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Schizophrenia Research 46 (2000) 217–229

SCHIZOPHRENIA RESEARCH

www.elsevier.com/locate/schres

Modification of affect perception deficits in schizophrenia

D.L. Penn [a,*], D. Combs [b]

[a] University of North Carolina–Chapel Hill, Department of Psychology, Davie Hall, CB#3270, Chapel Hill, NC 27599-3270, USA
[b] Louisiana State University, Department of Pschology, 236 Auolubon Hall, Baton Rouge, LA 70803-5501, USA

Received 29 September 1999; accepted 15 December 1999

Abstract

This study investigated two strategies for improving facial affect perception in schizophrenia: monetary reinforcement and promoting facial feedback via mimicry of the expressions of target faces. A total of 40 inpatients with schizophrenia were administered the face emotion identification test during four phases: baseline, intervention, immediate post-test, and 1 week follow-up. Subjects were randomly assigned to one of four interventions: repeated practice, monetary reinforcement, facial feedback, and a combination of reinforcement and facial feedback. Generalization of the intervention to a test of facial affect discrimination was also examined. The results showed that all groups of subjects, with the exception of those in the repeated practice group, improved in their ability to identify facial affect, with these effects showing some stability over time. There was limited evidence of these effects generalizing to the test of facial affect discrimination. © 2000 Elsevier Science B.V. All rights reserved.

Keywords: Affect perception; Modification; Schizophrenia

1. Introduction

It is well documented that persons with schizophrenia have deficits in their ability to perceive the affect of others. In particular, persons with schizophrenia have deficits in facial affect perception relative to both non-clinical controls and clinical subjects without psychotic features; for reviews, see Edwards et al. (1999), Hellewell and Whittaker (1998), Mandal et al. (1998), and Morrison et al. (1988). These deficits may reflect generalized poor performance, although there is also evidence of specific impairments in emotion perception [discussed in Mandal et al. (1998) and Penn et al. (1997)]. Finally, these deficits appear to have functional significance as they show an association with social functioning (Mueser et al., 1996; Penn et al., 1996; Ihnen et al., 1998).

Given the presence of facial affect perception deficits in schizophrenia, and its association with social behavior, an important question is whether these deficits can be ameliorated. This question can be addressed in a number of ways. For example, there is mixed evidence regarding the stability of facial affect perception deficits in schizophrenia; longitudinal studies indicate a trait-like deficit (Gaebel and Wolwer, 1992), whereas cross-sectional studies, comparing acutely ill with remitted patients, suggest that the deficit may be episodic (Cutting, 1981; Gessler et al., 1989). Another way of addressing this question is by examining whether facial affect perception can be modified by psychopharmacologic or psychosocial interventions. In particular, a recent study showed that Risperidone, relative to Haloperidol, had a greater effect on the

* Corresponding author. Fax: +1-919-962-2537.
E-mail address: dpenn@email.unc.edu (D.L. Penn)

0920-9964/00/$ - see front matter
PII: S0920-9964(00)00005-0

performance of treatment-resistant subjects with schizophrenia on a battery of emotional perception tasks, including facial affect perception (Kee et al., 1998). Interestingly, unlike the study of cognitive deficits, there has been little empirical work on developing specific psychological strategies for remediating affect perception deficits schizophrenia. The work that has been done has typically embedded affect perception training within a broader treatment package including both cognitive and behavioral interventions (Brenner et al., 1992; Spaulding et al., 1998). Therefore, it is difficult to evaluate which interventions, if any, accounted for changes in affect perception. Thus, the development of specific psychological interventions focused on facial affect perception is needed.

In this paper, two interventions for modifying deficits in affect perception were investigated. First, there is some evidence that schizophrenia patients' performance on cognitive tasks can be improved with contingent monetary reinforcement, especially when combined with other remediation approaches [reviewed by Green (1993) and Kern et al. (1995); see Hellman et al. (1998) for an exception]. Therefore, a similar intervention was utilized in the current study. Specifically, subjects were rewarded $0.10 for each correct response on an affect identification task. This intervention not only provides a methodological link between this study and that in the cognitive remediation literature, but it also allows for the evaluation of motivation on affect identification performance (Bellack et al., 1999).

The second intervention was based on the 'Facial Feedback Hypothesis'. According to this theory, facial actions influence experienced emotions. For example, research conducted with non-clinical samples indicates that manipulating one's face into a specific emotional expression (e.g. happiness) is associated with increased *experience* of that particular emotion (i.e. increased happiness) [reviewed by McIntosh (1996)]. McIntosh (1996, p. 140) has even argued that facial feedback may impact social perception: "…it could provide the subjective experience of others' emotions that allows normal individuals to develop understandings of others". Recently, Kring et al. (1999) reviewed evidence suggesting a link between mimicry of facial expressions and facial affect perception in non-clinical subjects (e.g. Wallbott, 1991). Kring et al. (1999, p. 187) concluded that "… pictures of facial expressions elicit similar facial reactions in observers, and these reactions may aid in the recognition and perception of emotion depicted in the faces". Thus, promoting facial feedback, via mimicry, may impact facial affect perception in schizophrenia.

