

Is Emotion Processing a Predictor of Functional Outcome in Schizophrenia?

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Abstract

Deficits in the ability to perceive facial and vocal emotion expression are common in schizophrenia. However, relatively little is known about how such deficits might affect functional outcomes. This prospective study examined cross-sectional and longitudinal relationships between perception of emotion and aspects of psychosocial functioning, including family relationships, social relationships, work functioning, and independent living/self-care in 94 clinically stabilized schizophrenia outpatients from five community-based rehabilitation programs. Emotion perception (facial emotion, voice emotion, and affect perception) and psychosocial outcome (Strauss and Carpenter Outcome Scale and Role Functioning Scale) were assessed at baseline and after 12 months of psychosocial rehabilitation. Significant associations were found between perception of emotion and work functioning/independent living both cross-sectionally and prospectively over the 12 months. Causal explanatory models suggested that perception of emotion might cause work functioning/independent living outcome over 1 year. The results remained significant when conceptual disorganization was statistically controlled. We did not find differences between men and women in the correlations between emotion perception and work functioning/independent living. Associations between social functioning/family relationships and perception of emotion were not significant. These findings suggest that emotion processing is a key determinant of work functioning/independent living for individuals with serious mental illness.

Keywords: Schizophrenia, emotion perception, affect recognition, social cognition, functional outcome, psychosocial functioning.

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I once said something to Jim with a smile, and he told me that a smile was no good if it was deceptive. On another occasion, Jim reacted to a smile by asking why I was laughing at him. (Anonymous 1983, p. 442)

In this first person account, a father reflects on encounters with his son Jim, who suffers from schizophrenia. Jim's difficulties in perceiving and interpreting emotion in others are not rare or inconsequential for individuals with this disorder. Decades of research have established that patients with schizophrenia generally are less able to accurately perceive and appraise facial and vocal emotion expression compared with controls (e.g., Turner 1964; Dougherty et al. 1974; Walker et al. 1984; Feinberg et al. 1986; Borod et al. 1993; Kerr and Neale 1993). Such impairments have been demonstrated to be moderately stable over time (Gaebel and Wolwer 1992; Streit et al. 1997; Addington and Addington 1998; Kee et al. 1998a). Deficits in perception of emotion have been reported to be related to psychotic symptoms (Addington and Addington 1998; Kee et al. 1998c) such as bizarre behaviors (Schneider et al. 1995; Poole et al. 2000), hallucinations, and thought disorder (Kohler et al. 2000). These impairments also appear to be associated with negative symptoms, including alogia (Gaebel and Wolwer 1992; Kohler et al. 2000) and anergia (Mueser et al. 1996).

Only recently, however, have the implications of emotion processing deficits for the everyday functioning of schizophrenia patients emerged as an area of considerable interest. In two recent articles (Green et al. 2000a, 2000b), we proposed that emotion processing may be a key mediator between basic neurocognitive abilities and functional outcome. In support of this view, several studies (e.g.,

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Bryson et al. 1997; Addington and Addington 1998; Kee et al. 1998b; Kohler et al. 2000) have uncovered relationships between perception of emotion and aspects of neurocognitive functioning in schizophrenia.

Only four studies have directly explored the relationship between emotion perception and social functioning in schizophrenia. Mueser et al. (1996) examined the association between facial emotion perception and interpersonal behavior and social adjustment on the ward in a sample of 28 long-term schizophrenia inpatients. They found that patients' performance on both facial emotion perception tasks (i.e., identification and discrimination) was moderately correlated with the ability to make appropriate social contacts and to maintain personal appearance and hygiene. Only facial emotion identification was related to ratings of nonverbal-paralinguistic social skills in a structured role-play assessment. Similarly, Penn et al. (1996) compared the performance of 27 chronic inpatients with schizophrenia or schizoaffective disorder on a battery of social-cognitive measures, which included facial emotion identification, and social behavior on the ward, as measured by the Nurses' Observation Scale for Inpatients Evaluation, 30 items. Deficits in the perception of facial emotion predicted poor adaptive ward behavior, such as decreased social competence, social interest, and neatness.

Ihnen et al. (1998) investigated the functional relevance of social perception, including facial emotion identification and discrimination, in a sample of 26 stabilized outpatients with schizophrenia. Their findings showed that patients' performance on the test of facial emotion identification, but not discrimination, was significantly correlated with several domains of conversational skills. The magnitude of the significant correlations was modest, and speech clarity was the strongest predictor. Poole et al. (2000) assessed 40 stabilized schizophrenia outpatients with tests of facial and vocal emotion recognition and a battery of clinical, quality of life, general cognitive, and nonemotion facial and vocal recognition measures. Results indicated that performance on emotion recognition moderately correlated with the interpersonal relationships domain from the Quality of Life Scale and bizarre behaviors (i.e., social-sexual behaviors, clothing, and appearance), even when clinical symptoms and general cognitive abilities were statistically controlled.

