

## Outcome of Cognitive–Behavioral Therapy for Depression: Relation to Hemispheric Dominance for Verbal Processing

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Unmedicated depressed outpatients were tested on dichotic syllable and complex tone tests prior to receiving 16 weekly sessions of cognitive therapy ( $n = 31$ ) or 6–12 weeks of placebo treatment ( $n = 45$ ). Cognitive-therapy responders had twice the right-ear (left hemisphere) advantage for syllables when compared with nonresponders but did not differ from nonresponders on the nonverbal task. The larger right-ear advantage in cognitive-therapy responders was due to better right-ear accuracy; they did not differ from nonresponders in left-ear accuracy. No differences in perceptual asymmetry or accuracy were found between placebo responders and nonresponders. Right-ear accuracy for syllables was the best predictor of response to cognitive therapy in a logistic regression analysis. The findings suggest that greater left-hemisphere advantage for verbal processing is associated with more favorable outcome of cognitive therapy for depression.

Cognitive–behavioral therapy, psychosocial therapy, and pharmacotherapy provide a wide variety of effective treatments for depression. Although it has long been suspected that some depressed patients may respond better to one form of therapy than another, there are few clinical or biological predictors of treatment outcome (Joyce & Paykel, 1989; Rude & Rehm, 1991; Simons & Thase, 1992; Sotsky et al., 1991). There is evidence that better cognitive functioning is predictive of favorable response to cognitive–behavioral therapy, but this effect does not appear to be specific to cognitive therapy (Rude & Rehm, 1991; Sotsky et al., 1991). Several studies have found that cognitive–behavioral therapy is more effective in patients with lower (i.e., less dysfunctional) scores on the Dysfunctional Attitudes Scale (Keller, 1983; Jarrett, Eaves, Grannemann, & Rush, 1991; Simons, Murphy, Levine, & Wetzel, 1986). In the National Institute of Mental Health (NIMH) Treatment for Depression Collaborative Research Program (Sotsky et al., 1991), high cognitive-functioning patients responded better to either cognitive–behavioral therapy or imipramine treatment than to a placebo, whereas low cognitive-functioning patients did not. In a re-analysis of

these data (Klein & Ross, 1993), higher scores on the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) were associated with relative superiority of interpersonal therapy over cognitive therapy. It has also been suggested that patients who benefit most from short-term cognitive therapy are those with cognitive skills or abilities consistent with the demands of the treatment (Rude & Rehm, 1991; Sotsky et al., 1991). These studies have, however, primarily relied on self-report measures of dysfunctional attitudes. There has been little or no research on whether performance on neuropsychological tests might be predictive of therapeutic response to cognitive therapy.

Tucker, Shearer, and Murray (1977) suggested that outcome of cognitive–behavioral therapy may depend on an individual's cognitive style, that is, whether they tend to use more verbal processing mediated by the left hemisphere or more nonverbal processing mediated by the right hemisphere. Studies have found evidence of right frontal activation in negative affect and depression (Davidson, 1992; Davidson & Tomarken, 1989; Otto, Yeo, & Dougher, 1987; Tucker, Stenslie, Roth, & Shearer, 1981). Otto et al. pointed out that cognitive therapies for depression involve primarily verbal procedures and that they may help activate the language-dominant (left) hemisphere by providing the patient with the means to use verbal skills to re-interpret negative events. This view of cognitive therapy suggests the following hypotheses concerning the relation of hemispheric laterality and outcome of cognitive therapy. One hypothesis would be that depressed patients with a hemispheric imbalance favoring right- over left-hemisphere activation will benefit most from cognitive therapy because it helps reactivate the language-dominant (left) hemisphere. If, however, verbal skills and left-hemisphere dominance for language are of importance for the success of cognitive therapy, an alternative hypothesis would be that patients with greater left-hemisphere advantage for verbal processing will benefit most from cognitive therapy.