There is indirect evidence that a facial feedback intervention is appropriate for persons with schizophrenia. For example, persons with schizophrenia tend to be less facially expressive than non-clinical control subjects [reviewed by Mandal et al. (1998)]. This lack of expressiveness is present in medication-free subjects (Kring and Neale, 1996) and does not appear to be an artifact of medication side-effects (e.g. Berenbaum and Oltmanns, 1992). This reduced expressiveness may provide persons with schizophrenia with fewer proprioceptive cues when attempting to understand the emotions of themselves or others. Although there is evidence for a disassociation between emotional expression and experience in schizophrenia (Berenbaum and Oltmanns, 1992; Kring et al., 1993; Kring and Neale, 1996), studies in this area have been criticized for investigating only a few types of emotional expression and experience, and for manipulating expressive behaviors indirectly (i.e. via emotionally charged films) rather than directly controlling specific facial expression production [discussed in Flack et al. (1999)]. And, in a recent study, Flack et al. (1999) reported a correspondence between a range of emotions (i.e. happy, sadness, fear, and surprise) and the facial expressions of outpatients with schizophrenia when the expressions were manipulated into a specific emotional state. Furthermore, Shaw et al. (1999) showed that inappropriate affect (as measured by the Scale for the Assessment of Negative Symptoms) was associated with facial affect recognition among inpatients with schizophrenia (although facial affect recognition was not associated with verbal affective expressiveness). Thus, these findings lend support for utilizing a facial feedback intervention for persons with schizophrenia.

It was hypothesized that the two interventions (i.e. monetary reinforcement and facial feedback) would significantly improve performance on a facial affect identification task relative to a no-intervention control condition, with this effect being strongest when the two interventions are combined. These effects were assessed both immediately following the intervention and at 1 week follow-up. Finally, generalization of the effects to an affect discrimination task was investigated.

2. Methods

2.1. Participants

A total of inpatients (23 men, 17 women) at Southeast Louisiana State Hospital participated in the study.[1] All subjects met criteria for schizophrenia ($n=29$) or schizoaffective disorder ($n=11$) based on the Structured Clinical Interview for DSM-IV, Patient version (SCID-P, Spitzer et al., 1995) and a chart review. The SCID-P was administered by a clinical psychology doctoral student who had been trained to an agreement (i.e. with respect to primary diagnosis) of 100% with a criterion rater. Subjects were excluded from participation if they had a chart history of neurological injury, corrected vision of less than 20/30, and evidence of substance abuse or dependence in the previous 3 months. The total sample was comprised of 22 Caucasians and 18 African-Americans. The mean age, educational level, and duration of illness were 39.83 years (SD = 8.06), 11.50 years (SD = 2.01), and 17.13 years (9.25) respectively.

2.2. Materials

2.2.1. Brief Psychiatric Rating Scale (BPRS)

Subjects were administered the expanded version of the BPRS (Ventura et al., 1993) by a clinical psychology graduate student trained to a minimum intraclass correlation coefficient (ICC; Shrout and Fleiss, 1979) of 0.80 with a criterion rater. Based on a recent factor analysis of the BPRS (Mueser et al., 1997), four symptom clusters were computed: Affect, anergia, thought disorder, and disorganization.

2.2.2. Facial affect recognition tasks

Facial affect recognition was trained on the face emotion identification task (FEIT; Kerr and Neale, 1993). The FEIT is comprised of 19 black-and-white photographs of faces expressing six basic emotions (happy, sad, angry, afraid, surprised, ashamed). The items are presented on videotape for 15 s. After viewing the item, the subject identifies which of the six emotions best represents the affect expressed by the face. The average internal consistency of the FEIT across the four test administrations (described below) was 0.59.

Generalization of affect recognition training was assessed with the face emotion discrimination task (FEDT, Kerr and Neale, 1993). The FEDT requires the subject to determine whether two faces presented next to one another are expressing the same or different emotions. The average internal consistency of the FEDT across the three test administrations (described below) was 0.64. Performance on both tasks was indexed as the total number correct with a range of 0–19 and 0–30 for the FEIT and FEDT respectively.

2.3. Procedure

Subjects from the total sample were randomly assigned to one of four groups that differed in the intervention received during the second of four administrations of the FEIT. These four administrations of the FEIT were: baseline, intervention, immediate post-test, and 1 week follow-up. The first three administrations were conducted during a single session. Standard instructions on the FEIT were given at baseline, immediate post-test, and 1 week follow-up.

In the intervention phase, subjects were administered the FEIT under one of four conditions. In the repeated practice condition, subjects were administered in the FEIT with standard instructions (i.e. “You will be viewing faces of people displaying various emotions.” “Your task is to

[1] The original sample included a total of 43 subjects. However, it was determined that three subjects did not fully meet study criteria. These subjects were immediately excluded from the data analysis.

identify the emotion that is being displayed from one of the six emotions on this list."). The second group (i.e. 'reinforcement') was instructed that they would receive monetary reinforcement (i.e. $0.10) for every correct response. The reward was given immediately following a correct response and placed in a small cup next to the subject. The third group (i.e. 'facial feedback') was prompted to imitate the facial expression of the target face on the FEIT. After the subject imitated the face, she/he was instructed to identify the target's facial affect. Following the initial instructions, subjects were prompted to imitate all 19 target facial expressions unless they did so spontaneously. Subjects in the fourth group (i.e. 'combination') received the same instructions as those in the reinforcement and facial feedback groups. The same research assistant administered the FEIT and FEDT across all test phases.