In general, the above findings have provided preliminary evidence that the ability to process emotion is critical for interpersonal and social functioning in schizophrenia. However, although promising and highly informative, these investigations have some limitations. First, all the studies have used only cross-sectional designs to evaluate the functional role of emotion perception in schizophrenia patients. We know nothing about the relationship between patients' emotion processing and multiple aspects of psy-

chosocial outcome across different time points. Second, three of the four studies had fairly small sample sizes, ranging from 26 to 28 schizophrenia patients. Such limited samples raise the possibility that they might not have sufficient statistical power to detect significant findings. Hence, replication of previous findings using reasonably large sample sizes of schizophrenia patients is needed to adequately examine the relationship between performance on measures of emotion processing and psychosocial functioning.

The present study examined the associations between emotion processing and specific aspects of psychosocial functioning such as family and social relationships, vocational capacity, and independent living in a sample of 94 stabilized schizophrenia outpatients of five community-based psychosocial rehabilitation programs. To our knowledge, this is the first prospective research to determine the functional role of perception of emotion longitudinally (over a period of 12 months). We hypothesized that (1) performance on measures of emotion perception would be cross-sectionally related to functional outcome domains at both baseline and 12 months, and (2) higher levels of baseline emotion perception would predict better specific domains of functional outcome at the 12-month followup. For this study, we included three perception of emotion measures that differed according to presentation mode (i.e., visual, auditory, and combined) and two psychosocial outcome measures (Strauss and Carpenter Outcome Scale, and Role Functioning Scale). The two measures of psychosocial outcome were selected because their indexes (e.g., social functioning, work functioning, independent living situation) have been commonly used as indicators of functional outcome in previous schizophrenia studies (e.g., Test 1984; McGlashan et al. 1988; Brekke 1992; Brekke et al. 1993). Like previous emotion perception researchers (i.e., Ihnen et al. 1998; Poole et al. 2000), we also examined whether other pertinent variables, such as psychiatric symptoms and gender, explained the associations between emotion perception performance and psychosocial outcome.

Method

Participants. Ninety-four clinically stabilized outpatients (63 men, 31 women) of five community-based psychosocial rehabilitation services in Los Angeles were recruited from a larger study investigating neuropsychological and psychophysiological factors as predictors of psychosocial rehabilitation outcome (J.S. Brekke, P.I., and M.F. Green, Co-P.I.). All five rehabilitation programs have rich client-to-staff ratios and similar psychosocial rehabilitation ideologies, including comprehensive and service-

intensive rehabilitative environments that combine a consumer-oriented philosophy with a high push for increased functioning in the areas of social, vocational, and independent living. Informed consent was obtained from each subject using both written materials and verbal description.

The mean age of the subjects was 38.7 years (standard deviation [SD] = 9.8), and the mean level of education was 12.1 years (SD = 1.8). Forty-six patients were Caucasian, 27 were African-American, 14 were Latino, and 7 were Asian or other. The mean duration of illness was 13.6 years (SD = 10.4). Of the initial sample, partial data were obtained for 13 patients because these subjects either had missing data at the baseline assessment or dropped out before completion of retesting at 12 months. Hence, the complete sample size for the analyses was 81 (57 men, 24 women).

All subjects met the criteria for either schizophrenia, schizoaffective disorder, or schizophreniform disorder based on the *DSM-IV* (American Psychiatric Association 1994) checklist procedure. The diagnoses were confirmed using chart information and reports from clinicians as well as on-site psychiatrists. Raters administering the diagnostic checklist were trained by the Diagnostic and Psychopathology Unit of the University of California, Los Angeles, Intervention Research Center (R.P. Liberman, P.I.). Subjects were excluded if they had a history of substance use disorder in the past 6 months, had an identifiable neurological disorder, or were less than 18 or over 55 years of age.

Eighty-four of the 94 patients were receiving antipsychotic medication at baseline ($n = 40$ for atypical; $n = 44$ for conventional). Of the group that received atypical medication, two patients had been switched to conventional and one had been taken off antipsychotic medications at 12 months. Sixteen patients who received conventional antipsychotics had been switched to atypical medications and two were taking no medication 1 year later. Of the patients who were unmedicated at baseline, three were receiving conventional and two were receiving atypical antipsychotic medication at 12 months.