Therapeutic response to antidepressant medication has been

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found to be associated with performance on dichotic listening measures of hemispheric lateralization. In dichotic tests, different stimuli (syllables or tones) are simultaneously presented to the left and right ears, and the difference in accuracy of performance between ears provides a measure of perceptual asymmetry (PA). Favorable response to a tricyclic antidepressant was associated with failure to show a left-ear (right hemisphere) advantage for a nonverbal dichotic test (Bruder et al., 1990). In a recent multicenter study, depressed patients who responded to fluoxetine (Prozac) differed from nonresponders in showing both a larger right-ear (left hemisphere) advantage for dichotic words and less left-ear (right hemisphere) advantage for complex tones (Bruder et al., 1996). These findings supported the hypothesis that fluoxetine responders relatively favor left- over right-hemisphere activation during dichotic listening.

The question addressed in the present study was whether this difference in dichotic listening between treatment responders and nonresponders is specific to antidepressants or whether it also occurs for cognitive-behavioral therapy. The hypothesis that patients who benefit most from cognitive therapy have greater left-hemisphere advantage for verbal processing would lead to the prediction that cognitive-therapy responders will have a larger right-ear advantage on a verbal dichotic test when compared with nonresponders. An additional feature of this study was the inclusion of a control group of depressed patients who were treated with a placebo. This allowed a determination of whether differences in dichotic listening between cognitive-therapy responders and nonresponders are indicators of responsiveness to this specific treatment or of a more transient depressive disorder that responds to a placebo. It was hypothesized that differences in dichotic listening would be found between responders and nonresponders to cognitive therapy but not to treatment with placebo.

## Method

### Participants

The participants were right-handed outpatients between 18 and 60 years of age who were participants in treatment studies at two university-affiliated research clinics. They met criteria of the *Diagnostic and Statistical Manual of Mental Disorders*, 3rd edition revised (*DSM-III-R*; American Psychiatric Association, 1987) for major depressive disorder (MDD;  $n = 63$ ), dysthymic disorder (DD;  $n = 12$ ), or cyclothymic disorder (CD;  $n = 1$ ). Only patients without current or past history of a neurological problem or a hearing impairment (i.e., a hearing loss greater than 30 dB at 500, 1000, or 2000 Hz) participated in this study. Prior to treatment, ratings of severity of depression were made with the 21-item Hamilton Depression Scale (HAM-D; Hamilton, 1960). Following treatment, outcome was evaluated using the Clinical Global Impression (CGI) Scale (Guy, 1976) by a rater who was unaware of treatment condition and dichotic listening results. Treatment responders were defined as those rated to be much improved or very much improved, whereas patients with ratings of minimally improved, unchanged, or various degrees of worsening were defined as nonresponders. Ratings were conservative, such that a patient who was improved somewhat but remained significantly symptomatic would be rated as minimally improved and would be considered a nonresponder.

Table 1 gives the characteristics of the patients who were judged to be responders or nonresponders following treatment with cognitive therapy or placebo. These groups were not significantly different in gender, age, education, or in handedness laterality quotients on the Edinburgh Handedness Inventory (Oldfield, 1971). There was also no difference among groups in severity of depression as indexed by pretreatment HAM-D ratings. Although most patients in the responder and nonresponder groups met *DSM-III-R* criteria for MDD, all but 1 of the patients having a dysthymic or cyclothymic disorder were nonresponders to either cognitive therapy or placebo (see Table 1). When the dichotic listening data were analyzed for only patients having a MDD, differences between responder and nonresponder groups were the same as reported

Table 1  
Patient Characteristics

Variable	Cognitive therapy		Placebo	
	Responders	Nonresponders	Responders	Nonresponders
Gender				
No. of women	12	11	11	20
No. of men	3	5	1	13
Age				
<i>M</i>	38.9	37.8	37.7	38.5
<i>SD</i>	9.2	8.8	9.9	9.9
Education				
<i>M</i>	16.2	14.8	16.1	15.5
<i>SD</i>	3.1	2.7	3.1	2.1
Edinburgh Handedness Inventory				
<i>M</i>	81.8	76.5	89.1	85.7
<i>SD</i>	18.8	30.3	13.4	20.1
Hamilton Depression Scale				
<i>M</i>	15.0	15.1	14.0	14.8
<i>SD</i>	3.0	3.5	4.4	4.9
Diagnosis				
MDD	14	13	12	24
DD	1	3	0	8
CD	0	0	0	1

Note. MDD = major depressive disorder; DD = dysthymic disorder; CD = cyclothymic disorder.

below for the full samples. The results obtained when excluding the dysthymic and cyclothymic patients are presented in footnotes.