Generalization of affect recognition training was assessed by administering the FEDT immediately after the FEIT during the baseline, post-test, and follow-up phases.[2]

3. Results

3.1. Data analytic plan

The following steps were taken in the data analyses. First, the four groups were compared on the demographic and clinical variables. Second, analyses of covariance (ANCOVAs) were conducted on FEIT and FEDT performance through the post-test phase with baseline performance as a covariate. A separate series of ANCOVAs was conducted on FEIT and FEDT performance at follow-up because five subjects were unable to complete the follow-up assessment (discussed below). Therefore, the follow-up analyses allowed us to determine whether the results at post-test were replicated 1 week later. For all of the above analyses, effect sizes (i.e. η^2) are reported for facilitating interpretation of the results. Finally, unless noted otherwise, significant effects were probed using conservative post-hoc tests (i.e. those that adjust the alpha level for multiple comparisons).

3.2. Demographic and clinical analyses

The demographic and clinical characteristics of the four groups are summarized in Table 1. Analyses of variance and χ^2 analyses revealed that the groups did not significantly differ on any of the demographic or clinical variables.

3.3. Training and generalization analyses through post-test

Separate one-way analyses of variance (ANOVAs) were conducted on the FEIT and FEDT scores to determine if the four groups differed in performance at baseline (see Table 2, for group descriptive statistics). These analyses revealed that the four groups did not significantly differ from one another in either FEIT $F(3, 36)=0.724$, *ns* or FEDT $F(3, 36)=0.98$, *ns* performance at baseline.

The effects of the intervention on FEIT performance were examined with a 2(monetary reinforcement: monetary reinforcement versus no monetary reinforcement) × 2(facial feedback: facial feedback versus no facial feedback) × 2(phase: intervention, post-test) mixed model ANCOVA, with baseline performance on the FEIT as the covariate, and repeated measures for phase. This analysis revealed main effects for phase, $F(1, 35)=5.74$, $P<0.05$ ($\eta^2=0.14$), facial feedback, $F(1, 35)=4.74$, $P<0.05$ ($\eta^2=0.12$), and monetary reinforcement, $F(1, 35)=5.9$, $P<0.05$ ($\eta^2=0.14$), which were qualified by two significant interactions: phase × facial feedback interaction, $F(1, 35)=15.4$, $P<0.01$ ($\eta^2=0.19$), and facial feedback × monetary reinforcement, $F(1, 35)=4.64$, $P<0.05$ ($\eta^2=0.11$). Follow-up analyses of the phase × facial feedback interaction showed that the groups receiving facial feedback instructions improved significantly from intervention ($M=12.3$) to post-test ($M=14.1$) (Table 2).

To explore the facial feedback × monetary reinforcement interaction (Fig. 1), a one-way

[2] The data from this study were part of a broader project on social cognition in schizophrenia. Therefore, the baseline FEIT and FEDT data for the entire sample (i.e. 40 subjects) are also reported in a second paper (i.e. Penn et al., in press).

Table 1
Demographic and clinical characteristics of the four groups

Measure	Repeated practice	Monetary reinforcement	Facial feedback	Combination
Age				
Mean	41.5	40.42	39.1	38.3
SD	(12.0)	(6.08)	(8.3)	(6.04)
Education (years)				
Mean	11.5	11.5	11.4	11.4
SD	(2.1)	(2.4)	(1.6)	(2.0)
Ethnicity (*n*)				
Caucasian	5	6	8	3
African-American	5	6	1	6
Gender (*n*)				
Male	5	7	6	5
Female	5	5	3	4
DSM diagnosis (*n*)				
Schizophrenia	8	9	6	6
Schizoaffective	2	3	3	3
CPZ equivalents (mg/day)				
Mean	980.0	875.0	638.8	780.0
SD	(656.2)	(541.7)	(429.9)	(858.6)
Anticholinergic status (*n*)				
Not receiving	5	4	1	5
Receiving	5	8	8	4
GAF				
Mean	31.7	29.9	26.3	36.9
SD	(9.1)	(14.4)	(6.9)	(10.3)
BPRS factors				
Affect				
Mean	7.0	7.5	8.6	7.4
SD	(2.2)	(3.3)	(4.3)	(3.0)
Anergia				
Mean	8.9	9.8	6.5	6.2
SD	(4.7)	(5.7)	(4.0)	(4.1)
Disorganization				
Mean	4.6	4.4	5.0	4.3
SD	(1.5)	(1.5)	(1.8)	(1.4)
Thought disorder				
Mean	10.6	8.9	9.5	11.1
SD	(4.6)	(4.2)	(2.4)	(5.3)

ANCOVA was conducted on the FEIT scores for the four groups across test phase, with baseline FEIT performance as a covariate. The results revealed a significant group effect, $F(3, 35)=5.1$, $P<0.01$ ($\eta^2=0.30$). The post-hoc test showed that the monetary reinforcement, facial feedback, and combination conditions all resulted in higher FEIT performance than the repeated practice condition (all $P<0.05$).