Measures and Procedure. Data were collected on three measures of perception of emotion, two psychosocial outcome measures, and psychiatric symptoms at baseline and again at 12 months following psychosocial rehabilitation. For each time point, subjects were tested in two separate sessions that were a median length of 15 days apart. Psychosocial functioning assessments (via face-to-face interviews with the subjects) and clinical ratings of symptoms were conducted in the first session, and measures of emotion perception were administered in the second. For each perception of emotion test, the outcome measure

was the total number of correct responses. The tests were administered in the order described below.

Psychosocial outcome measures. Psychosocial outcome was assessed using the Strauss and Carpenter Outcome Scale (SCOS; Strauss and Carpenter 1972). This scale contains four discrete dimensions, each of which was rated from 0 (most dysfunction) to 4 (least dysfunction). For the current study, the two dimensions most relevant to functional outcome were used: social contacts and useful employment. For example, useful employment in one's primary role, such as wage earner, student, or housewife, was rated as follows: 0 = no useful work; 1 = employed less than half of the time in the past 6 months; 2 = employed part-time or full-time about half of the time in the past 6 months; 3 = employed more than 3 months but less than continuously in the past 6 months; and 4 = employed continuously in the past 6 months.

The Role Functioning Scale (RFS; McPheeters 1984) measures four major domains of subjects' functioning in everyday life: work productivity, independent living/self-care, relationships with family and spouse, and relationships with friends, each rated on specific anchor points ranging from 1 (severely limited functioning) to 7 (optimal functioning). The RFS has sound psychometric properties (Goodman et al. 1993) and has been widely used in service outcome studies in schizophrenia (e.g., Green and Gracely 1987; Brekke et al. 1997; Brekke and Long 2000). Examples of anchor points for the family relationships component are as follows: 1 = no contact with any family members or severely deviant behaviors within family network; 4 = relationships that are often minimal and fluctuating in quality (contact once a month); and 7 = positive relationships with several family members and assertive contributions to these relationships.

Clinical rating scales. Psychiatric symptoms, including psychotic exacerbations, were assessed using the 24-item Brief Psychiatric Rating Scale (BPRS; Ventura et al. 1993). This semistructured interview, with specific anchor points, required approximately 20 minutes to complete. Three scales were derived from the BPRS for use in statistical analyses, which included a measure of positive symptoms (sum of hallucinations and unusual thought content), the conceptual disorganization item, and an index of negative symptoms (sum of blunted affect, emotional withdrawal, and motor retardation).

Perception of emotion tests. The Facial Emotion Identification Test (Kerr and Neale 1993) consists of 19 black-and-white still photographs depicting differing facial emotions presented on videotape. After each photograph, the subjects were asked to circle on an answer sheet which one of six emotions (i.e., happy, angry, afraid, sad, surprised, and ashamed) best described the emotion of the photograph. Definitions of these six emo-

tions were presented in written form and read aloud to the subjects before testing.

For the Voice Emotion Identification Test (Kerr and Neale 1993), subjects were presented 21 sentences of neutral content on audiotape (e.g., "Fish can jump out of the water," "He tossed the bread to the pigeons"). Each sentence was spoken aloud in such a manner as to convey one of the same six emotions used in the Facial Emotion Identification Test. The subjects listened to each sentence and then circled on an answer sheet which of the six emotions best described the speaker's tone of voice.

The Videotape Affect Perception Test (Bellack et al. 1996) includes 30 brief scenes from movies and television. At the start of each scene, the subjects were told to attend to a particular character. After viewing each scene, the subjects then selected one of six emotions that best described what that character was feeling.

Results

Descriptive data from the measures of emotion perception, psychosocial outcome, and psychiatric symptoms at baseline and 12 months are displayed in table 1. Primary data analyses for the current study focused on two issues: (1) evaluating the cross-sectional relationship between perception of emotion variables and domains of functional outcome at baseline and 12 months, and (2) predicting the longitudinal effects of emotion perception factors (baseline) on the specific functional outcome domains over 12 months. In addition, subsequent analyses were conducted to evaluate the role of gender and symptomatology in the relationship between perception of emotion and psychosocial functioning. To address concerns about excessive type I error associated with multiple significance testing, we reduced the data and simplified interpretation using a principal components analysis. Unless otherwise noted, significance levels were 2-tailed.

