Monaural and binaural story recall by schizophrenic subjects.

By: Thomas R. Kwapil, Loren J. Chapman and Jean P. Chapman

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Abstract:

P. Green and other investigators have reported that schizophrenic Ss have poorer recall of stories presented to both ears than to the single best ear (binaural deficit) and poorer recall of stories presented to the left ear than to the right ear (monaural asymmetry) than do normal control Ss. These studies are plagued by potential methodological problems, including differences in overall accuracy, which artifactually affect the difference scores, and scoring methods that are vulnerable to systematic bias. In this study, scores of schizophrenic, bipolar, and normal control Ss on the Auditory Comprehension Test were compared. Scoring bias was avoided by the use of blind scoring and a revised scoring manual, and artifactual effects of accuracy were considered in interpreting the results. Contrary to previous findings, the groups did not differ on either monaural asymmetry or binaural deficit.

Keywords: auditory perception | auditory stimulation | memory | schizophrenia | bipolar disorder | monaural asymmetry | psychology

Article:

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Correspondence concerning this article should be addressed to: Thomas R. Kwapil, Department of Psychology, University of North Carolina-Greensboro, 296 Eberhart Building, Greensboro, North Carolina 27412-5001

Schizophrenic subjects have been reported to demonstrate poor performance on a variety of tasks designed to test interhemispheric transfer, including visual tasks (e.g., Beaumont & Dimond, 1973) and tactile tasks (e.g., Carr, 1980; P. Green, 1978). P. Green and his colleagues (P. Green, Glass, & O'Callaghan, 1979; P. Green & Kotenko, 1980) suggested that schizophrenic subjects (as well as other psychopathological groups) exhibit deficiencies on auditory tasks thought to involve interhemispheric transfer. We compared the performance of schizophrenic subjects, subjects with bipolar affective disorder, and normal control subjects on one such task on which P. Green and his collaborators have relied heavily. The focus of the study is to determine whether such a task measures a schizophrenic defect. Our purpose in undertaking the study was to determine whether the task might prove promising as a marker of the predisposition to schizophrenia.

While studying speech lateralization in schizophrenics, P. Green and Kotenko (1980) presented subjects with short stories from Neale's (1966) Test of Reading Comprehension through headphones under three conditions: to the left ear, to the right ear, and to both ears (binaurally). The subjects were then asked questions about the content of the stories. The investigators found, as they expected, that schizophrenic subjects had poorer comprehension of stories presented to the left ear than of stories presented to the right ear, a phenomenon that they termed monaural asymmetry. They attributed the finding to defective interhemispheric transfer, on the assumption that language is localized in the left hemisphere. To P. Green and Kotenko's surprise, schizophrenic subjects, but not control subjects, also demonstrated better story comprehension in the better single ear than in the binaural condition. They termed this phenomenon binaural deficit or monaural advantage. They likewise attributed binaural deficit to defective interhemispheric transfer, speculating that transcallosal input to the left hemisphere might interfere with the more direct input from the right ear. They found that control subjects did not demonstrate either binaural deficit or monaural asymmetry.

Hallett and Green (1983) and Hallett, Quinn, and Hewitt (1986) presented the children of schizophrenic and of matched control parents with stories from P. Green and Kotenko's (1980) study, as well as items based on the logical memory subtest of the Wechsler Memory Scale (Wechsler, 1945). They reported that the offspring of the schizophrenic parents, but not those of the control subjects, demonstrated the binaural deficit. The groups did not differ on monaural asymmetry.