To evaluate the generalization of affect perception training, a 2(facial feedback: facial feedback versus no facial feedback) $\times$ 2(monetary reinforcement: monetary reinforcement $\times$ no monetary reinforcement) ANCOVA was conducted on the FEDT scores at post-test, with baseline FEDT performance as the covariate. This analysis resulted in a significant facial feedback $\times$ monetary reinforcement interaction, $F(1, 35)=7.04$, $P<0.05$, ($\eta^2=0.16$), which is depicted in Fig. 2. To examine this interaction further, a one-way ANCOVA was conducted on the FEDT scores at post-test for the four groups. This analysis only

Table 2
Descriptive statistics for the FEIT and FEDT as a function of group and test-phase (uncorrected means)

	Test phase							
	Baseline		Intervention		Post-test		Follow-up	
Group	Mean	SD	Mean	SD	Mean	SD	Mean	SD
FEIT								
Repeated practice	9.9	3.9	10.2	4.0	10.0	3.3	10.1	3.0
Monetary reinforcement	11.4	2.2	13.7	1.8	14.0	2.0	15.0	1.1
Facial feedback	11.0	1.6	12.5	2.9	14.3	2.8	13.6	3.0
Reinforcement + facial feedback	10.3	1.8	12.1	3.3	14.0	2.0	12.8	2.4
FEDT								
Repeated practice	22.5	3.7	–	–	22.9	3.6	24.5	3.4
Monetary reinforcement	22.6	4.0	–	–	25.0	3.6	26.3	2.0
Facial feedback	25.0	2.5	–	–	26.2	2.2	27.3	1.0
Reinforcement + facial feedback	23.4	3.5	–	–	23.2	3.2	22.2	3.3

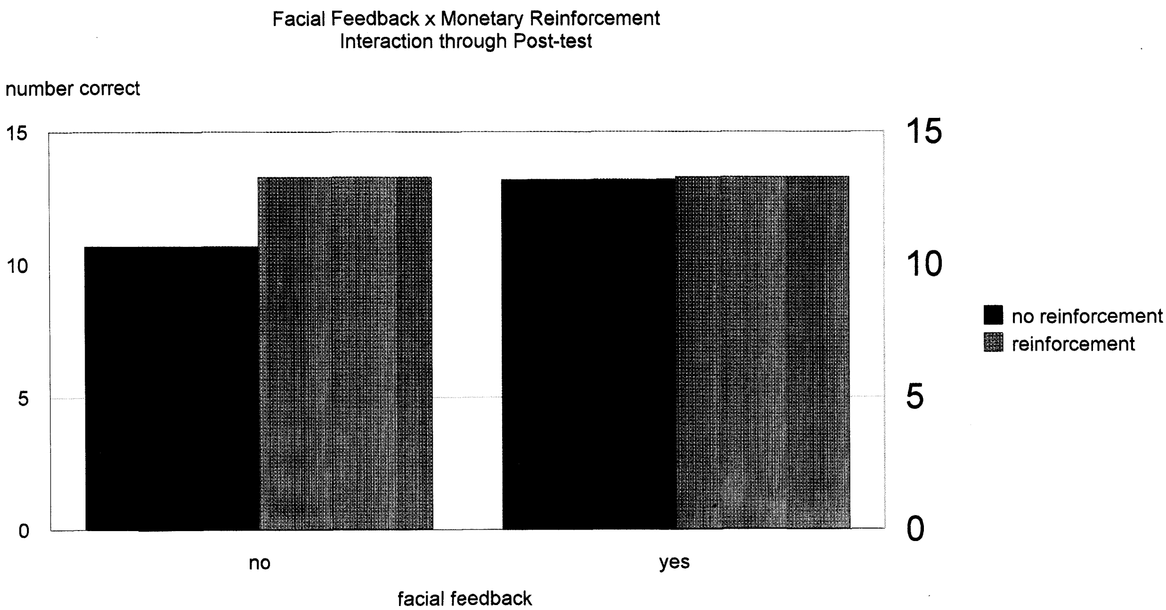

Fig. 1. Monetary reinforcement × facial feedback interaction effects for FEIT performance through post-test.

approached statistical significance, $F(3, 35)=2.52$, $P<0.08$ ($\eta^2=0.17$), with none of groups significantly differing from one another when a conservative post-hoc test was applied. However, a more liberal post-hoc test (i.e. the LSD) revealed that the group receiving monetary reinforcement had significantly higher FEDT scores than either the repeated practice ($P=0.05$) or combination groups ($P<0.05$). However, this finding needs to be interpreted very cautiously.

3.4. Follow-up analyses

Follow-up data were available for 35 of the 40 subjects. These five subjects did not have follow-up data for the following reasons: refused to participate