Data Reduction. To reduce data, we first summed the three measures of emotion perception (i.e., facial emotion, voice emotion, and affect perception) into a single measure of perception of emotion (maximum score = 70), as in our previous studies (Kee et al. 1998b, 1998c).

For the functional outcome data, we applied a principal components analysis with orthogonal varimax rotation to restrict the six dependent variables to a delimited number of identified primary outcome domains. Two factors had eigenvalues greater than 1 and accounted for 68.1 percent of the total variance. Factor loadings are listed in table 2. At both baseline and 12 months, the strongest loadings for the first factor were work productivity (RFS), useful employment (SCOS), and independent living/self-care (RFS). Relationships with friends (RFS), social con-

tacts (SCOS), and relationships with family and spouse (RFS) loaded on the second factor. Although the independent living/self-care variable also loaded on the second factor at 12 months, its highest loading was on the first factor at baseline. In the subsequent analyses, we used these two factors (factor 1 = work functioning/independent living and factor 2 = social functioning/family relationships) as the psychosocial outcome measures.

Cross-Sectional Correlations. Figure 1 shows a series of Pearson product-moment correlations between emotion perception performance and domains of psychosocial outcome for data collected at baseline and 12 months. At baseline, patients' emotion perception performance was moderately correlated with work functioning/independent living ($r = 0.36, p = 0.002$) but not social functioning/family relationships. Similarly, at 12 months the only significant correlation was between emotion perception and the psychosocial domain of work functioning/independent living ($r = 0.29, p = 0.016$), indicating that better occupational skills and more appropriate self-care were related to greater performance on the emotion perception tasks.

Prediction of Longitudinal Relationships. Figure 1 also presents the cross-temporal correlations between baseline measures in one domain and 12 months measures in the other. Pearson product-moment correlations revealed only one significant association: between baseline perception of emotion and work functioning/independent living 12 months later ($r = 0.41, p = 0.0004$). The effect size was moderate, and the correlation was in the direction of greater baseline emotion perception performance predicting better later work functioning/independent living. Because the cross-sectional and longitudinal relationships between perception of emotion and work functioning/independent living outcome were similar, the results suggested good stability of these associations.

Causal Explanatory Models: Directionality of Causal Effects. With the two-wave panel design in this study (0 and 12 months), we were able to further explore the directionality of causal effects for the relationship between perception of emotion and work functioning/independent living outcome. A causal analysis was not justified for the other psychosocial variables because they were not correlated with emotion perception performance. As recommended by Campbell and Kenny (1999), we used three different statistical methods. The first is the cross-lagged panel correlation analysis. This method, described in detail by Kenny (1979), is a long-standing and well-known technique for uncovering simple causal relationships in a longitudinal context. Cross-lagged panel correlation examines directionality of causal relations between

Table 1. Mean scores and SDs for measures of emotion perception and psychosocial outcome

	Baseline		12 Mos	
	Mean	SD	Mean	SD
Perception of emotion measures				
Facial emotion	10.58	3.52	11.02	3.21
Voice emotion	9.44	3.52	9.64	3.57
Affect perception	18.51	4.57	19.56	4.13
Emotion perception total score	38.07	10.18	39.99	9.74
Strauss and Carpenter Outcome Scale				
Social contacts	1.84	1.31	2.21	1.47
Useful employment	0.92	1.39	1.56	1.72
Role Functioning Scale				
Work productivity	2.06	1.63	2.77	1.95
Independent living/self-care	3.42	1.77	4.14	1.90
Relationships with family and spouse	4.00	1.96	4.30	2.05
Relationships with friends	2.94	1.57	3.48	1.96
Clinical Rating Scale				
Positive symptoms	4.26	3.23	3.74	2.43
Conceptual disorganization symptoms	1.63	1.23	1.42	1.02
Negative symptoms	4.62	2.44	3.87	1.68

Note.—SD = standard deviation.

Table 2. Factor loadings for principal components analysis¹

Baseline outcome variables	Baseline factor 1	Baseline factor 2	12 mos factor 1	12 mos factor 2
Social contacts	0.17	0.88	0.09	0.91
Useful employment	0.90	-0.06	0.93	0.02
Work productivity	0.95	-0.01	0.92	0.22
Independent living/self-care	0.68	0.26	0.41	0.44
Relationships with family and spouse	-0.08	0.43	0.06	0.59
Relationships with friends	0.18	0.90	0.19	0.92

