as a function of diagnosis. Considering the dearth of studies on EBL in depression and the inconsistencies in the literature on depression and emotion perception from face stimuli, specific predictions on valence and direction of potential abnormalities were not made.

Examination of perception of EBL during remission was also a focus of the present report. This aspect of the present research was planned based on studies suggesting that alterations in the processing of social stimuli may continue into remission (Leppanen and Hietanen, 2004; LeMoult et al., 2009) but also on views that some alterations of brain activity in depression may revert to normalcy following remission (Drevets, 1998; Mayberg et al., 1999; Sheline et al., 2001; Drevets et al., 2002). Finally, analyses were planned to examine the association between variables showing a significant group effect on perception of EBL and psychosocial adaptation. It was expected that depression would be characterized by alterations in emotion perception and these would correlate with poorer social adaptation.

2. Methods

2.1. Participants

The study sample consisted of 51 patients examined during an active episode of depression, 68 examined while in remission (estimated *mean* time in remission in months = 50.7; *S.D.* = 54.9) and 69 healthy comparison participants (i.e., reporting no life-time episodes of depression) recruited from the University of Iowa Departments of Internal Medicine and Psychiatry inpatient and outpatient services and from the Iowa City Veterans Administration Medical Center Primary Care service and through advertisements as part of a study on late-life depression and social perception (Paradiso et al., 2011). Exclusion criteria were: (a) major psychiatric co-syndromal disorder including history or presence of obsessive compulsive disorder, psychosis other than that accompanying depression, bipolar affective disorder, primary anxiety disorder, eating or somatoform disorder and related disorders or substance use disorders; (b) history of brain injury or other neurological or medical or surgical disease potentially impairing cognition; (c) clinical evidence of preexisting dementia as defined by DSM-IV criteria (American Psychiatric Association, 2005), (d) vision or hearing deficits. Informed consent was obtained according to the Institutional Review Board (IRB) of the University of Iowa. All participants were compensated for their participation.

Descriptive information on demographic, clinical, and cognitive variables for the groups is shown in Table 1. There were no significant group differences in age, sex and education as well as in (visual and verbal) memory and visual/spatial abilities. A group effect of Full Scale IQ (FSIQ), F (2; 187) = 5.5, P = 0.005 was found to be significant. However, all participants with depression showed FSIQ compatible with accurately understanding directions for the experimental tasks (FSIQ *ranges*: depression = 65–132; remission = 84–134; healthy volunteers = 78–141). Participants with active illness suffered from moderate to severe depression (Table 1). Participants with current depression and in remission did not differ on classes of psychoactive medications used for treatment, χ^2 (5) = 8.75, P > 0.05 (Table 2).

2.2. Psychiatric assessment

The Structured Clinical Interview for DSM-IV-TR Axis 1 Disorder (SCID, First et al., 2002) was administered by a trained research assistant to confirm diagnosis of depression and exclude other Axis 1 disorders. When possible, medical records were reviewed in order to confirm information gathered during patient interviews (Paradiso et al., 2011). Severity of depression was assessed using the 24-item version of the Hamilton Depression Rating Scale (HAM-D, Hamilton, 1960). Remission was defined as no longer meeting major depression diagnosis during the previous two months (American Psychiatric Association, 2005) and having a score of 7 or less on the HAM-D (Hamilton, 1960). Anxiety was measured using the Hamilton Anxiety Rating Scale (HAMA, Hamilton, 1959). Some of the patients were receiving pharmacological treatment (Table 2).

Social adjustment over the previous two weeks was assessed using the Social Adjustment Scale Self-Report (SAS-SR), a widely-used self-report scale consisting of 42 items rated on a 5-point scale and measuring six social domains: work (time lost, impaired performance, distress, disinterest, feelings of inadequacy), social and leisure time (diminished contact with friends and social interactions, loneliness, boredom), extended family (reticence, withdrawal, family attachment, resentment, worry), marital relationship (sexual problems, dependency, lack of affection), parental (lack of involvement and affection, impaired communication) and family unit (economic, inadequacy of family unit, guilt) based on patient's performance on a day-to-day basis, quality of interpersonal relationships, friction with others, inner feelings and satisfaction (Weissman, 1999). Scores for each domain were computed by averaging the scores for all answered items within that domain with higher scores indicating greater impairment. The total SAS-SR score was calculated by averaging all items (Shapira et al., 1999; Weissman et al., 2001).

2.3. Experimental stimuli

Experimental tasks included emotion recognition from point-light walkers (PLWs), body postures, movie stills with masked and unmasked faces. These tasks were developed and modified in the Departments of Neurology and Psychiatry at the University of Iowa. The use of these tasks has been validated in several studies and with different populations of participants (see below). Total administration time was 40–45 min. Participants had the opportunity to take breaks between each task if they so desired.

Table 1
Demographic, clinical and cognitive data.

	Depression (n=51)	Remission (n=68)	Healthy (n=69)
Age (years)	48.7 (15.7)	49.8 (18.0)	55.3 (22.3)
Sex (% women)	70.6%	64.7%	53.6%
Education (years)	14.7 (3.9)	15.1 (3.0)	14.9 (3.7)
Parental status: *N* (%) with children	37 (72.5%)	45 (64.3%)	45 (65.2%)
FS IQ[a]	107.9 (13.4)	112.0 (11.7)	115.6 (12.6)
BJLO	25.3 (4.0)	25.8 (3.2)	26.3 (3.4)
BFRT	47.6 (4.2)	47.7 (3.8)	47.5 (3.6)
ROCFT			
Immediate	17.8 (6.6)	18.7 (7.7)	19.3 (7.8)
Delayed	18.1 (6.7)	18.9 (7.5)	19.4 (7.6)
RAVLT			
Delayed	9.5 (4.0)	10.5 (3.6)	10.9 (3.1)
Correct	13.6 (1.7)	13.9 (2.0)	14.2 (1.1)
HAM-D[b]	20.7 (6.2)	4.7 (5.2)	1.5 (2.1)
HAM-A[c]	13.9 (6.3)	4.1 (4.6)	2.3 (2.2)

Note: Means and (standard deviations). FSIQ—Full Scale IQ; BJLO – Benton Judgment of Line Orientation; BFRT—Benton Face Recognition Test; ROCFT—Rey–Osterrieth Complex Figure Test; RAVLT—Rey Auditory Verbal Learning Task.

[a] $F(2;\ 187)=5.5$; $P=0.005$.
[b] $F(2;\ 187)=273.1$, $P<0.001$.
[c] $F(2;\ 187)=104.9$, $P<0.001$.

Table 2
Pharmacotherapy.

	Antidepressants	MAOIs (%)	Antipsychotics (%)	Sedatives (%)	Others (%)	Total (%)
Medication Class						
Depression	25.4	0.8	5.7	0	10.7	42.6
Remission	36.9	6.6	6.5	0.8	6.6	57.4

Note. Antidepressants—Serotonin Selective Reuptake Inhibitors (SSRIs) and Tricyclics; MAOIs—Monoamine Oxidase Inhibitors; Antipsychotics—traditional and novel; Sedatives—Anxiolytics/Hypnotics/Antihistamines. Others—all other medications. Statistic: [χ^2 (5)=8.75; $P>0.05$].

2.3.1. Body postures

Emotion recognition from static body postures was examined using a forced-choice emotion-labeling task with a set of 50 photographs showing professional actors portraying five basic emotions (10 for each emotion: happy, sad, fear, anger, and neutral) with their faces masked out (Fig. 1). Participants were asked to select one of the five words (happy, sad, fear, anger, and neutral) that best described a posture. Static displays of emotion have been validated in several studies as a source of EBL (Coulson, 2004; Meeren et al., 2005; Bigelow et al., 2006; Atkinson et al., 2007) and have been shown to activate specific brain areas involved in the processing of EBL (de Gelder et al., 2004; Grezes et al., 2006). To prepare the stimuli actors were instructed to freely portray the emotion requested so as to maximize natural conveyance of the depicted emotion. Emotions were communicated exclusively by the body posture because there was no contextually meaningful information in the pictures. The body postures contain a great deal more physical information about the human body relative to the PLWs (see below).