### Procedure

Although patients were not randomly assigned to treatment with cognitive therapy or placebo, diagnostic assessments, as well as assessments of treatment outcome, were carried out by the same group of research psychiatrists using similar schedules and rating standards. As indicated in Table 1, the patients treated with cognitive therapy or placebo had comparable participant characteristics.

Cognitive-therapy patients were initially evaluated using a modified version of the Structured Clinical Interview for *DSM-III-R* (SCID) (Spitzer, Williams, Gibbon, & First, 1992); then, study procedures were explained and informed consent was obtained. Those who remained depressed at the time of re-evaluation (1 to 2 weeks after the initial interview) began 16 weekly 50-min cognitive-therapy sessions which were performed as described by Beck, Rush, Shaw, and Emery (1979) and Stewart, Mercier, Agosti, Guardino, and Quitkin (1993). All therapists had undergone extensive training and were judged to perform adequate cognitive therapy according to a review of audiotaped sessions of two cases by the method of Young and associates using the Cognitive Therapy Scale for judging adequacy of cognitive therapy (Young & Beck, 1980). In addition, all therapists received weekly supervision from a certified training cognitive therapist.

Diagnostic assessment and treatment of patients who received placebo were carried out by research psychiatrists as part of ongoing pharmacotherapy studies at the same outpatient clinics. After a baseline semistructured interview, patients received a placebo (single blind) for a period of 7 to 10 days. At the end of this period, patients who did not show significant clinical improvement were randomized to treatment (double blind) with an active antidepressant (in most cases imipramine, phenelzine, or fluoxetine) or a placebo. After 6–12 weeks of treatment, patients were evaluated for treatment outcome using the CGI Scale.

Patients were tested on a verbal and nonverbal dichotic listening test after a drug-free period of at least 7 days, although most patients were unmedicated for a considerably longer period or were never treated with psychotropic medication. The drug-free period for patients treated with fluoxetine was at least 4 weeks.

The verbal and nonverbal dichotic tests are described in detail elsewhere (Bruder et al., 1989). The verbal test provides a measure of left dominance for the identification of consonant–vowel syllables, and the nonverbal test provides a measure of right-hemispheric dominance for complex pitch discrimination. The order of these tests was counterbalanced across patients. A brief description of each test is given below.

**Consonant–vowel test.** This test consisted of presenting a different stop-consonant–vowel syllable (e.g., *ba, da, ga, ka, pa, or ta*) simultaneously to each ear. The participant reported the two syllables using a multiple-choice answer sheet. Following practice trials, each patient was tested in two blocks of 30 trials. This test has consistently yielded a mean right-ear (left hemisphere) advantage for groups of normal right-handed adults and children (Berlin, Hughes, Lowe-Bell, & Berlin, 1973; Bruder et al., 1989; Speaks, Niccum, & Carney, 1982).

**Complex tone test.** This test required patients to compare the pitch of a binaural complex tone with the pitches of a dichotic pair of complex tones presented 1 s earlier. Patients pointed to a response card labeled *yes* when the probe tone was the same as either member of the previous dichotic pair, or to a card labeled *no* when it differed from both. After practice trials, participants were tested on four blocks of 28 trials in which half of the probe tones matched a member of the dichotic pair and half did not. The Complex Tone test has yielded a mean left-ear (right hemisphere) advantage in normal adults (Bruder et al., 1989; Sidtis, 1981).