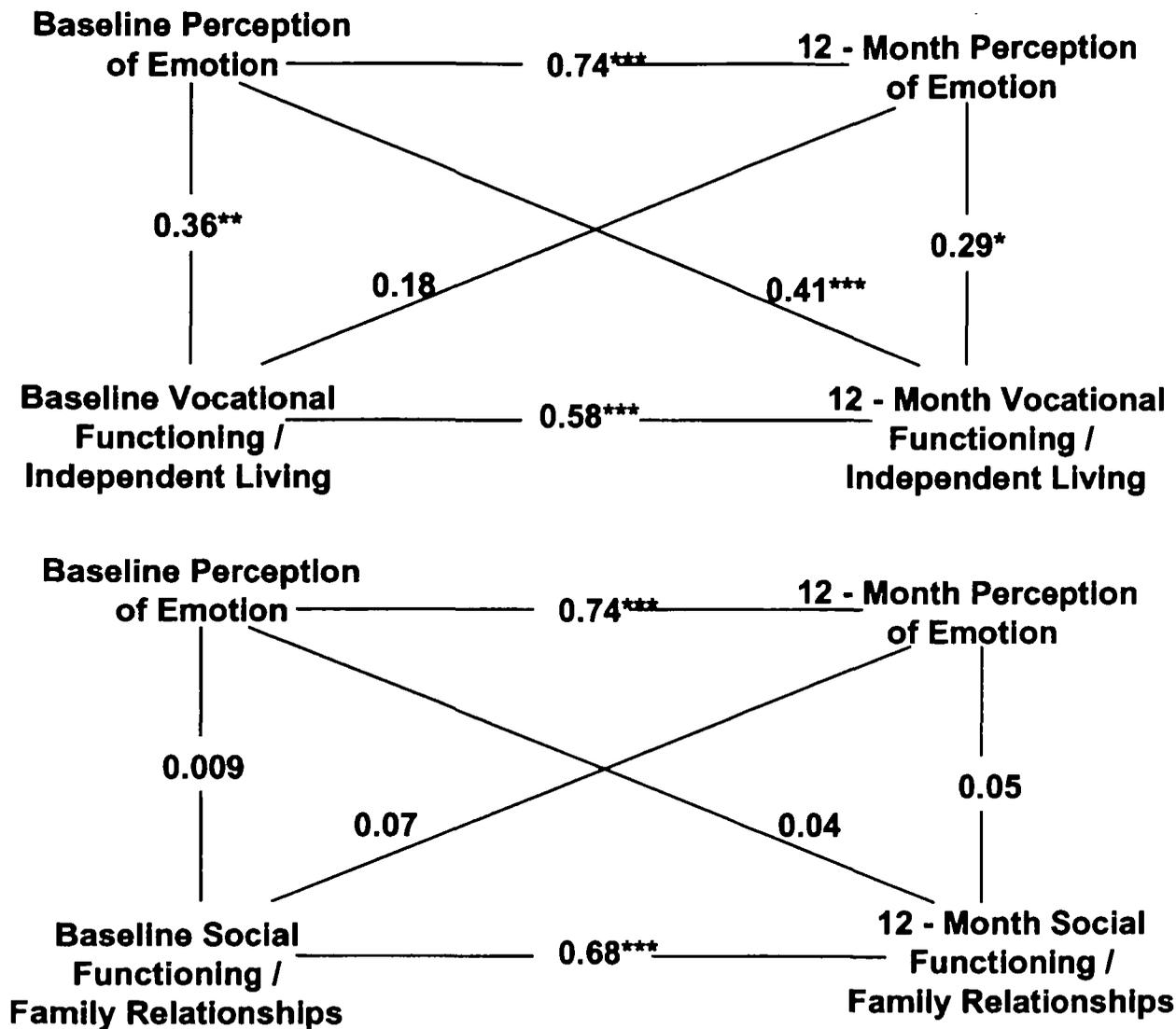
¹ The highest absolute value loading for each factor at each time point is in boldface.

two variables, using the “cross-lagged” correlations. These are the correlations between each measure at one time point (e.g., baseline) and the other measure at some later time. A finding that one of these cross-lagged correlations is significantly larger suggests that the direction of causality is from that baseline variable (or unmeasured variables associated with it) to the other. The significant test for this comparison uses a formula that takes autocorrelations and concurrent correlations into account. In our current data, the correlation between baseline perception of emotion and 12-month work functioning/independent living was significantly greater than the other cross-lag (baseline work functioning/independent living to 12-

month perception of emotion), $z = 1.95$, $p = 0.026$ (1-tailed).