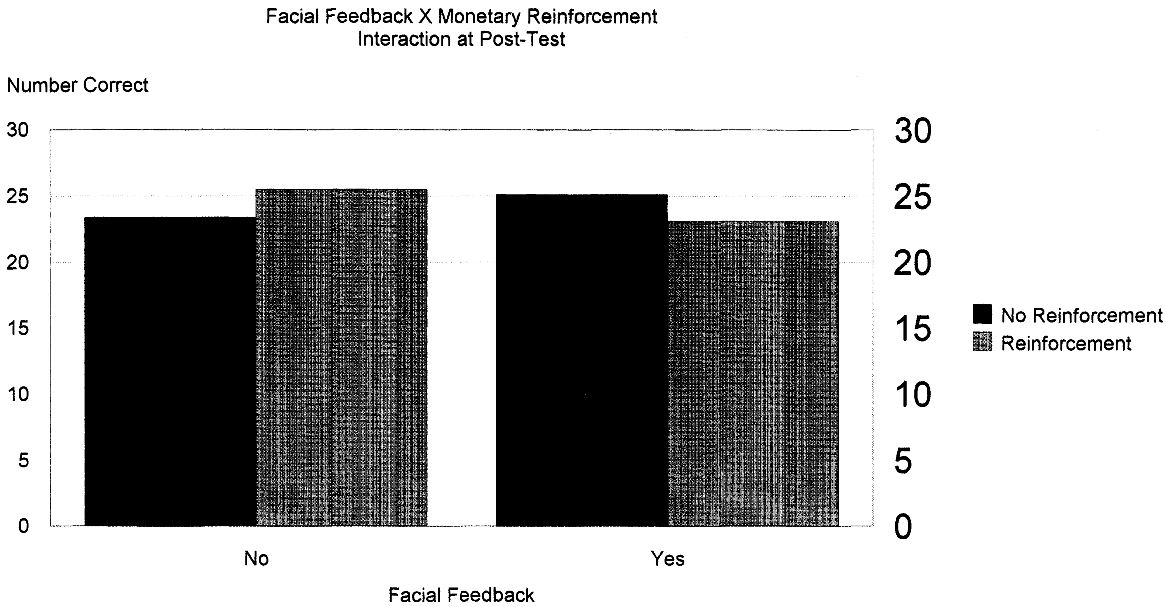

Fig. 2. Monetary reinforcement × facial feedback interaction effects for FEDT performance at post-test.

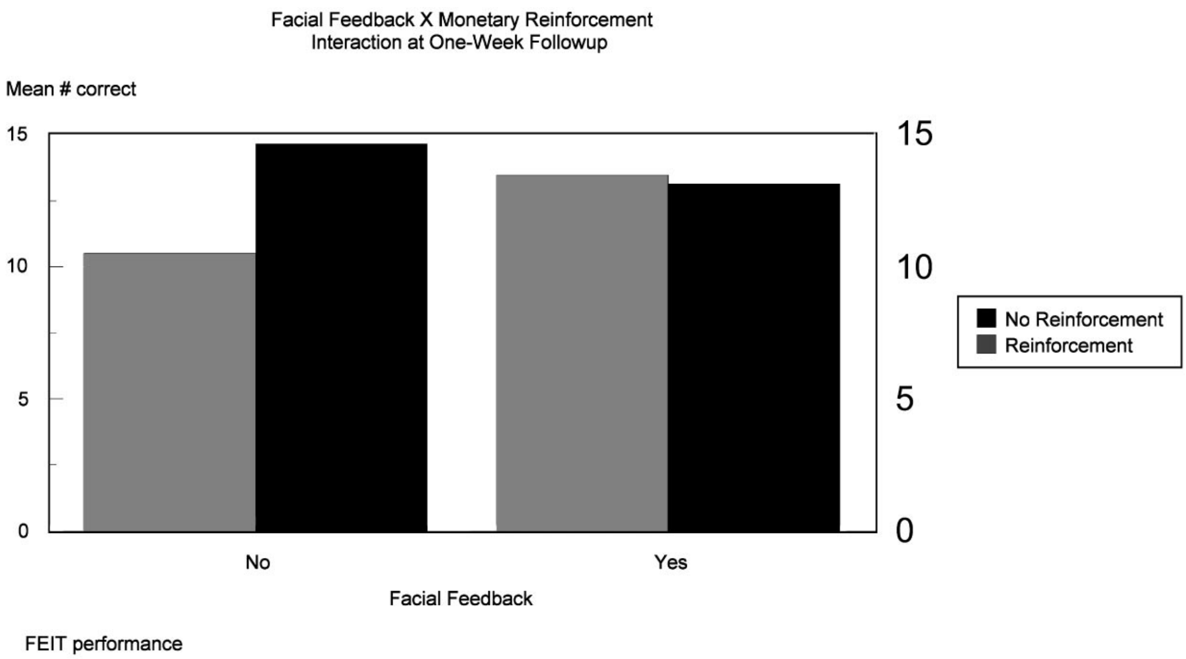

Fig. 3. Monetary reinforcement × facial feedback interaction effects for FEIT performance at 1 week follow-up.

($n=1$) and discharged ($n=4$). The subjects who completed the study did not differ from the five study dropouts on any of the clinical or demographic variables with the exception of the GAF; subjects who dropped out of the study had higher GAF scores than those who completed the follow-up assessment.