2.3.2. Movie stills

This task assesses the ability to extract affective information from still stimuli of interacting individuals that were drawn from scenes of black and white movies portraying people experiencing emotions. The task offers the possibility to evaluate to what extent appraisal of affective information from complex social situations relies on perception of human faces as stimuli are presented with the faces blanked out (movie stills masked, presented first) or in full view (movie stills unmasked, presented afterwards) (Fig. 2). The validity of these stimuli as appropriate source of EBL has been confirmed by several studies examining the responses of participants with focal brain lesions and major mental illness (Adolphs and Tranel, 2003; Bigelow et al., 2006; Losh et al., 2009; Couture et al., 2010). Each version of the task includes 16 images representing four basic emotions (4 happy, 4 angry, 4 afraid, and 4 sad). Participants were requested to choose which word best described the emotion depicted in the scene from a list of the four emotions shown at the bottom of the screen.

2.3.3. Point-Light Walkers (PLWs)

Originally developed by Gunnar Johansson (see Johansson (1994)), this task has been subsequently reproduced and extensively used to measure the ability of individuals to detect movement from stimuli conveying less information than normally available in daily life (Vaina et al., 2001; Grossman and Blake, 2002; Saygin, 2007). A growing amount of data from neuropsychological as well as neuroimaging studies has proven that humans reliably recognize gender (Pollick et al., 2005), personality traits and emotions (Dittrich et al., 1996; Pollick et al., 2001; Heberlein et al., 2004; Bigelow et al., 2006) from such displays of motion. Validity of the task as source of emotional information comes from studies of patients with schizophrenia and focal brain lesions (Heberlein et al., 2004; Bigelow et al., 2006). In the version used here, the task includes 25 “movies” and aims at evaluating the ability of participants to extrapolate emotional information from impoverished stimuli of human motion. Stimuli were constructed by attaching 12 small LED lights to the major joints and head of an actor wearing black clothes and a black hood who was instructed to freely display five basic emotions while walking against a black background (Fig. 3). All walks were within the frame of a screen and from left to right. This task is therefore particularly suited to study the perception of body emotions from a pattern of motion alone without interference from other cues such as clothes or context. Five basic emotions were studied: happiness (7 movies), sadness (5 movies), fear (5 movies), anger (1 movie) and a neutral state (7 movies). Participants were asked to choose the word that best described the emotion from a selection of five words (happy, sad, fear, anger and neutral) displayed at the bottom of the screen. Anger was included in the analyses for comprehensiveness but because there was only one movie showing anger, this emotion may not be assessed as reliably as the others.

2.4. Neuropsychological assessment

To assess whether cognitive differences may influence group performance on the experimental tasks, general intelligence (Wechsler Abbreviated Scale of Intelligence, WASI, Wechsler, 1999), visual perception and memory (Judgment of Line Orientation Benton Lines, Benton et al., 1978), Benton Face Recognition (Benton et al., 1983) and the Rey–Osterrieth Complex Figure (ROCFT, Meyers and Meyers, 1995) and verbal memory (Rey Auditory Verbal Learning Task RAVLT, Schmidt, 1996) were assessed.

2.5. Data analysis

Measures of accuracy are reported by emotion for each task (Table 3). Participants were assigned 1 point for each correct response and 0 points in case of wrong response. Thus, for instance, if a participant who was administered happy PLW stimuli resulted in 5 correct responses out of 7, then happy stimulus would receive a score of 5/7=0.71 (or 71%). Measures of accuracy were entered into analyses of covariance (ANCOVA) as dependent variables. Not all the subjects completed all the tasks and this is reflected in the presence of different degrees of freedom reported from task to task. Reasons for missing data points included test fatigue and limited compliance. Age was used as covariate because emotion recognition has been shown to vary as a function of age (Calder et al., 2003; MacPherson et al., 2006; Isaacowitz et al., 2007; Suzuki et al., 2007). Additional analyses used Full Scale IQ (FSIQ), education (Ekman et al., 1969) and sex (Killgore et al., 2000) as co-variates for their known effects on performance on emotion recognition tasks (Ruffman et al., 2008). These factors were included as covariates also because there were significant correlations between these variables and EBL perception accuracy. Across groups, significant positive correlations were found between FSIQ and PLWs happy stimuli, r (186)=0.15, P=0.04, R^2=2.3%, and between FSIQ and Postures happy stimuli, r (180)=0.23, P=0.002, R^2=5.3%. Negative correlations between FSIQ and movie stills masked happy stimuli, r (181)=−0.16, P=0.03, R^2=2.6% were also found to be significant. A small positive and non-significant relationship between FSIQ and movie stills unmasked happy stimuli, r (181)=0.07, P=0.33, was also found. Across groups, correlational analyses indicated that participants with a higher educational level were more likely to correctly recognize happy displays in PLWs, r (182)=0.21, P=0.003, R^2=4%, and happy movie unmasked stimuli, r (181)=0.24, P=0.001, R^2=5.8%, while no other correlation was found to be significant [happy body postures, r (180)=0.096, P=0.2, and happy movie masked stimuli, r (181)=−0.05, P=0.51]. Since gender is a dichotomous categorical variable and task performance is a continuous variable, a point-biserial correlation analysis was carried out (Field, 2009). There were positive correlations between male sex and performance on happy PLW stimuli, r (182)= 0.16, P=0.026, R^2=3%, while being a female was associated with greater ability to recognize happy stimuli on the movie masked, r (182)=−0.17, P=0.022, R^2=2.9%. No other correlations where found to be significant [happy displays of body postures, r (181)=−0.074, P=0.32, and movie unmasked stimuli, r (182)=−0.11, P=0.13]. Significant group main effects were followed by post-hoc analyses using least square differences (LSD). Also, examination of data as a function of static and dynamic tasks was carried out.

Data were analyzed using the Statistical Package for Social Sciences-17 (SPSS-17, SPSS, 2001). Cohen's f has been used as an estimate of effect size for analyses of variance, where it is considered “small” up to f=0.25, “medium” up to 0.39, and f=0.40 or greater large (Cohen, 1977; Volker, 2006). In order to determine the association between emotion recognition variables showing significant group effects and social adjustment scores, Pearson product moment correlations were computed. As higher scores on the SAS-SR indicate lower levels of social adjustment, negative correlations were expected between emotion accuracy and psychosocial adjustment scores.

3. Results

3.1. Point-Light Walkers

Table 3 shows group means and standard deviations for all emotions within each task. The main effect of group on happy

Fig. 1. Body posture display of happiness.

Fig. 3. Single still of human display of walker.

Fig. 2. Happiness as it is represented in masked (left) and unmasked (right) Movie Still tasks.

Table 3
Recognition of basic emotions from static and dynamic body stimuli.