Although the cross-lagged panel correlation analysis provides a good test of spuriousness, its model of causation is limited (see Campbell and Kenny 1999 for a detailed discussion). The multiple regression approach developed by Rogosa (1980) has an explicit model of causal effects but poor estimation of spuriousness. Rogosa’s model, applied to the current data, revealed a significant causal path from baseline perception of emotion to 12-month work functioning/independent living ($t = 2.25$, $p = 0.028$) but no causal effect from baseline work functioning/independent living to 12-month emotion perception ($p = 0.276$).

Figure 1. Cross-sectional and cross-temporal correlations between perception of emotion and psychosocial outcome



***p<0.001; **p<0.01; *p<0.05

Finally, as a check for regression artifacts, the data were reanalyzed using the little-known method of time-reversed analysis (Kenny and Campbell 1984). This method is a reanalysis of the original data in which the temporal ordering is reversed (i.e., baseline data are used as the dependent measures and followup data as the predictors). Kenny and Campbell note that if presumed causal effects are actually artifacts of regression to the mean, the original and time-reversed analyses will yield similar “causal” paths. Thus, finding that the causal paths in the

original and time-reversed analyses differ supports the hypothesis that the causal effects are not due to regression artifacts. The results of the time-reversed analysis (using baseline work functioning as the dependent measure and 12-month outcomes as the predictors) were markedly different from the original findings. The regression coefficient between presumed cause and effect was highly significant in the original analysis (beta = 0.024, standard error [SE] = 0.01, p = 0.015) and essentially nil in the time-reversed analysis (beta = 0.002, SE = 0.10, p = 0.86).

Role of Clinical Symptoms. Several additional analyses were conducted to determine whether the association between perception of emotion and later work functioning/independent living outcome was affected by psychiatric symptoms. Positive symptoms correlated with emotion perception performance at a trend level at baseline only ($r = -0.20$, $p = 0.075$). Conceptual disorganization, on the other hand, was significantly correlated with emotion perception both at baseline ($r = -0.39$, $p < 0.001$) and at 12 months ($r = -0.38$, $p = 0.001$). A measure of negative symptoms did not correlate with perception of emotion at either time point and was thus not considered further. Based on these correlations, the cross-sectional and cross-temporal correlations between perception of emotion and work functioning/independent living were repeated, partialing out conceptual disorganization. The pattern of results was comparable at baseline ($r = 0.30$, $p = 0.01$), 12 months ($r = 0.23$, $p = 0.05$), and across the 1-year interval (baseline emotion perception by 1-year work functioning/independent living [$r = 0.36$, $p = 0.002$]). Similarly, the results of both the cross-lagged panel analysis ($z = 1.95$, $p = 0.026$ 1-tailed) and the multiple regression model ($t = 4.82$, $p = 0.0001$) were most consistent with the interpretation that better perception of emotion may be a causal factor in improved work functioning/independent living outcome even after controlling for clinical symptoms.

Role of Gender. We also examined whether perception of emotion predicted work functioning/independent living skills differently in male and female patients. When we analyzed these relationships separately for the two genders, the correlations were essentially the same (figure 2). For men ($n = 57$) at baseline and 12-month followup, emotion perception performance was moderately correlated with work functioning/independent living skills ($r = 0.34$, $p < 0.02$ and $r = 0.29$, $p < 0.03$, respectively). The longitudinal association between baseline emotion perception and later work functioning/independent living was also significant ($r = 0.40$, $p < 0.005$). For women ($n = 24$), performance on perception of emotion was correlated with work functioning/independent living at a trend level at both baseline and 12-month followup ($r = 0.38$, $p < 0.06$ and $r = 0.29$, $p < 0.10$, respectively). Cross-temporal association between baseline emotion perception and later work functioning/independent living skills was significant ($r = 0.43$, $p < 0.04$). Finally, we conducted contrast comparisons between all correlation coefficients for males versus females. The correlation coefficients involving emotion perception and work functioning/independent living domains showed no significant differential pattern of associations related to gender.