### Data Analyses

The number of correct responses was computed for right (R) and left (L) ear items in the dichotic syllable and tone tests. These scores were used to compute a standard measure of PA, that is,  $PA = 100(R - L) / (R + L)$ . A series of analyses were used to test for a difference in PA between treatment responders and nonresponders, which was hypothesized to be present for patients treated with cognitive therapy but not for patients treated with a placebo. An overall  $2 \times 2 \times 2$  analysis of variance (ANOVA) of the PA scores, which included the factors of treatment (cognitive therapy vs. placebo), outcome (responder vs. nonresponder), and test (syllables vs. complex tones), was used to test for hypothesized differences in PA between responders and nonresponders and to evaluate their dependence on treatment and test. A separate  $2 \times 2$  ANOVA, with the factors of outcome and test, was also performed on the PA scores to evaluate effects within each treatment, and *t* tests evaluated differences between responders and nonresponders for each test.

The data were analyzed with not only PA scores but also absolute accuracy scores for each ear. This is important for examining whether treatment responders and nonresponders differ in overall accuracy levels and for providing information on the ear responsible for a difference in the relative asymmetry score. The hypothesis that cognitive-therapy responders differ from nonresponders in having greater left-hemisphere advantage for verbal processing would lead to the prediction of a group difference in accuracy for identifying syllables in the right ear. An overall  $2 \times 2 \times 2 \times 2$  ANOVA was performed on the absolute accuracy scores, with the factors being treatment, outcome, test, and ear. Additional analyses of the accuracy scores evaluated effects within each treatment for each test and ear.

The significance of PA and accuracy scores for predicting outcome of cognitive therapy was evaluated with logistic regression analyses (Fleiss, Williams, & Dubro, 1986). The PA score for each test and the right- and left-ear accuracy scores were examined as individual predictors and as combined predictors in a hierarchical logistic equation.

## Results

### Asymmetry Scores

Figure 1 shows the mean PA scores on the dichotic syllable and complex tone tests for responders and nonresponders to treatment with cognitive therapy or placebo and also gives normative values of PA (arrows labeled *N*) for 103 right-handed adults (56 women and 47 men with a mean age of 31.8). There was a striking difference in PA between cognitive-therapy responders and nonresponders on the syllables test but not on the complex tones test. In contrast, there was no significant difference in PA between placebo responders and nonresponders on either test. The dependence of PA differences between responders and nonresponders on treatment and test was reflected in a significant Outcome  $\times$  Treatment  $\times$  Test interaction in an overall ANOVA of these data,  $F(1, 72) = 5.81, p = .018$ . Further analyses indicated that this three-way interaction was due to the presence of a significant Outcome  $\times$  Test interaction for cognitive therapy,  $F(1, 29) = 5.67, p = .025$ , but not for placebo,  $F(1, 43) = 0.96, p = .332$ . Cognitive-therapy responders had a significantly larger right-ear (left hemisphere) advantage for syllables when compared with nonresponders,  $t(29) = 2.58, p = .015$ , but no significant group difference was found for the tones test,  $t(29) = -1.12, p = .270$ . Cognitive-therapy responders also had about twice as large a right-ear (left hemisphere) advantage for syllables when compared with normal adults,

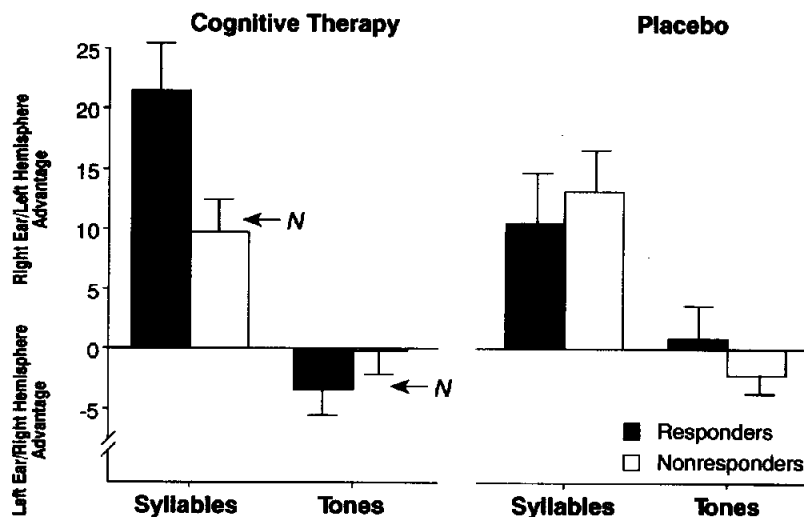


Figure 1. Mean perceptual asymmetry scores for syllables and tones in responders and nonresponders to cognitive therapy or placebo. The arrows (labeled *N*) give mean normative values for 103 right-handed adults.