Task-stimulus	Mean (S.D.)					
PLWs	Depression		Remission		Healthy	
Happy*	0.77	(0.20)	0.84	(0.13)	0.83	(0.15)
Sad	0.62	(0.21)	0.61	(0.20)	0.58	(0.17)
Afraid	0.65	(0.23)	0.65	(0.20)	0.70	(0.21)
Anger	0.57	(0.50)	0.53	(0.50)	0.38	(0.49)
Neutral	0.50	(0.16)	0.54	(0.17)	0.51	(0.19)
Mean	0.62	(0.16)	0.63	(0.13)	0.60	(0.14)
Body Postures	Depression		Remission		Healthy	
Happy*	0.81	(0.16)	0.89	(0.12)	0.87	(0.14)
Sad	0.88	(0.17)	0.93	(0.11)	0.90	(0.12)
Afraid	0.92	(0.13)	0.94	(0.09)	0.94	(0.09)
Anger	0.86	(0.15)	0.84	(0.15)	0.84	(0.14)
Neutral	0.68	(0.18)	0.74	(0.12)	0.72	(0.15)
Mean	0.82	(0.10)	0.87	(0.07)	0.86	(0.07)
Movie S. Masked	Depression		Remission		Healthy	
Happy	0.82	(0.27)	0.86	(0.23)	0.87	(0.24)
Sad	0.52	(0.31)	0.46	(0.31)	0.48	(0.35)
Fear	0.56	(0.27)	0.48	(0.26)	0.57	(0.27)
Anger	0.42	(0.20)	0.37	(0.20)	0.42	(0.21)
Mean	0.58	(0.14)	0.54	(0.11)	0.59	(0.14)
Movie S. Unmasked	Depression		Remission		Healthy	
Happy*	0.97	(0.13)	1.0	(0.00)	0.99	(0.06)
Sad	0.70	(0.32)	0.68	(0.32)	0.67	(0.32)
Fear	0.69	(0.25)	0.63	(0.24)	0.66	(0.27)
Anger	0.47	(0.17)	0.43	(0.20)	0.46	(0.24)
Mean	0.70	(0.14)	0.68	(0.13)	0.69	(0.15)

Note. PLWs—Point-Light Walkers. Move S.—Movie Stills. *indicates $p<0.05$ PLWs: [F (2; 186)=3.6 P=0.029; Cohen's f =0.20]. Body Postures: [F (2; 170)=4.60; P=0.011, Cohen's f=0.23]. Movie Stills Unmasked: [F (2; 170)=3.45; P=0.03; Cohen's f=0.2].

stimuli for PLWs was found to be significant (F (2; 186)=3.6; P=0.029; Cohen's f=0.20). Post-hoc tests indicated that participants with current depression scored significantly lower on happy stimuli than subjects in remission (P=0.018) and healthy comparison participants (P=0.019). The difference between healthy comparison and remission groups did not reach conventional levels of significance (P=0.08). All other emotion stimuli did not show significant group effects, anger: F (2; 186)=2.63; P=0.43; fear: F (2; 186)=1.47; P=0.23; sadness: F (2, 186) = 0.56; P = 0.57; neutral: F (2; 186)=0.86 P=0.43. Analyses of variance carried out with FSIQ, education and sex as covariates did not change the results. As already indicated, the accuracy figures obtained for the angry emotion in PLWs were not compared across groups for it contained only one stimulus. Its values have been reported for completeness of information (Table 3).

3.2. Body postures

A group effect for the happy condition for body postures was found to be significant, F (2; 170)=4.60; P=0.011, Cohen's f=0.23. Post-hoc tests showed that participants with current depression (M=0.81; $S.D.$=0.16) performed more poorly relative to both in remission (M=0.89; $S.D.$=0.12; P=0.003) and healthy comparison participants (M=0.87; $S.D.$=0.14; P=0.04). Differences between remission and healthy participants were not statistically significant (P=0.36). All other emotions did not show significant group effects, anger: F (2; 170)=0.18; P=0.82; fear: F (2; 170)=0.58; P=0.56; neutral: F (2; 170)=2.81; P=0.63; sadness: F (2; 170)= 1.95; P=0.14. Analyses performed using sex, education, and FSIQ as covariates yielded essentially same results.

3.3. Movie stills

The unmasked version of the task showed a group effect for happy stimuli, F (2; 170)=3.45; P=0.03; Cohen's f=0.2. Post-hoc analyses showed that the depressed participants performed worse than healthy comparison subjects (P=0.027) but the difference with participants in remission did not reach statistical significance (P=0.13). Remission and healthy participants were also not significantly different (P=0.55). Due to a potential ceiling effect (Table 3) an additional analysis on happy stimuli was conducted using a non-parametric F test on ranks for the overall comparison between the three groups. With this computation, results were essentially the same, F(2; 173)=2.95, P=0.055. All other emotions did not show significant differences across groups, anger: F (2; 173)=0.59; P=0.55; fear: F (2; 173)=0.63; P=0.53; sadness: F (2; 173)=0.087; P=0.91. Covarying for FSIQ, gender and education left results essentially unaltered.

On the movie stills masked version (Table 3) group differences were not significant for happiness, F (2; 173)=0.65; P=0.52, or other emotion stimuli, anger: F (2; 173)=1.27; P=0.28; fear: F (2; 173)=1.86; P=0.15; sadness: F (2; 173)=0.49; P=0.6.

3.4. Dynamic versus static stimuli

An important question arising from these analyses concerns the extent to which these findings relate to dynamic (i.e., PLWs) or static (e.g., postures) stimuli. Mean accuracy for happy stimuli on postures and movie stills (masked and unmasked) were averaged to obtain a mean accuracy score for happy emotion on static tasks. An ANOVA using static and dynamic mean accuracy scores as a within-subjects factor and group diagnosis as between-subjects factor and their interaction was computed. The model yielded a significant effect of task, F (1; 172)=32.6; P<0.001; Cohen's f=0.43, as well as a main effect of diagnosis, F (2; 172)=4.27; P=0.015; Cohen's f=0.47, but no significant task by diagnosis interaction, F (2; 172)=0.05; P=0.96. Depressed, remission, and healthy comparison groups showed better performance on static (depression: M=0.86, $S.D.$=0.13; remission: M=0.92, $S.D.$=0.91; healthy comparison: M=0.91, $S.D.$=0.9) relative to dynamic tasks (depression: M=0.79, $S.D.$=0.19; remission: M=0.84 $S.D.$=0.13; healthy comparison: M=0.83, $S.D.$=0.16).

Since the static measure included a task that portrayed faces (movie stills unmasked), but the dynamic measure did not, analyses were repeated omitting movie stills unmasked in the computation of the static measure to minimize a potential confound of facial expression stimuli in the static/dynamic comparison. This analysis showed a significant main effect of task, F (1; 172)=4.45; P = 0.03; Cohen's f=0.25, as well as a main effect of diagnosis, F (2; 172)=4.23; P=0.016; Cohen's f=0.47, but no significant task by diagnosis interaction, F (2; 172)=0.02 P=0.9. Depressed, remission, and comparison groups showed better performance on static (depression: M=0.81, $S.D.$=0.16; remission: M=0.88, $S.D.$=0.12; healthy participants: M=0.87, $S.D.$=0.14) relative to dynamic tasks (depression: M=0.79, $S.D.$=0.19; remission: M=0.84 $S.D.$=0.13; healthy comparisons: M=0.83, $S.D.$=0.16).

3.5. Association with social adjustment

SAS-SR total score (Table 4) differed significantly across the three groups, F (2; 177)=9.45; $P\leq0.001$; Cohen's f=0.40. Post-hoc analyses showed poorer social adjustment for depression (M=2.45; $S.D.$=0.54) compared to both remission (M=1.93; $S.D.$=0.38; P<0.001) and comparison participants (M=1.62; $S.D.$=0.31; P<0.001). The remission group also showed significantly poorer social adjustment than comparison participants (P<0.001).