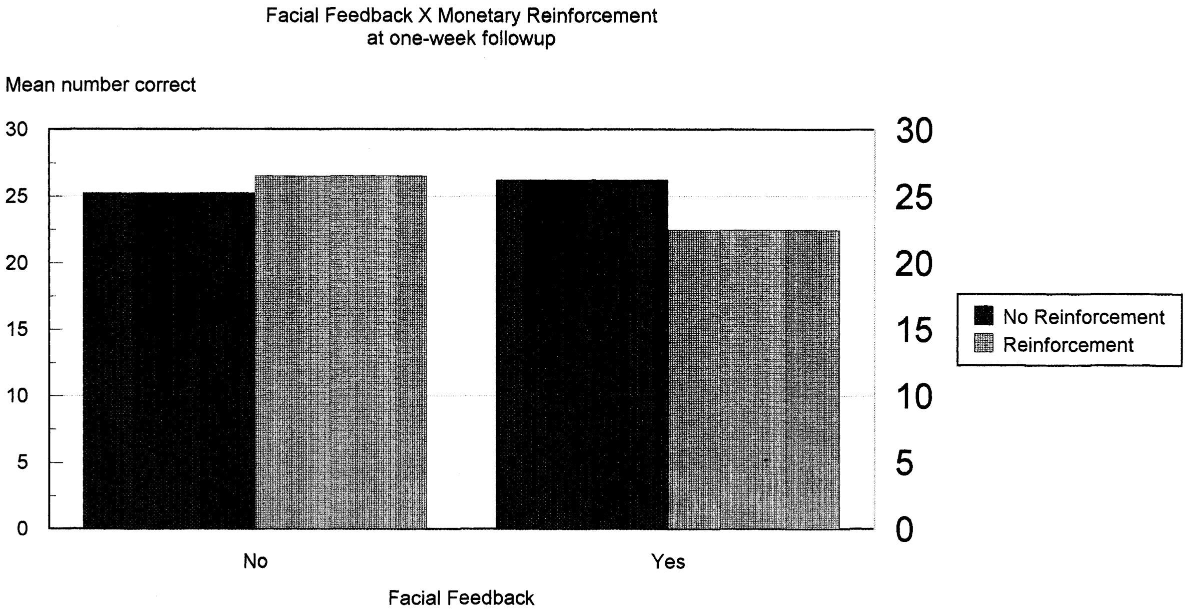

Fig. 4. Monetary reinforcement × facial feedback interaction effects for FEDT performance at 1 week follow-up.

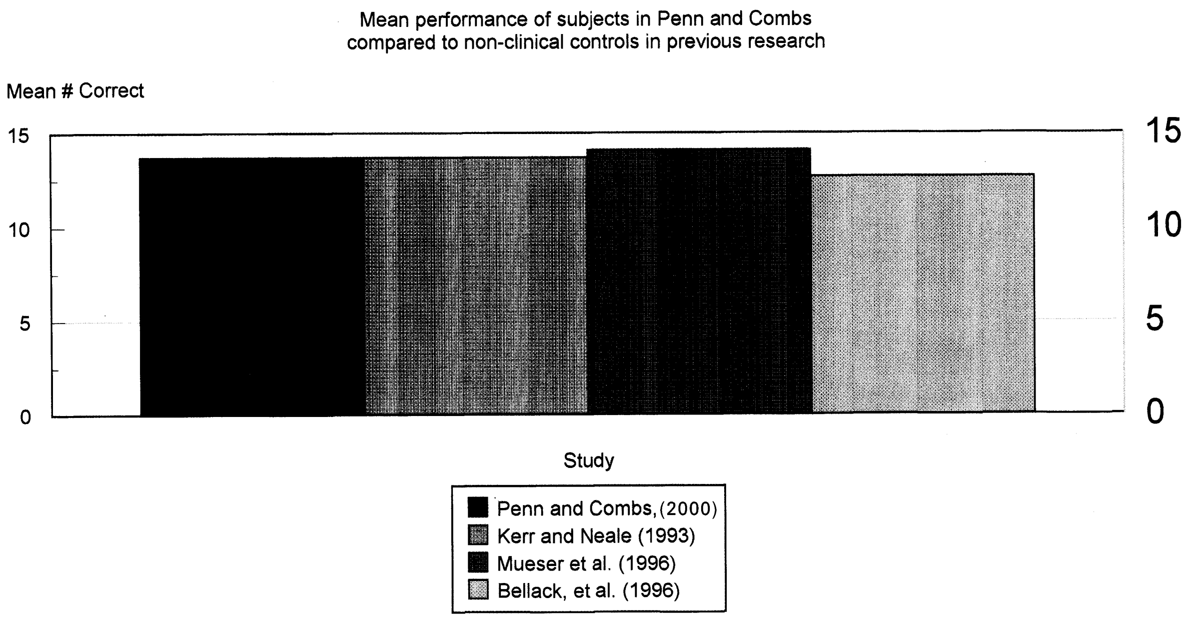

Fig. 5. Performance of the study subjects on the FEIT at 1 week follow-up relative to non-clinical control subjects in previous research.

A 2(facial feedback: facial feedback versus no facial feedback) × 2(monetary reinforcement: monetary reinforcement versus no monetary reinforcement) ANCOVA was conducted on the FEIT scores at follow-up, with baseline FEIT performance as a covariate. From this analysis, a significant main effect for monetary reinforcement emerged, $F(1, 30)=6.2$, $P<0.05$ ($\eta^2=0.36$), which was qualified by a significant facial feedback × monetary reinforcement interaction, $F(1, 30)=7.9$, $P<0.01$ ($\eta^2=0.21$) (Fig. 3). This interaction was further examined with a one-way ANCOVA conducted on the FEIT follow-up scores for the four groups. The group effect was significant, $F(3, 30)=5.4$, $P<0.01$ ($\eta^2=0.35$), with post-hoc tests revealing that the group which received monetary reinforcement had higher FEIT scores than those receiving repeated practice ($P<0.01$). There was also a non-significant trend of an advantage for the group receiving facial feedback instructions over those in the repeated practice condition ($P<0.08$).