$t(17.1) = 2.71, p = .015$ , but had the same left-ear (right hemisphere) advantage for tones.<sup>1</sup>

#### Accuracy Scores

Table 2 gives the mean percentage of correct responses for each group on the dichotic syllable and complex tone tests. The accuracy scores for syllables show that the larger right-ear advantage for cognitive-therapy responders than nonresponders was due to their better right-ear (left hemisphere) performance,  $t(29) = 3.35, p = .002$ . There was no significant difference between cognitive-therapy responders and nonresponders in accuracy for left-ear syllables,  $t(29) = 0.36, p = .718$ , for right-ear tones,  $t(29) = 0.10, p = .918$ , or left-ear tones,  $t(29) = 0.99, p = .329$ . The dependence of the difference in accuracy between cognitive-therapy responders and nonresponders on test and ear was reflected in an Outcome  $\times$  Test  $\times$  Ear interaction in an ANOVA of their accuracy data,  $F(1, 29) = 5.94, p = .021$ . In contrast, this interaction was not found in the accuracy data for placebo responders and nonresponders,  $F(1, 43) = 0.65, p = .425$ . This would account for the significant Treatment  $\times$  Outcome  $\times$  Test  $\times$  Ear interaction in an overall ANOVA of the accuracy data for the cognitive-therapy and placebo groups,  $F(1, 72) = 5.25, p = .025$ .<sup>2</sup>

#### Predictors of Treatment Outcome

The PA score for each test, as well as the accuracy scores for each ear, were examined as an individual predictor of response to cognitive therapy and as combined predictors in a hierarchical logistic regression equation. PA score for syllables was a significant predictor on its own,  $\chi^2(1, N = 31) = 6.59, p = .01$ , as was accuracy for identifying syllables in the right ear,  $\chi^2(1, N = 31) = 11.01, p = .001$ . Right-ear accuracy for syllables was the most powerful predictor of cognitive therapy outcome. It offered a significant improvement in predictability

when the PA score for syllables was entered first in a hierarchical multiple regression equation,  $\chi^2(1, N = 31) = 6.48, p = .01$ . In contrast, the PA score for syllables did not offer a significant increment in predictability when the right-ear accuracy for syllables was first entered in the regression equation,  $\chi^2(1, N = 31) = 2.05, p = .15$ .

To examine the goodness of fit between observed treatment outcomes and those predicted by the logistic equation, a probability of greater than .50 was used to predict treatment response and less than .50 to predict treatment nonresponse. Twelve of 15 cognitive-therapy responders were correctly predicted to be responders (i.e., a sensitivity of 80%), and 12 of 16 nonresponders were correctly predicted to be nonresponders (i.e., a speci-

<sup>1</sup> Analyses of PA scores were repeated after excluding patients who met criteria for dysthymia ( $n = 12$ ) or cyclothymia ( $n = 1$ ) but not MDD. The findings remained unchanged. An overall analysis of variance of PA scores revealed an Outcome  $\times$  Treatment  $\times$  Test interaction,  $F(1, 59) = 5.81, p = .018$ . This three-way interaction was due to the presence of an Outcome  $\times$  Test interaction for cognitive therapy,  $F(1, 25) = 5.03, p = .034$ , but not for placebo,  $F(1, 34) = 0.91, p = .346$ . Cognitive-therapy responders had significantly larger right-ear advantage for syllables when compared with nonresponders,  $t(25) = 2.37, p = .026$ , but no significant group difference was found for tones,  $t(25) = -1.13, p = .269$ . There was no difference in PA between placebo responders and nonresponders on either test.