Significant differences were found on the following SAS-SR subdomain scores:

(a) *Activities*, F (2; 177)=25.14; P<0.001; Cohen's f=0.22 with depressed (M=2.6; $S.D.$=0.8) showing greater impairment than both remission (M=2.2; $S.D.$=0.6; P<0.001) and healthy comparison participants (M=1.8; $S.D.$=0.6; P<0.001) and participants in remission showing greater impairment than healthy participants (P<0.001);
(b) *Extended family*, F (2; 177)=41.95; P<0.001; Cohen's f=0.32 with post-hoc analyses showing greater impairment for the depressed group (M=2.3; $S.D.$=0.6) relative to both remission (M=1.8; $S.D.$=0.4; P<0.001) and healthy participants (M=1.4; $S.D.$=0.4; P<0.001) while remission participants were more impaired than healthy participants (P<0.001);
(c) *Parental* role, F (2; 177)=6.33; P<0.05; Cohen's f=0.07 with post-hoc analyses indicating more impairment for the depression participants (M=0.7; $S.D.$=1.0) compared to both remission (M=0.4; $S.D.$=0.7; P<0.05) and healthy participants (M=0.2; $S.D.$=0.5; P<0.001) while remission and healthy participants did not differ significantly (P>0.05);
(d) *Family unit*, F (2; 177)=20.85; Cohen's f=0.19 with post-hoc analyses demonstrating more impairment for the depressed (M=2.5; $S.D.$=1.0) compared to both remission (M=2.0; $S.D.$=0.8; P<0.005) and healthy participants (M=1.5; $S.D.$=0.6; P<0.001), and remission participants more impaired than healthy comparison participants (P<0.005).

Pearson product moment correlations computed between happy stimuli accuracy scores and SAS-SR total scores in the whole sample did not yield significant results, PLWs: r (187)=−0.11, P=0.12; body postures: r (187)=−0.13, P=0.09; movie unmasked: r (187)=−0.024, P=0.75. Since the data could be statistically parsed group-wise (and therefore were not homogenous), within-group correlations were also computed. Correlations within each diagnostic group also did not show significant results, depressed: PLWs r (46)=−0.03, P=0.82; body postures r (40)=−0.03, P=0.63; movie unmasked r (40)=0.11, P=0.49; remission: PLWs r (66)=0.09, P=0.5; body postures r (62)=0.17, P=0.2; movie unmasked not computed because in this group there was no variability in performance; healthy comparisons: PLWs r (68)=−0.08, P=0.53; body postures r (62)=−0.12, P=0.33; movie unmasked r (66)=0.003, P=0.98. Additionally, whereas some (4 of 24) correlations between performance on the happy stimuli and SAS-SR subscales reached statistical significance (Table 5), they were uniformly low and not consistently in the same direction.

Table 4
Social Adjustment Scores across groups.

Subscale SAS-SR	Depression (N=46)		Remission (N=65)		Healthy (N=68)	
Work	1.7	(1.4)	1.4	(0.7)	1.3	(0.5)
Activities**	2.6	(0.8)	2.2	(0.6)	1.8	(0.6)
Extended family**	2.3	(0.6)	1.8	(0.4)	1.4	(0.4)
Marital	1.4	(1.4)	1.2	(1.3)	1.1	(1.0)
Parental*	0.7	(1.0)	0.4	(0.7)	0.2	(0.5)
Family unit**	2.5	(1.0)	2.0	(0.8)	1.5	(0.6)
Total score**	2.5	(0.5)	1.9	(0.4)	1.6	(0.3)

* Indicates P<0.05.
** Indicates P<0.001.

4. Discussion

Perception of emotion through body language has been shown to be a promising measure of social cognition and posited to be a factor potentially influencing social adaptation (Seay and Altekruse, 1979; Noller, 1980; Trower, 1980; Hodgins and Zuckerman, 1990). To our knowledge this is the first study to examine perception of emotion in body stimuli in individuals with clinical depression. The findings in the present study indicated that patients with current depression displayed poorer emotion recognition accuracy for happy body language stimuli that did not include facial expressions. Results were similar for stimuli including facial expressions (i.e., movie stills unmasked). Poorer recognition of happiness was evident both with static and dynamic stimuli. Psychosocial adjustment was found to be worse in both depression and remission relative to healthy participants.

Participants with history of depression in remission showed worse psychosocial adjustment compared to participants who had no history of depression. However, with respect to perception of emotions, participants in remission behaved essentially the same as individuals without a history of depression. Analyses examining the relationship between social functioning measures and recognition of happiness scores revealed few and weak significant associations.

Before discussing the significance of these results, some caveats need to be acknowledged. First, there was a significant group difference in general intelligence favoring participants in remission and healthy participants. However, when general intelligence was controlled for, the results remained unaltered. Differences in the cognitive domains of visual spatial abilities (Rey–Osterrieth Complex Figure) and visual and verbal memory (Rey Auditory Verbal

Table 5
Correlation Matrix between happy dependent variables and SAS-SR domains.

	1	2	3	4	5	6	7	8	9	10	11
1. PLWs	–										
2. Body postures	0.09	–									
3. Movie masked	0.09	0.01	–								
4. Movie unmasked	0.28**	0.10	0.29**	–							
5. SAS-work	−0.02	−0.02	0.03	0.08	–						
6. SAS-activities	0.03	−0.11	0.06	−0.04	−0.09	–					
7. SAS-extend. family	−0.06	−0.06	0.05	−0.06	0.11	0.52**	–				
8. SAS-parental	−0.16*	−0.04	−0.16*	−0.16*	−0.01	0.19*	0.14	–			
9. SAS-marital	−0.06	0.21**	−0.11	0.08	0.10	−0.20**	0.05	0.19**	–		
10. SAS-family unit	−0.05	−0.09	0.00	0.00	0.17*	0.35**	0.53**	0.17*	0.07	–	
11. SAS-total score	−0.11	−0.13	0.00	−0.02	0.24**	0.65**	0.74**	0.18*	0.12	0.8**	–

Note. PLWs—Point-Light Walkers. SAS—SR-Social Adjustment Scale Self-Report. Extend.—Extended.

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Learning Task) were not statistically different consistent with previous (Sweeney et al., 1989) but not other research (Austin et al., 1992) perhaps owing to differing depression severity across study samples.

The present study used stimuli created in the laboratory. Normally this would impose use of caution in the interpretation of the “real world” significance of such stimuli. However nearly all studies of emotion (Adolphs et al., 1996; Ridout et al., 2007; Yoon et al., 2009) use posed stimuli to reliably allow recognition of isolated emotions (consistent with the results attained with the healthy comparison subjects in the present study). Nonetheless studies undertaking the important and daunting task of comparing posed to “real” stimuli will be welcome in the field. The present study is cross-sectional. Therefore causal inference is limited. Participants with depression and those in remission were taking medications (Table 2). Perhaps results may have been different if participants had not been taking psychotropic medications. It is noteworthy that emerging data suggest that antidepressant treatment normalizes emotion recognition from facial expressions (Harmer et al., 2003; Norbury et al., 2007), findings consistent with the role of antidepressants in enhancing cognition irrespective of their effect on depression (Narushima et al., 2007). Nonetheless, the findings of the present study have naturalistic validity and demonstrate that participants in remission (purportedly in part from the beneficial effects of pharmacologic treatment) show normal perception of emotion from body language. Consistent with this view is also recent research showing that antidepressant treatment restitutes “normal functioning” to brain regions known to subserve processing of emotion from human facial expressions (Sheline et al., 2001; Fu et al., 2004; Fu et al., 2007). In the present study, participants with depression were enrolled while suffering from moderate to severe depression as measured by the HAM-D (Yonkers and Samson, 2000). Their symptom severity was comparable to other studies' samples that used facial expressions to measure emotion perception in depression and showed significant findings (Gur et al., 1992; Surguladze et al., 2004). Nonetheless it is not known if emotion recognition effects would have been greater with a sample of more severe depression. Social adaptation was measured using the SAS-SR, a questionnaire described as one of the most appropriate tools to measure social competence (Weissman et al., 2001). As it is often the case with all psychological domains, assessment of psychosocial adaptation may improve using multiple instruments. Use of a different or multiple questionnaires may have yielded different results.