Generalization of affect perception training to FEDT performance at 1 week follow-up was examined with a 2(facial feedback: facial feedback versus no facial feedback) × 2(monetary reinforcement: monetary reinforcement versus no monetary reinforcement) ANCOVA. Significant main effects of facial feedback, $F(1, 30)=5.9$, $P<0.05$ ($\eta^2=0.16$) and monetary reinforcement, $F(1, 30)=4.2$, $P=0.05$ ($\eta^2=0.12$), were again qualified by a significant facial feedback × monetary reinforcement interaction, $F(1, 30)=16.1$, $P<0.01$ ($\eta^2=0.34$) (Fig. 4). This interaction was examined with a one-way ANCOVA conducted on the FEDT follow-up scores for the four groups, which was significant, $F(3, 30)=8.3$, $P<0.01$ ($\eta^2=0.45$). Post-hoc tests showed that the group receiving both the facial feedback instructions and monetary reinforcement (i.e. the 'combination' group) performed significantly worse on the FEDT relative to the three other groups (all $P<0.05$).

3.5. Clinical significance

To examine the potential clinical significance of the interventions, the mean performance of the monetary reinforcement, facial feedback, and combination groups on the FEIT at follow-up was compared with the performance of non-clinical control subjects from previous studies (i.e. Kerr and Neale, 1993; Bellack et al., 1996a,b; Mueser et al., 1996; Salem et al., 1996) (Fig. 5; NOTE: the FEIT scores from Penn and Combs are corrected for baseline performance). As summarized in Fig. 5, the performance of the subjects receiving one of the active interventions in this study was comparable to control subjects without a psychiatric disorder.

4. Discussion

The present study examined whether performance on a facial affect identification task, the FEIT, could be improved in inpatients with schizophrenia. Furthermore, we investigated whether training effects maintained over time (i.e. a 1 week follow-up) and generalized to a test of facial affect discrimination (i.e. the FEDT). The findings showed that groups receiving monetary reinforcement, facial feedback instructions, or a combination of both, significantly improved their performance on a facial affect identification task relative to a repeat administration group. These results appeared to be fairly stable over time, especially for the group receiving monetary reinforcement. However, the generalization findings were less impressive. There was limited evidence that the intervention effects generalized to a task of facial affect discrimination. These findings are discussed in order below.

The findings supported our primary hypothesis that the two interventions (i.e. monetary reinforcement and facial feedback) would significantly improve performance on a facial affect identification task relative to a no-intervention control condition. As noted elsewhere (Kern et al., 1995; Bellack et al., 1999), contingent reinforcement effects may improve subjects' motivation to succeed on a given task. The fact that reinforcement effects were robust over time suggests that, if motivation was enhanced, it may have had an indirect effect on other cognitive processes, such as attention, concentration, memory, etc.[3] In addi-

[3] Post-hoc analyses suggest that performance gains were a function of some type of learning rather than an immediate response to the experimental manipulation. A pair of 2(facial feedback) × 2(monetary reinforcement) ANCOVAs, with FEIT baseline performance as a covariate, were performed on the FEIT scores during the intervention and post-test phases, separately. The results showed that the facial feedback × monetary feedback interaction approached statistical significance at the intervention stage $F(1, 35)=2.28$, $P=0.14$, with the means in the expected direction (i.e. the repeated practice group having the fewest number correct). However, the interaction was significant at the post-test stage, $F(1, 35)=5.40$, $P<0.05$, with the repeated practice group performing significantly worse than the other three groups. Therefore, the performance gains observed during the intervention stage were strengthened by post-test.

tion, performance gains may have resulted from the corrective feedback given to the subject during this intervention. Therefore, an increase in motivation or in knowledge about the task (due to the corrective feedback component), or a combination of both, may have accounted for the intervention effects. Unfortunately, the current design does not allow a further investigation of these underlying processes, such as attention or memory, as they were not assessed in this study. Until such work is conducted, we can merely conclude that the performance of persons with schizophrenia on an affect identification task can be improved with contingent monetary reinforcement.

The findings also indicate that promoting facial feedback results in improvement in facial affect identification. Interestingly, the mechanisms underlying facial feedback, even in non-clinical subjects, is a matter of debate [reviewed in Adelman and Zajonc (1989), McIntosh (1996) and Zajonc et al. (1989)]. Thus, it is possible that subjects receiving facial feedback instructions were able to use proprioceptive cues to help them identify the affect depicted in the target faces. Given the profound cognitive deficits often observed in schizophrenia, an intervention that circumvents cognition has some appeal. In fact, asking persons with schizophrenia to imitate subtly the expressions of others may facilitate social interactions, especially for persons with flat or inhibited affect, whose limited expressiveness can have a negative impact on others (Keltner and Kring, 1998). This facilitation of interaction may occur because the person with schizophrenia will then be able to *reciprocate* the other's facial affect. Therefore, teaching persons to match the facial affect of others could be a technique incorporated in current social skills training programs.