<sup>2</sup> Analyses of accuracy data were repeated after excluding patients having a dysthymic or cyclothymic disorder, and the findings were unchanged. An overall ANOVA of the accuracy data revealed an Outcome  $\times$  Treatment  $\times$  Test  $\times$  Ear interaction,  $F(1, 59) = 4.72, p = .034$ . Further analyses indicated that this four-way interaction was due to the presence of an Outcome  $\times$  Test  $\times$  Ear interaction for cognitive therapy,  $F(1, 25) = 5.03, p = .034$ , but not for placebo treatment,  $F(1, 34) = 0.55, p = .465$ . Cognitive-therapy responders had significantly greater accuracy than nonresponders for right-ear syllables,  $t(25) = 2.87, p = .008$ , but not for left-ear syllables ( $t = -0.69, p = .505$ ), right-ear tones ( $t = -0.14, p = .886$ ), or left-ear tones ( $t = 0.78, p = .440$ ).

Table 2  
Mean Accuracy Scores for Treatment Responders and Nonresponders

Test	Cognitive therapy		Placebo	
	Responders	Nonresponders	Responders	Nonresponders
Syllables				
Right ear				
<i>M</i>	78.9	65.8 <sup>a</sup>	72.5	72.7
<i>SD</i>	9.7	11.9	14.1	14.0
Left ear				
<i>M</i>	52.2	53.8	58.4	56.4
<i>SD</i>	14.9	9.8	11.9	15.9
Complex tones				
Right ear				
<i>M</i>	79.9	79.4	86.8	82.5
<i>SD</i>	15.8	12.8	16.1	12.1
Left ear				
<i>M</i>	84.7	80.1	86.4	85.9
<i>SD</i>	12.1	13.7	18.6	10.5

<sup>a</sup> Cognitive-therapy responders differed significantly from cognitive-therapy nonresponders,  $t(29) = 3.35$ ,  $p = .002$ .

ficacy of 75%). Overall, 78% of the patients were correctly classified by the logistic regression equation using right-ear accuracy for syllables as the predictor variable.

Figure 2 shows the distribution of right-ear accuracy scores for cognitive-therapy responders and nonresponders on the syllables test. To illustrate the potential of these accuracy scores for predicting treatment outcome, the accuracy level for normal adults (labeled with an arrow in Figure 2) was used as a cutoff

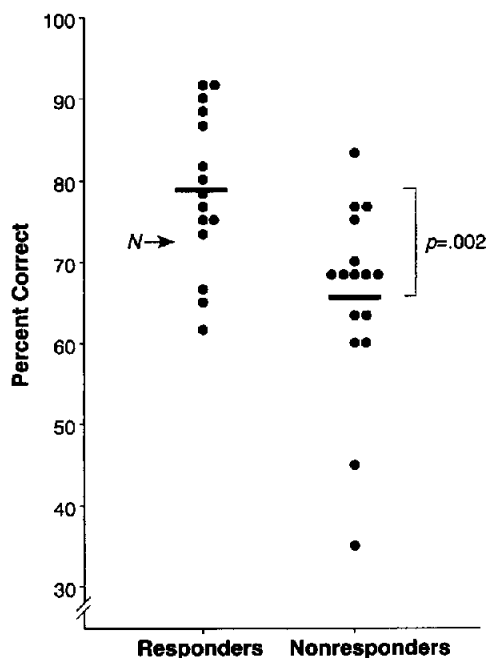


Figure 2. Right-ear accuracy scores for syllables for individual cognitive-therapy responders and nonresponders. The arrow gives the mean normative value for 103 right-handed adults.