4.1. Emotion recognition: bias or deficit?

Distinguishing between deficit and bias in the mood disorders and emotion recognition literature may be useful. Persistent bias may be a putative mechanism of depression vulnerability and relapse (LeMoult et al., 2009; Anderson et al., 2011). However there is poor agreement as to what constitutes bias or deficit (Silvia et al., 2006). A possible definition of deficit includes low accuracy rates, slower recognition times, or weaker discrimination abilities (e.g., measured using stimuli with varying emotional intensity) (Johnston et al., 2001; Silvia et al., 2006; Demenescu et al., 2010). Deficits need not be mood congruent. Bias on the other hand may reflect a mood congruent consistent tendency to misinterpret stimuli of a given valence (e.g., bipolar disorder participants showing poor perception of sadness during mania) (Lennox et al., 2004; Rocca et al., 2009; Shankman et al., 2013). Based on these definitions, the observation that alterations in the depressed patients in the present study were limited to positive valence points to a bias more than a deficit. Reduced recognition accuracy for both positive and negative valence stimuli would have been consistent, in our opinion, with a deficit-like phenomenon. Mood congruent reduced perception of happiness in facial expressions (Walker, 1981; Walker et al., 1984; Mandal and Bhattacharya, 1985; Csulkly et al., 2009), increased emotion recognition accuracy towards negative stimuli (Bouhuys et al., 1999) and away from positive facial expressions (Hale, 1998; Surguladze et al., 2004; Liu et al., 2012) are all consisent with our definition of bias (Bourke et al., 2010). However, depression may also be accompanied by deficit as suggested by at least one study in which patients with severe depression displayed poor recognition of negative emotions (Douglas and Porter, 2010). Further longitudinal research is warranted to determine the extent to which severity of depression (or other clinical factors) may lead to deficit in addition to bias.

4.2. Dynamic versus static stimuli

While cortical structures subserving elaboration of static and dynamic stimuli partially overlap (Downing et al., 2001; Adolphs et al., 2003), recognition of dynamic stimuli may be in part dependent upon accurate perception of speed (a critical component of displays of emotion). The *speed factor* in information processing may be critical in depression research (Cooley and Nowicki, 1989). Therefore, the static versus dynamic analysis deserves further consideration. Firstly, all participants, irrespective of diagnosis performed better when exposed to static relative to dynamic stimuli. Many factors may explain this difference and, among these, the presence of contextual features (e.g., in movie stills), interacting characters (movie stills masked and unmasked) and the presence of facial expressions (movie stills unmasked). Kan et al. (2004) did not find significant differences in emotion recognition between depressed and healthy participants on a set of dynamic displays of facial expressions. They attributed the lack of significant difference to the increased amount of information available in moving paradigms thus making more clues available to correctly judge the presented stimuli (Kan et al., 2004). In the present study, the impairment in emotion recognition related specifically to the happy domain in both static and dynamic stimuli. Although all the groups generally performed better on static than dynamic stimuli, our results did not show a task by diagnosis interaction indicating that dynamic stimuli were not more challenging (or helpful) for participants with active depression relative to the other groups. Note that the dynamic stimuli in the present study are rather impoverished relative to dynamically displayed facial expressions used by Kan et al. (2004). Additional analyses carried out after excluding the movie stills unmasked scores so as to eliminate the impact of facial expression on the overall static scores did not change the results.

4.3. The nature of stimuli conveying happiness: faces versus body language stimuli

Another interesting aspect of our findings concerns mean group accuracies across body language tasks (Table 3). The extant literature shows that happiness is more easily recognized than other emotions (Coulson, 2004; Heberlein et al., 2004; Atkinson et al., 2007). The healthy comparison group in the Atkinson et al.'s (2007) study showed a 95% accuracy on body language tasks while Heberlein et al.'s (2004) healthy subjects achieved 77.6% accuracy on PLWs. Coulson (2004) reported normative scores of 78.6% on body postures. In addition, the results in the present study are consistent with accuracy reports for recognition from happy facial displays of emotion (Mandal and Bhattacharya, 1985; Kirita and Endo, 1995; Ruffman et al., 2008). These data support the notion that among non-clinical populations stimuli conveying happiness (facial expressions but also words) are more easily and rapidly recognized than negative or neutral stimuli (Kirita and Endo, 1995). The reasons behind the advantage in happy recognition are not fully clear (Leppanen and Hietanen, 2004). Some posit the existence of a lower recognition threshold for happy as opposed to negatively valenced emotions (Esteves and Ohman, 1993). Alternatively, the relatively more frequent occurrence of happy stimuli in everyday life may lead to a more efficient processing of these emotions (Ohman et al., 2001). Adolphs suggested that happy facial expressions include specific physiognomic features that make them visually more distinctive (Adolphs, 2002). The existence of an asymmetry in the recognition of happiness could reflect the workings of a cognitive system biased towards the positive appraisal of its surroundings (Diener and Diener, 1996). This system appears to be altered in depression as suggested by the findings in the present report: while EBL stimuli portraying happiness are generally easier to recognize, they are judged less accurately as happy during the active phase of the depressive illness.

4.4. Social adaptation and perception of body language

Longitudinal studies have shown that patients affected by unipolar depression continue to exhibit diminished psychosocial adjustment during the remission phase of their illness (Hays et al., 1995; Shapira et al., 1999; Meltzer-Brody and Dadson, 2000; Furukawa et al., 2011). Many of these studies have used the SAS-SR to assess psychosocial adjustment thus allowing comparison with the results in the present study. Whereas a link between impaired recognition of emotional stimuli and reduced degree of social competence has been posited (Persad and Polivy, 1993; Keltner and Kring, 1998; LeMoult et al., 2009; Demenescu et al., 2010), such a phenomenon has never been empirically demonstrated in depression. One partial exception is the study of Marshall et al. (2011) reporting the mediating effects of negatively biased perception of facial expressions as possible explanatory link between depressive symptoms and psychological aggression towards the participants' partners. Differences between this (Marshall et al., 2011) and the present study are: measurement of a single aspect of social adjustment (i.e., psychological aggression to the intimate partner), inclusion of a non-clinical sample and use of facial expressions as experimental stimuli (Marshall et al., 2011).

In the present study, individuals with depression showed worse psychosocial functioning than individuals in remission who in turn had a lower level of psychosocial functioning relative to healthy participants. This phenomenon involved most domains covered in the SAS-SR. However, correlations computed between SAS-SR total score and measures of accuracy on perception of happiness in body language tasks were not statistically significant. The overall pattern of correlations with the SAS-SR sub-scales also pointed to weak or inconsistent associations (for details on correlations see Table 5). Although preliminary, these findings suggest caution when positing an association between abnormal patterns of emotion recognition and psychosocial adaptation in depression.

In conclusion, the present study showed that participants diagnosed with unipolar depression have reduced recognition of happy dynamic and static body displays of emotion compared to remission and healthy comparison participants. This finding suggests state- and bias-like qualities of the phenomenon (Mikhailova et al., 1996). The lack of association between psychosocial adaptation and recognition of emotion from EBL stimuli suggests a reconceptualization of what has been hitherto theorized as a straightforward relationship between emotion processing changes and psychosocial functioning in depression (Hodgins and Zuckerman, 1990; Ridout et al., 2003; Yoon et al., 2009; Gollan et al., 2010; Paradiso and Rudrauf, 2012).

Acknowledgments

The authors thank Lavanya Vijayaraghavan, MBBS, MSc. for her valuable comments on this research and Erika Holm-Brown for data collection. Thanks to Ralph Adolphs for his supportive mentorship to Sergio Paradiso and to Andrea Heberlein for providing some of the stimuli used in this study. Sergio Paradiso was supported by the Dana foundation, the Mallinckrodt foundation, NARSAD and the National Institute on Aging (5K23AG027837). Felice Loi expresses his gratitude to Anna Maria Fogliani, Director of the School of Specialization in Psychiatry and Psychotherapy at the University of Catania (Italy)

References

Adolphs, R., Damasio, H., Tranel, D., Damasio, A.R., 1996. Cortical systems for the recognition of emotion in facial expressions. The Journal of Neuroscience 16, 7678–7687.