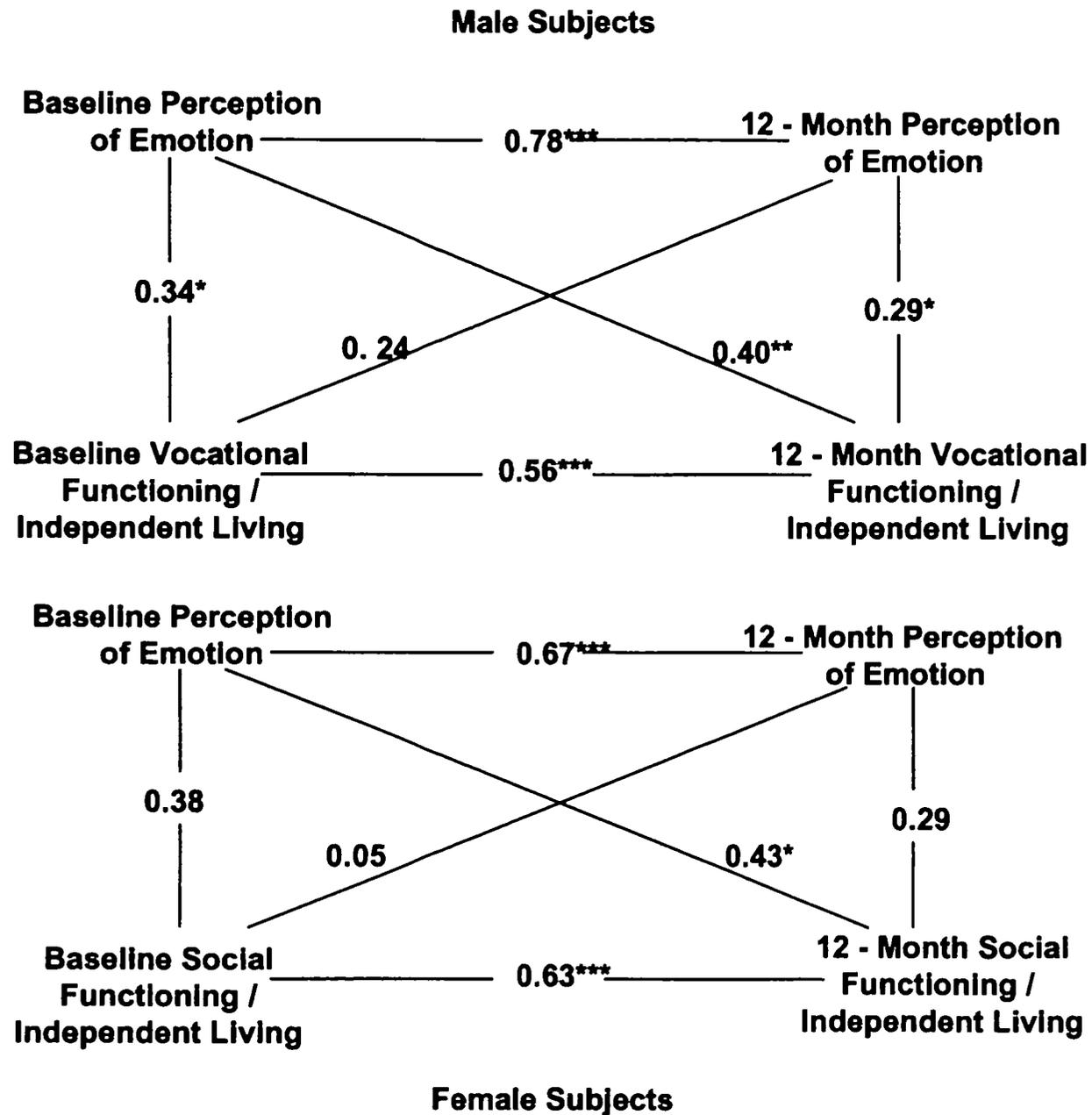
Discussion

The primary finding from these analyses was that schizophrenia patients' performance on perception of emotion was significantly correlated with work functioning/independent living both at baseline and at 12-month followup. The longitudinal association between baseline emotion perception and later work functioning/independent living was also significant, implying that this relationship is relatively stable. Most important, the findings suggested that higher levels of baseline emotion perception not only predict, but may also cause, better work functioning/independent living outcome over 1 year. When conceptual disorganization was controlled statistically, the findings remained significant. In addition, there were no overall gender differences in the relationships between perception of emotion and work functioning/independent living. Contrary to our expectations, performance on the other functional outcome factor (i.e., social functioning/family relationships) was not significantly associated with performance on perception of emotion, either cross-sectionally or longitudinally.

Why was perception of emotion related to work functioning/independent living but not to social functioning/family relationships? One possible reason is that work functioning and independent living assessments are more objective and more valid for use with schizophrenia patients than are assessments for social and family relationships. Data from previous studies, however, suggest that these relationships can be reliably measured in schizophrenia. Alternatively, we can speculate that perhaps work and school settings (with their greater emphasis on performing prescribed tasks and achieving set goals) might be less tolerant of negative consequences arising from emotion misperceptions compared with social or family relationships. Even with adequate job skills and work habits, patients' difficulty in understanding emotion in others could lead to inappropriate responding or ideas of persecution, which might hamper their ability to carry out job requirements. Along these lines, Anthony and Jansen (1984) suggested that for individuals with psychiatric disabilities, the most important element of vocational performance, beyond doing the job and being dependable, was the interpersonal dimension of getting along with others. The present findings suggest that perception of emotion might be a key component of this interpersonal dimension of vocational performance.