score to divide the patients into subgroups with higher versus lower accuracy, and a comparison was made of their treatment response. This resulted in essentially the same predictions of treatment outcome as observed for the logistic regression analysis. Patients with greater right-ear accuracy than normal adults had a 75% (12 out of 16) response rate to cognitive therapy, whereas patients with less than normal accuracy had only a 20% (3 out of 15) response rate,  $\chi^2(1, N = 31) = 9.39$ ,  $p = .002$ . When same cutoff was used to divide patients treated with placebo into subgroups, those with accuracy greater than the mean of normal individuals had a 28% (7 out of 25) response rate to placebo and those with accuracy less than normal had a 25% (5 out of 20) response rate,  $\chi^2(1, N = 45) = 0.05$ ,  $p = .82$ . Thus, patients with higher right-ear accuracy (i.e., greater than normal mean) had a substantially better chance of benefiting from cognitive therapy than from placebo (75% vs. 28%), whereas patients with lower right-ear accuracy (i.e., less than normal mean) had a response rate to cognitive therapy that was no better than the response rate to placebo (20% vs. 25%),  $2 \times 2 \times 2$ ,  $\chi^2(1, N = 76) = 4.30$ ,  $p = .04$ .

## Discussion

Depressed patients who responded to cognitive therapy had more than twice the right-ear advantage for dichotic syllables when compared with either nonresponders or normal adults. The larger right-ear (left hemisphere) advantage of cognitive-therapy responders resembles that previously seen for responders to treatment with fluoxetine (Bruder et al., 1996). However, cognitive-therapy responders did not show the reduced left-ear (right hemisphere) advantage seen for responders to a tricyclic antidepressant (Bruder et al., 1990) or to fluoxetine (Bruder et al., 1996). What also distinguished cognitive-therapy responders was their better accuracy for right-ear syllables when compared with treatment nonresponders or normal adults. Given the largely contralateral projections between each ear and hemisphere, the greater right-ear advantage for syllables in cognitive-therapy responders would

appear to have been due to their superior left-hemisphere processing of consonant–vowel syllables. This supports the hypothesis that patients with greater left-hemisphere advantage for verbal processing benefit most from cognitive therapy.

The findings of this study are consistent with the view that cognitive therapy and other forms of psychotherapy involve learning techniques to relieve depression and that patients with higher cognitive skills that are consistent with the demands of the therapy will be most responsive (Rude & Rehm, 1991; Sotsky et al., 1991). In the present case, patients with greater left-hemisphere superiority for verbal processing may have been better able to use the language-dominant hemisphere in learning to reinterpret negative life events. This explanation might also predict that greater verbal cognitive skills would be associated with more favorable response to cognitive therapy. There is, however, little evidence that cognitive-therapy responders do in fact have superior verbal skills. There was no difference in overall accuracy of dichotic consonant–vowel perception between cognitive-therapy responders and nonresponders. Also, studies linking low cognitive dysfunction to better outcome have measured dysfunctional attitudes and have not measured cognitive skills (Rude & Rehm, 1991; Sotsky et al., 1991).

An alternative interpretation would be that the difference between cognitive-therapy responders and nonresponders lies not in their left-hemisphere superiority or verbal skills, but in their cognitive style. For instance, the larger right-ear advantage of responders might reflect a characteristic favoring of left- over right-hemisphere processing modes. The concept of characteristic perceptual asymmetry was introduced by Levy, Heller, Banich, and Burton (1983) to describe a tendency for relatively greater left- or right-hemisphere activation regardless of the task. The lack of a difference between responders and nonresponders on the nonverbal dichotic test does not, however, provide support for a generalized favoring of left- over right-hemisphere processing in cognitive-therapy responders.

Larger right-ear advantage for a verbal dichotic test is associated with positive treatment response not only for cognitive therapy but also for antidepressants (Bruder et al., 1990; Bruder et al., 1996). The basis for this relationship appears, however, be very different for cognitive therapy and tricyclic antidepressants. The larger right-ear advantage in cognitive-therapy responders was due to their better right-ear (left hemisphere) performance, whereas the asymmetry in tricyclic responders was due to poorer left-ear (right hemisphere) performance (Bruder et al., 1990). Thus, the same direction of hemispheric imbalance may have been due to right hemisphere dysfunction in tricyclic responders but to left-hemisphere superiority in cognitive-therapy responders. This argues for the existence of subgroups of depression with distinctive disorders that respond best to different treatments.