Adolphs, R., 2002. Recognizing emotion from facial expressions: psychological and neurological mechanisms. Behavioral and Cogntive Neuroscience Review 1, 21–62.

Adolphs, R., Tranel, D., Damasio, A.R., 2003. Dissociable neural systems for recognizing emotions. Brain and Cognition 52, 61–69.

Adolphs, R., Tranel, D., 2003. Amygdala damage impairs emotion recognition from scenes only when they contain facial expressions. Neuropsychologia 41, 1281–1289.

American Psychiatric Association, 2005. Diagnostic and Statistical Manual of Mental Disorders, 4th ed., text revision. APA, Arlington, VA.

Anderson, I.M., Shippen, C., Juhasz, G., Chase, D., Thomas, E., Downey, D., Toth, Z.G., Lloyd-Williams, K., Elliott, R., Deakin, J.F.W., 2011. State-dependent alteration in face emotion recognition in depression. The British Journal of Psychiatry 198, 302–308.

Asthana, H.S., Mandal, M.K., Khurana, H., Haque-Nizamie, S., 1998. Visuospatial and affect recognition deficit in depression. Journal of Affective Disorders 48, 57–62.

Atkinson, A.P., Heberlein, A.S., Adolphs, R., 2007. Spared ability to recognise fear from static and moving whole-body cues following bilateral amygdala damage. Neuropsychologia 45, 2772–2782.

Austin, M.P., Ross, M., Murray, R.E., O'Carroll, R.E., Ebmeier, K.P., Goodwin, G.M., 1992. Cognitive function in major depression. Journal of Affective Disorders 25, 21–30.

Benton, A.L., Hamsher, K., Varney, N.R., Spreen, O., 1983. Facial recognition: stimuli and multiple choice pictures. Oxford University Press, New York, NY.

Benton, A.L., Varney, N.R., Hamsher, K.D., 1978. Visuospatial judgment. A clinical test. Archives of Neurology 35, 364–367.

Bigelow, N.O., Paradiso, S., Adolphs, R., Moser, D.J., Arndt, S., Heberlein, A., Nopulos, P., Andreasen, N.C., 2006. Perception of socially relevant stimuli in schizophrenia. Schizophrenia Research 83, 257–267.

Bistricky, S.L., Ingram, R.E., Atchley, R.A., 2011. Facial Affect processing and depresion susceptibility: cognitive biases and cognitive neuroscience. Psychological Bulletin 137, 998–1028.

Bouhuys, A.L., Geerts, E., Gordijn, M.C., 1999. Depressed patients' perceptions of facial emotions in depressed and remitted states are associated with relapse: a longitudinal study. Journal of Nervous and Mental Disease 187, 595–602.

Bourke, C., Douglas, K., Porter, R., 2010. Processing of facial emotion expression in major depression: a review. Australian and New Zealand Journal of Psychiatry 44, 681–696.

Burgoon, J.K., 1985. In: Knapp, M.L., Miller, G.R. (Eds.), Handbook of Interpersonal Communication. Sage Publications, Beverly Hills, CA, pp. 344–390.

Calder, A.J., Keane, J., Manly, T., Sprengelmeyer, R., Scott, S., Nimmo-Smith, I., Young, A.W., 2003. Facial expression recognition across the adult life span. Neuropsychologia 41, 195–202.

Calvo-Merino, B., Jola, C., Glaser, D.E., Haggard, P., 2008. Towards a sensorimotor aesthetics of performing art. Consciousness and Cognition 17, 911–922.

Cohen, J., 1977. Statistical Power Analysis for the Behavioral Sciences, revised edition. Academic Press, New York.

Cooley, E.L., Nowicki Jr., S., 1989. Discrimination of facial expressions of emotion by depressed subjects. Genetic Social and General Psychology Monographs 115, 449–465.

Coryell, W., Scheftner, W., Keller, M., Endicott, J., Maser, J., Klerman, G.L., 1993. The enduring psychosocial consequences of mania and depression. The American Journal of Psychiatry 150, 720–727.

Coulson, M., 2004. Attributing emotion to static body postures: recognition, accuracy, confusions, and viewpoint dependence. Journal of Nonverbal Behavior 28, 117–139.

Couture, S.M., Penn, D.L., Losh, M., Adolphs, R., Hurley, R., Piven, J., 2010. Comparison of social cognitive fuctioning in schizophrenia and high