The current finding of a relationship between perception of emotion and independent living/self-care skills is congruent with results from previous cross-sectional studies that have found that accurate perception of emotion expressions is related to personal appearance and hygiene (Mueser et al. 1996), neatness on an inpatient ward (Penn

Figure 2. Cross-sectional and cross-temporal correlations between perception of emotion and work functioning/independent living skills for male and female patients with schizophrenia



*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

et al. 1996), and appropriate clothing and appearance (Poole et al. 2000). Emotion perception measures rely on a patient's ability to extract emotion information from briefly presented stimuli (Feinberg et al. 1986; Kee et al. 1998b). Similarly, the ability to meet self-care needs and independently manage household tasks would seem to require this skill of information processing and would

place demands on patients' ability to perform task-oriented requirements.

The finding that social functioning was not associated with perception of emotion in schizophrenia patients might appear inconsistent with previous studies (e.g., Mueser et al. 1996; Penn et al. 1996; Ihnen et al. 1998). For this study, the associations between emotion percep-

tion and social functioning were examined within an ecologically valid context of community-based environments, using in vivo measures of community functioning. The outcome of this social functioning component depends on how well and how often patients participate or communicate with their close friends or how assertively they contribute to positive relationships. This type of distal and more complex aspect of social functioning differs from other types, such as ratings of microlevel social skills during laboratory role-play tests (i.e., maintaining eye contact, initiating conversation) or social adjustment in treatment settings, which have been the primary focus of prior studies in this area.

This study has some limitations. First, although the current findings have suggested a causal relationship between baseline emotion perception and later vocational functioning, the specific factors that explain this causation have yet to be identified. For example, emotion perception may be related to a third variable that mediates the relationship. Furthermore, little is known about what role emotion perception plays in specific components of vocational outcome such as work performance and retention of employment. In addition, we do not know the extent to which the relationships between perception of emotion and functional outcome are independent of other known predictors, such as neurocognition.

Second, it is possible that our findings of the relationship between emotion perception and work functioning/independent living but not social functioning/family relationships might be due to a differential pattern in the range of variance for these two psychosocial domains. For the useful employment variable from the SCOS, there was an increase in variance between baseline and 12 months, whereas the social contacts variable showed a more restricted increase over the same time period. While we cannot rule out the influence of restricted range, it should be noted that our statistical analyses focused on two main factor scores derived from a principal components analysis and that these factor scores consisted of multiple social and work functioning variables. By using the two factor scores as our outcome predictors, we have greatly minimized the effect of variance restrictions.

Third, we were not able to examine the role of atypical versus conventional antipsychotic medications in mediating the observed relationship between perception of emotion and work functioning/independent living. It is possible that newer antipsychotic medications improve both perception of emotion and functional outcome, but it is less obvious how such effects would explain the full pattern of results, including cross-lags of different magnitudes.

Fourth, it should be noted that this study employed a sample of stabilized schizophrenia outpatients, with no

other comparison groups. Thus, it is not known whether the patterns of cross-sectional and longitudinal relationships here would also apply to other psychiatric or nonpsychiatric samples or whether they are specific to schizophrenia.

Fifth, subjects for this study were drawn from different community-based psychosocial rehabilitation programs with relatively similar service characteristics. Service characteristics including intensity, specificity, continuity, and length of service delivery have been shown to be associated with improved rehabilitation outcome (Brekke et al. 1997, 1999; Brekke and Long 2000). At this time, we do not know whether these service characteristics affected the subjects' perception of emotion performance, which could then influence the relationships between emotion perception and domains of functional outcome.

To our knowledge, the present study is the first to explore the role of emotion processing in the psychosocial functioning of schizophrenia patients in the community over 1 year. Our findings provide relatively strong evidence that perception of emotion predicts and causes improvement in work functioning/independent living—important aspects of functional outcome in schizophrenia. One implication of this finding is that remediation training programs designed to improve facial emotion recognition (such as those developed by Penn and Combs [2000] and Wolwer et al. [2001]) could also serve as a useful adjunct for improving vocational functioning in individuals with severe mental illness.

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