Although the mechanism responsible for the larger right-ear advantage for syllables in cognitive-therapy responders remains unknown, a recent study of electroencephalogram (EEG) alpha asymmetry gives some insight into the pattern of regional brain activation associated with this asymmetry. Davidson and Hugdahl (1996) measured EEG alpha power of normal adults during rest, and 4 months later they tested the same participants on a dichotic syllables test. Larger right-ear advantage was predicted by alpha asymmetries indicative of greater activation of left posterior-tem-

poral and parietal regions, as well as right prefrontal regions. Given the finding of larger right-ear advantage for syllables in cognitive-therapy responders, a similar pattern of EEG alpha asymmetry in depressed patients, with relatively greater left temporoparietal and right frontal activation, may predict favorable response to cognitive therapy. This pattern of EEG alpha asymmetry has in fact been observed in some studies of depressed participants (Davidson, 1992; Davidson & Tomarken, 1989).

The potential clinical use of PA and accuracy scores on dichotic listening tests for predicting outcome of cognitive therapy was evaluated using hierarchical logistic regression analyses. Accuracy for identifying right-ear syllables proved to be a stronger predictor than PA scores. One reason for this may stem from the multiple paths that could lead to abnormal PA. An abnormally large right-ear advantage could result from better right-ear accuracy, poorer left-ear accuracy, or some combination of both. Larger right-ear advantage for syllables is not specific to cognitive-therapy responders, but also occurs in responders to an antidepressant. Moreover, some patients who fail to respond to cognitive therapy may nonetheless respond to an antidepressant (Stewart et al., 1993). On the other hand, the greater right-ear accuracy for identifying syllables in cognitive-therapy responders was not seen in responders to a tricyclic antidepressant (Bruder et al., 1990) and may therefore be a better predictor of cognitive-therapy response. Right-ear accuracy for syllables was successful in differentiating subgroups of depressed patients with significantly different response rates to cognitive therapy. Patients with right-ear accuracy greater than normal adults had a 75% response rate, whereas those with less than normal right-ear accuracy had only a 20% response rate, that is, a response no better than one seen for placebo. This finding should encourage further efforts to develop predictors that could ultimately aid the clinician in identifying depressed patients who will benefit most from cognitive therapy.

An important feature of this study was the inclusion of a sample of depressed patients treated with a placebo. There was no difference between placebo responders and nonresponders in ear advantages for either dichotic syllables or complex tones. Most important, placebo responders did not show any evidence of the larger right-ear (left hemisphere) advantage for syllables seen for cognitive-therapy responders. They had essentially the same right-ear (left hemisphere) advantage and accuracy level for syllables as normal adults. One limitation of this study is that patients were not randomly assigned to treatment with either cognitive therapy or placebo. The patients who received cognitive therapy were, however, comparable with those who received placebo in terms of their diagnosis, depression severity, and demographic characteristics, and assessments of their treatment outcome were performed in the same manner. A second limitation was the shorter placebo period than cognitive-therapy trial. There is evidence that “true placebo effects,” stemming from nonspecific effects of the caregiver or treatment setting, are characterized by abrupt improvement that tends to occur early during the treatment trial (Quitkin et al., 1991). This suggests that the 6–12-week placebo period should have provided an adequate control for true placebo effects. On the other hand, “spontaneous recovery” is likely to be more gradual and would have been less well controlled in this study. Caution must therefore be exercised in comparing the laterality findings for patients

treated with cognitive therapy or placebo. Nonetheless, it would appear that greater left-hemisphere advantage for verbal processing is predictive of responsiveness to cognitive therapy and not to placebo.

Further study of the relation of brain laterality to outcome of cognitive therapy would be worthwhile. Some very basic questions remain to be answered. For instance, do cognitive-therapy responders differ from nonresponders in their verbal cognitive abilities or cognitive styles? Do left-handers differ from right-handers in their responsiveness to cognitive therapy? Do measures of hemispheric laterality for verbal processing shift following cognitive therapy? It would be advantageous in future studies to also use more direct measures of regional brain activation (e.g., EEG alpha asymmetry or positron emission tomography measures) before and after cognitive therapy.

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