functioning autism: more convergenge than divergence. Psychological Medicine 40, 569–579.
Csukly, G., Czobor, P., Szily, E., Takacs, B., Simon, L., 2009. Facial expression recognition in depressed subjects: the impact of intensity level and arousal dimension. Journal of Nervous and Mental Disease 197, 98–103.
de Gelder, B., Snyder, J., Greve, D., Gerard, G., Hadjikhani, N., 2004. Fear fosters flight: A mechanism for fear contagion when perceiving emotion expressed by a whole body. Proceedings of the National Academy of Sciences of the United States of America 101, 16701–16706.
de Gelder, B., 2006. Towards the neurobiology of emotional body language. Nature Reviews Neuroscience 7, 242–249.
Demenescu, L.R., Kortekaas, R., den Boer, J.A., Aleman, A., 2010. Impaired attribution of emotion to facial expressions in anxiety and major depression. PLoS One, 5.
Diener, E., Diener, C., 1996. Most people are happy. Psychological Science 7, 181–185.
Dittrich, W.H., Troshianko, T., Lea, S.E., Morgan, D., 1996. Perception of emotion from dynamic point-light displays represented in dance. Perception 25, 727–738.
Douglas, K.M., Porter, R.J., 2010. Recognition of disgusted facial expressions in severe depression. The British Journal of Psychiatry197, 156–157.
Downing, P.E., Jiang, Y., Shuman, M., Kanwisher, N., 2001. A cortical area selective for visual processing of the human body. Science 293, 2470–2473.
Drevets, W.C., 1998. Functional neuroimaging studies of depression: the anatomy of melancholia. Annual Review of Medicine 49, 341–361.
Drevets, W.C., Bogers, W., Raichle, M.E., 2002. Functional anatomical correlates of antidepressant drug treatment assessed using PET measures of regional glucose metabolism. European Neuropsychopharmacology 12, 527–544.
Ekman, P., Sorenson, E.R., Friesen, W.V., 1969. Pan-cultural elements in facial displays of emotion. Science 164, 86–88.
Ekman, P., 1993. Facial expression and emotion. American Psychologist 48, 376–379.
Esteves, F., Ohman, A., 1993. Masking the face: recognition of emotional facial expressions as a function of the parameters of backward masking. Scandinavian Journal of Psychology 34, 1–18.
Feinberg, T.E., Rifkin, A., Schaffer, C., Walker, E., 1986. Facial discrimination and emotional recognition in schizophrenia and affective disorders. Archives of General Psychiatry 43, 276–279.
Field, A., 2009. Discovering Statistics Using SPSS, 3rd ed., Sage, London.
Figueira, M.L., Brissos, S., 2011. Measuring psychosocial outcomes in schizophrenia patients. Current Opinion in Psychiatry 24, 91–99.
First, M.B., Spitzer, R.L., Gibbon, M., Williams, J.B.W, 2002. Structured Clinical Interview for DSM-IV-TR Axis 1 Disorder, Non-patient Edition. American Psychiatric Association, Washington, DC.
Fu, C.H., Williams, S.C., Brammer, M.J., Suckling, J., Kim, J., Cleare, A.J., Walsh, N.D., Mittershiffthaler, M.T., Andrew, C.M., Pich, E.M., Bullmore, E.T., 2007. Neural responses to happy facial expressions in major depression following antidepressant treatment. The American Journal of Psychiatry 164, 599–607.
Fu, C.H., Williams, S.C., Cleare, A.J., Brammer, M.J., Walsh, N.D., Kim, J., Andrew, C.M., Pich, E.M., Williams, P.M., Reed, L.J., Mittershiffthaler, M.T., Suckling, J., Bullmore, E.T., 2004. Attenuation of the neural response to sad faces in major depression by antidepressant treatment: a prospective, event-related functional magnetic resonance imaging study. Archives of General Psychiatry 61, 877–889.
Furukawa, T.A., Azuma, H., Takeuchi, H., Kitamura, T., Takahashi, K., 2011. 10-year course of social adjustment in major depression. International Journal of Social Psychiatry 57, 501–508.
Gollan, J.K., McCloskey, M., Hoxha, D., Coccaro, E.F., 2010. How do depressed and healthy adults interpret nuanced facial expressions? Journal of Abnormal Psychology 119, 804–810.
Grezes, J., Pichon, S., de Gelder, B., 2006. Perceiving fear in dynamic body expressions. Neuroimage 35, 959–967.
Grossman, E.D., Blake, R., 2002. Brain areas active during visual perception of biological motion. Neuron 35, 1167–1175.
Gur, R.C., Erwin, R.J., Gur, R.E., Zwil, A.S., Heimberg, C., Kraemer, H.C., 1992. Facial emotion discrimination: II. Behavioral findings in depression. Psychiatry Research 42, 241–251.
Hale, W., 1998. Judgment of facial expressions and depression persistence. Psychiatry Research 80, 265–274.
Hamilton, M., 1959. The assessment of anxiety states by rating. British Journal of Medical Psychology 32, 50–55.
Hamilton, M., 1960. A rating scale for depression. Journal of Neurology, Neurosurgery and Psychiatry 23, 56–62.
Hammen, C.L., Bistricky, S.L., Ingram, R.E., 2009. Vulnerability to depression in adulthood. In: Ingram, R.E., Price, J. (Eds.), Handbook of Vulnerability to Psychopathology: Risk Across the Lifespan. Guildford Press, New York, pp. 248–281.
Harmer, C.J., Hill, S.A., Taylor, M.J., Cowen, P.J., Goodwin, G.M., 2003. Toward a neuropsychological theory of antidepressant drug action: increase in positive emotional bias after potentiation of norepinephrine activicy. The American Journal of Psychiatry 160, 990–992.
Hays, R.D., Wells, K.B., Sherbourne, C.D., Rogers, W., Spritzer, K., 1995. Functioning and well-being outcomes of patients with depression compared with chronic general medical illnesses. Archives of General Psychiatry 52, 11–19.
Heberlein, A.S., Adolphs, R., Tranel, D., Damasio, H., 2004. Cortical regions for judgments of emotions and personality traits from point-light walkers. Journal of Cognitive Neuroscience 16, 1143–1158.
Heberlein, A.S., Saxe, R.R., 2005. Dissociation between emotion and personality judgments: convergent evidence from functional neuroimaging. Neuroimage 28, 770–777.
Hinzman, L., Kelly, S.D., 2012. Effects of emotional body language on rapid out-group judgments. Journal of Experimental Social Psychology 49, 152–155.
Hodgins, H.S., Zuckerman, M., 1990. The effect of nonverbal sensitivity on social interaction. Journal of Nonverbal Behavior 14, 155–170.
Hoffmann, H., Traue, H.C., Bachmayr, F., Kessler, H., 2006. Perception of dynamic facial expressions of emotion. Lecture Notes in Computer Science 4021, 175–178.
Isaacowitz, D.M., Lockenhoff, C.E., Lane, R.D., Wright, R., Sechrest, L., Riedel, R., Costa, P.T., 2007. Age differences in recognition of emotion in lexical stimuli and facial expressions. Psychology and Aging 22, 147–159.
Johansson, G., 1994. Visual Perception of Biological Motion and a Model for its Analysis, Perceiving Events and Objects. Lawrence Erlbaum Associates Publishers, Hillsdale, New Jersey.
Johnston, P.J., Katsikitis, M., Vaughan, C.J., 2001. A generalised deficit can account for problems in facial emotion recognition in schizophrenia. Biological Psychology 58, 203–227.
Kan, Y., Mimura, M., Kamijima, K., Kawamura, M., 2004. Recognition of emotion from moving facial and prosodic stimuli in depressed patients. Journal of Neurology, Neurosurgery and Psychiatry 75, 1667–1671.
Keltner, D., Kring, A.M., 1998. Emotion, social function and psychopathology. Review of General Psychology 2, 320–342.
Kessler, R.C., Berglund, P., Demler, O., Jin, R., Doreen, K., Merikangas, K.R, Rush, A.J., Walters, E.E., Wang, P.S., 2003. The epidemiology of major depressive disorder results from the National Comorbidity Survey Replication (NCS-R). JAMA. Journal of the American Medical Association 289, 3095–3105.
Killgore, W.D.S., Oki, M., Yurgelun-Todd, D., 2000. Sex specific developmental changes in amygdala responses to affective faces. Neuroreport 12, 427–433.
Kirita, T., Endo, M., 1995. Happy face advantage in recognizing facial expressions. Acta Psychologica 89, 149–163.
LeMoult, J., Joormann, J., Sherdell, L., Wright, Y., Gotlib, I.H., 2009. Identification of emotional facial expressions following recovery from depression. Journal of Abnormal Psychology 118, 828–833.
Lennox, B.R., Jacob, R., Calder, A.J., Lupson, V., Bullmore, E.T., 2004. Behavioural and neurocognitive responses to sad facial affect are attenuated in patients with mania. Psychological Medicine 34, 795–805.
Leppanen, J., Hietanen, J.K., 2004. Positive facial expressions are recognized faster than negative facial expressions, but why? Psychological Research 69, 22–29.
Liu, W., Huang, J., Wang, L., Gong, Q., Chan, R.C.K., 2012. Facial perception bias in patients with major depression. Psychiatry Research 197, 217–220.
Losh, M., Adolphs, R., Poe, M.D., Couture, S., Penn, D., Baranek, G.T., Piven, J., 2009. Neuropsychological profile of autism and the broad autism phenotype. Archives of General Psychiatry 66, 518–526.
MacPherson, S.E., Phillips, L.H., Della Sala, S., 2006. Age-related differences in the ability to perceive sad facial expressions. Aging Clinical and Experimental Research 18, 418–424.
Mandal, M.K., Bhattacharya, B.B., 1985. Recognition of facial affect in depression. Perceptual and Motor Skills 61, 13–14.
Marshall, A.D., Sippel, L.M., Belleau, E.L., 2011. Negatively biased emotion perception in depression as a contributing factor to psychological aggression perpetration: a preliminary study. The Journal of Psychology: Interdisciplinary and Applied 145, 521–535.
Maurage, P., Campanella, S., Philippot, P., Charest, I., Martin, S., de Timary, P., 2009. Impaired emotional facial expression decoding in alcoholism is also present for emotional prosody and body postures. Alcohol 44, 476–485.
Mayberg, H.S., Liotti, M., Brannan, S.K., McGinnis, S., Mahurin, R.K., Jerabek, P.A., Silva, J.A., Tekell, J.L., Martin, C.C., Lancaster, J.L., Fox, P.T., 1999. Reciprocal limbic-cortical function and negative mood: converging PET findings in depression and normal sadness. The American Journal of Psychiatry 156, 675–682.
Meeren, H.K., van Heijnsbergen, C.C.R.J., de Gelder, B., 2005. Rapid perceptual integration of facial expression and emotional body language. Proceedings of the National Academy of Sciences of the United States of America 102, 16518–16523.
Meltzer-Brody, S., Dadson, J.R.T., 2000. Completeness of response and quality of life in mood and anxiety disorders. Depression and Anxiety 12, 95–101.
Meyers, J.E., Meyers, K.R., 1995. Rey Complex Figure Test and Recognition Trial, Professional Manual. Psychological Assessment Resources, Inc., Lutz, FL.
Mikhailova, E.S., Vladimirova, T.V., Iznak, A.F., Tsusulkovskaya, E.J., Sushko, N.V., 1996. Abnormal recognition of facial expression of emotions in depressed patients with major depression disorder and schizotypal personality disorder. Biological Psychiatry 40, 697–705.
Monroe, S.M., Harkness, K.L., 2011. Recurrence in major depression: a conceptual analysis. Psychological Review 118, 655–674.
Narushima, K., Paradiso, S., Moser, D.J., Jorge, R., Robinson, R.G., 2007. Effect of antidepressant therapy on executive function after stroke. The British Journal of Psychiatry 190, 260–265.
Noller, P., 1980. Misunderstandings in marital communication: a study of couples' nonverbal communication. Journal of Personality and Social Psychology 39, 1135–1148.
Norbury, R., Mackay, C.E., Cowen, P.J., Goodwin, G.M., Harmer, C.J., 2007. Short-term antidepressant treatment and facial processing. Functional magnetic resonance study. British Journal of Psychiatry 190, 531–532.