It should be noted that other mechanisms underlying facial feedback have been raised, such as a cooling of the brain's blood via the cavernous sinus (associated with nasal breathing), conditioning, and self-perception [reviewed in McIntosh (1996)], which may have accounted for the observed facial feedback effects in this study. Furthermore, although subjects were prompted to imitate the facial expression depicted on the slides, they still got some incorrect. This suggests that facial feedback may not always result in accurate affect perception. Therefore, other factors in the affect perception process are likely impaired (e.g. difficulties in *labeling* internal states; poor visual–spatial skills) and/or the imitated expression did not activate a specific emotion. The latter point is supported from work in the neuropsychological literature showing that reduced facial expressiveness (e.g. facial paralysis) and/or excessive affective displays (e.g. as demonstrated in pseudobulbar palsy) do not always correspond to reduced or increased emotional experience (Heilman et al., 1993). Therefore, facial feedback may be best viewed as a contributor to the affect experience and perception process, rather than as a necessary or sufficient condition. Finally, in the absence of a *general* facial activation condition, it is possible that asking persons with schizophrenia to do anything with their faces while performing an emotion identification task will improve their performance. Thus, these questions underscore the need to investigate facial feedback further in schizophrenia.

The training effects may have some clinical significance. At 1 week follow-up, the subjects who received an active intervention performed at a level comparable to non-clinical control subjects in previous research. This finding is clearly promising. However, two additional points regarding the clinical significance of the affect perception training need to be made. First, it is unclear how the training would have affected the performance of non-clinical control subjects on the emotion identification task. Thus, the clinical significance of our results represents the relative performance of subjects with schizophrenia, who have received an intervention, relative to *intervention-naive* control subjects. Therefore, the performance of non-clinical controls following training may have been significantly higher than for non-clinical controls receiving standard instructions. Second, one could argue that a truly comprehensive measure of clinical significance is one that, in addition to raising performance to normative levels, impacts functional outcomes, such as social behavior, vocational performance, or prognosis [discussed in Bellack et al. (1999), Green (1996) and Spaulding et al. (1999)]. Therefore, it remains to be seen whether improving the ability of persons with schizophrenia to identify the affect in others is associated with concomitant improvements in social skill or quality of life.

Three major findings emerged from the generalization analyses. First, generalization effects were fairly weak. This is consistent with the findings of limited generalization found in studies in cognitive remediation research (Benedict et al., 1994; Bellack et al., 1996a,b). It is also possible that the task used to assess generalization, an emotion discrimination task, is inappropriate, as it measures different processes than an emotion-labeling task. Therefore, a better test of generalization may have been another emotion identification task or a neurocognitive task assessing similar processes (e.g. a non-social perception labeling task). Alternatively, one could argue that a trend for generalization of training was observed for the monetary reinforcement group at post-test. Therefore, owing to possible Type II error, this significant generalization effect was obscured.[4]

Second, performance on an emotion discrimination test seemed to improve over time in the absence of an active intervention. This suggests that utilizing repeated practice might strengthen emotion discrimination in schizophrenia. Third, subjects who received both monetary reinforcement and facial feedback instructions on an emotion identification task declined in performance on the emotion discrimination task at 1 week follow-up. It is possible that having subjects both imitate the facial expressions of target faces and focus on receiving contingent reinforcement prevented them from fully attending to the emotion discrimination test. Therefore, single interventions seemed to work better than the combination approach, at least for generalization to an emotion discrimination task.

In closing, the present study has shown that the emotion identification skills of persons with schizophrenia can be improved with either contingent monetary reinforcement or promoting facial feedback. This is the first study, to our knowledge, that has shown that affect perception in schizophrenia may be amenable to modification approaches typically used for cognitive impairments. Future work should examine whether these effects are associated with improvements in functional outcomes and if the durability of the improvement extends beyond a 1 week period, especially if the interventions are applied over a longer time period than those used in the study. It would also be useful to examine whether these interventions impact the perception of some emotions more than others. This was not investigated in the present study as the psychometric properties of the FEIT are based on the task as a whole, rather than on separate affect scales. However, in a post-hoc test, performance on 'positive' (i.e. happy items) and 'negative' emotion scales (i.e. sad, angry, and fear items) were computed for the FEIT (Kring et al., 1999). The results for the negative emotion scale largely paralleled those observed in the primary analyses. However, the interventions had little effect on performance on the positive emotion scale, which was at ceiling. These post-hoc analyses suggest that the interventions may have had a stronger effect on perception of negative rather than positive emotions, which makes sense, given that the FEIT is comprised of mainly negative affective displays.

Finally, it is likely that brief intervention approaches, such as monetary reinforcement and facial feedback, will never be 'stand-alone' treatments for the cognitive and social-cognitive impairments associated with schizophrenia. Therefore, the challenge for future work will be to integrate these approaches into the designs of the more sophisticated training techniques currently used for the cognitive treatment of schizophrenia (e.g. Medalia et al. 1998; Spaulding et al., 1998; Wykes et al., 1999).

Acknowledgements

The authors gratefully acknowledge the staff and patients at Southeast Louisiana State Hospital, as well as the following individuals during various phases of the project: Ms Gumpert and Dr Hebert, Dr Arretege, Dr Schwartz, Dr Morris, and Dr Comaty.

[4] Indirect support for the presence of Type II error is based on the observed power of this analysis, 0.57, which is below the recommended power for research in the behavioral sciences (Cohen, 1992).

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