Ohman, A., Lundqvist, D., Esteves, F., 2001. The face in the crowd revisited: a threat advantage with schematic stimuli. Journal of Personality and Social Psychology 80, 381–396.
Paradiso, S., Naridze, R., Holm-Brown, E., 2011. Lifetime romantic attachment style and social adaptation in late-onset depression. International Journal of Geriatric Psychiatry 27, 1008–1016.
Paradiso, S., Rudrauf, D., 2012. Struggle for life, struggle for love and recognition: the neglected self in social cognitive neuroscience. Dialogues in Clinical Neuroscience 14, 65–75.
Persad, S.M., Polivy, J., 1993. Differences between depressed and nondepressed individuals in the recognition of and response to facial emotional cues. Journal of Abnormal Psychology 102, 358–368.
Pollick, F.E., Paterson, H.M., Bruderlin, A., Sanford, A.J., 2001. Perceiving affect from arm movement. Cognition 82, B51–B61.
Pollick, F.E., Kay, J.W., Heim, K., Stringer, R., 2005. Gender recognition from point-light walkers. Journal of Experimental Psychology: Human Perception and Performance 31, 1247–1265.
Richards, D., 2011. Prevalence and clinical course of depression: a review. Clinical Psychology Review 31, 1117–1125.
Ridout, N., Astell, A.J., Reid, I.C., Glen, T., O'Carroll, R.E., 2003. Memory bias for emotional facial expressions in major depression. Cognition and Emotion 17, 101–122.
Ridout, N., O'Carroll, R.E., Dritschel, B., Christmas, D., Eljamel, M., Matthews, K., 2007. Emotion recognition from dynamic emotional displays following anterior cingulotomy and anterior capsulotomy for chronic depression. Neuropsychologia 45, 1735–1743.
Rocca, C.C., Heuvel, Ev., Gaetano, S.C., Lafer, B., 2009. Facial emotion recognition in bipolar disorder: a critical review. Revista Brasileira de Psiquiatria 31, 171–180.
Rubinow, D.R., Post, R.M., 1992. Impaired recognition of affect in facial expression in depressed patients. Biological Psychiatry 31, 947–953.
Ruffman, T., Henry, J.D., Livingstone, V., Phillips, L.H., 2008. A meta-analytic review of emotion recognition and aging: implications for neuropsychological models of aging. Neuroscience and Biobehavioral Reviews 32, 863–881.
Saygin, A.P., 2007. Superior temporal and premotor brain areas necessary for biological motion perception. Brain 130, 2452–2461.
Seay, A.T., Altekruse, M.K., 1979. Verbal and nonverbal behavior in judgments of facillitative conditions. Journal of Counseling Psychology 26, 108–119.
Silvia, P.J., Allan, W.D., Beauchamp, D.L., Maschauer, E.L., Workman, J.O., 2006. Biased recognition of happy facial expression in social anxiety. Journal of Social and Clinical Psychology 25, 585–602.
Schindler, K., Van Gool, L., de Gelder, B., 2008. Recognizing emotions expressed by body pose: a biologically inspired neural model. Neural Networks 21, 1238–1246.
Schmidt, M., 1996. Rey Auditory and Verbal Learning Test: A Handbook. Western Psychological Services, Los Angeles, CA.
Shankman, S.A., Katz, A.C., Passarotti, A.M., Pavuluri, M.N., 2013. Deficits in emotion recognition in pediatric bipolar disorder: the mediating effecs of irritability. Journal of Affective Disorders 144, 134–140.
Shapira, B., Zislin, J., Gelfin, Y., Osher, Y., Gorfine, M., Souery, D., Mendlewicz, J., Lerer, B., 1999. Social adjustment and self-esteem in remitted patients with unipolar and bipolar affective disorder: a case-control study. Comprehensive Psychiatry 40, 24–30.
Sheline, Y.I., Barch, D.M., Donnelly, J.M., Ollinger, J.M., Snyder, A.Z., Mintun, M.A., 2001. Increased amygdala response to masked emotional faces in depressed subjects resolves with antidepressant treatment: an fMRI study. Biological Psychiatry 50, 651–658.
SPSS, 2001. SPSS for Windows, Rel 17. SPSS, Inc., Chicago, IL.
Surguladze, S.A., Young, A.W., Senior, C., Brebion, G., Travis, M.J., Phillips, M.L., 2004. Recognition accuracy and response bias to happy and sad facial expressions in patients with major depression. Neuropsychology 18, 212–218.
Suzuki, A., Hoshino, T., Shigemasu, K., Kawamura, M., 2007. Decline or improvement? Age-related differences in facial expression recognition. Biological Psychology 74, 75–84.
Sweeney, J.A., Wetzer, S., Stokes, P., Kocsis, J., 1989. Cognitive functioning in depression. Journal of Clinical Psychology 45, 836–842.
Trower, P., 1980. Situational analysis of the components and processes of behavior of socially skilled and unskilled patients. Journal of Consulting and Clinical Psychology 48, 327–339.
Vaina, L.M., Solomon, J., Chowdhury, S., Sinha, P., Belliveau, J.W., 2001. Functional neuroanatomy of biological motion perception in humans. Proceedings of the National Academy of Sciences of the United States of America 98, 11656–11661.
Van den Stock, J., Peretz, I., Grezes, J., de Gelder, B., 2009. Instrumental music influences recognition of emotional body language. Brain Topography 21, 216–220.
Volker, M.A., 2006. Reporting effect size estimates in school psychology research. Psychology in the Schools 43, 653–672.
Walker, E., 1981. Emotion recognition in disturbed and normal children: a research note. Journal of Child Psychology and Psychiatry 22, 263–268.
Watzlawick, P., Beavin, J.H., Jackson, D.D., 1967. Pragmatics of Human Communication, A Study of Interactional Patterns, Pathologies, and Paradoxes. W.W. Norton and Company, New York, NY.
Wechsler, D., 1999. Wechsler Abbreviated Scale of Intelligence. The Psychological Corporation, New York, NY.
Weissman, M., 1999. Social Adjustment Scale-Self-Report. Multi-Health Systems, Inc., New York, NY.
Weissman, M.M., Olfson, M., Gameroff, M.J., Feder, A., Fuentes, M., 2001. A comparison of three scales for assessing social functioning in primary care. The American Journal of Psychiatry 158, 460–466.
Wells, K.B., Stewart, A., Hays, R.D., Burnam, M.A., Rogers, W., Daniels, M., Berry, S., Greenfield, S., Ware, J., 1989. The functioning and well-being of depressed patients. Results from the Medical Outcomes Study. JAMA. The Journal of the American Medical Association 262, 914–919.
Yonkers, K.A., Samson, J., 2000. Mood Disorders Measures. American Psychiatric Publishing, Washington, DC.
Yoon, L.K., Joormann, J., Gotlib, I., 2009. Judging the intensity of facial expressions of emotion: depression-related biases in the processing of positive affect. Journal of Abnormal Psychology 118, 223–228.