P. Green and Kramar (1983) developed the Auditory Comprehension Test (ACT) specifically for assessing binaural deficit and monaural asymmetry more effectively. The test consists of a series of short stories resembling brief news items, presented through earphones. Subjects are instructed simply to repeat as much as they can about each story. P. Green and his colleagues (P. Green, 1987; P. Green & Kramar, 1983; Hunter & Green, 1985) reported monaural asymmetry and binaural deficit in a variety of clinical groups, including schizophrenic subjects, subjects with affective disorders, subjects with brain injuries (including anterior temporal lobectomies, cerebrovascular accidents, and closed-head injuries), and children with learning disabilities. Other investigators (E. Green, 1985; Levick & Peselow, 1986) also reported monaural asymmetry and binaural deficit in schizophrenic subjects through the use of P. Green and Kotenko's (1980) task. However, E. Green (1986) failed to find group differences on either monaural asymmetry or binaural deficit on a similar task involving perception of musical chords. She suggested that the schizophrenic deficit may be specific to the processing of verbal information.

P. Green and his co-workers (P. Green, 1987; P. Green, Hallett, & Hunter, 1983) extended these findings to suggest that binaural interference may be responsible for the production of psychotic symptoms such as auditory hallucinations and formal thought disorder in schizophrenics. P. Green (1987) contended that blocking the deficient ear (typically the left) with an earplug is an effective treatment for increasing speech comprehension and decreasing gross psychotic symptoms.

Conflicting evidence has also been reported by investigators using P. Green's methods. Broks, Claridge, Matheson, and Hargreaves (1984) divided a group of control subjects into high and low scorers on Claridge's scale of schizotypy, calling the high-scoring half of their group schizotypal. They compared the two groups on P. Green and Kotenko's (1980) task. Broks et al. (1984) reported that P. Green's original tape had considerable static and suggested that this may have contributed to the deficient binaural performance, because twice as much static is present on binaural presentation as on monaural. The investigators found binaural deficit in their schizotypal subjects when using P. Green's original tape but not when using new recordings containing less static. However, it is difficult to interpret these findings because Broks et al.'s labeling one half of a normal group as schizotypal is unconventional, and the extent to which their schizotypal subjects were schizotypal according to conventional criteria is not clear.

Galin and Nachman (1990) failed to replicate P. Green's findings of both binaural deficit and monaural asymmetry in patients with anterior temporal lobectomies, finding that none of 11 subjects showed either deficit. This is in sharp contrast to P. Green's (1987) finding of both binaural deficit and monaural asymmetry in all three of the patients who underwent temporal lobectomy whom he studied.

Whereas investigators of studies reviewed in this article relied on monaural and binaural tasks, other investigators examined schizophrenic auditory asymmetries by using dichotic listening tasks, in which the subject is required to attend to competing messages in the two ears. The results of these studies have been contradictory and difficult to interpret. Bruder (1983) and Chapman and Chapman (1988) suggested factors that appear to contribute to the conflicting results.

Possible Biases and Artifacts in Prior Use of the Auditory Comprehension Test

We believe that the surprising findings of binaural deficit in schizophrenic subjects and other clinical groups may be attributable to systematic biases and artifacts. Biases may arise both from P. Green and Kramar's (1983) procedures of scoring the ACT and from statistical artifact in their mode of data analysis. Both of these sources of bias and artifact could affect the score of monaural asymmetry as well.

Scoring Problems With the Auditory Comprehension Test

P. Green and Kramar's (1983) ACT manual provides rules for scoring subjects' responses, but these rules often fail to address ambiguous situations. Moreover, the manual recommends that the examiner score the subject's performance during the administration of the task. Although doing so saves time, it provides the scorer with only a single opportunity to hear the response and score it. Because the examiners are unlikely to be unaware of the hypothesis being tested and of the subjects' group membership, systematic bias in scoring is possible. To avoid these potential biases in our study, we tape-recorded our subjects' responses and scored typed transcriptions, unidentifiable as to group membership and used a detailed scoring manual developed in our laboratory.

Artifactual Effects of Overall Accuracy

Binaural deficit is measured as a difference score: the accuracy score for the higher scoring single ear minus the accuracy score for binaural presentation (H − B). Likewise, monaural asymmetry is measured by the difference between accuracy on the two ears (R − L). These difference scores are artifactually related to overall accuracy, as measured by the sum of the component scores. This artifact and the problems that it presents for measuring individual and group differences were discussed in detail by Chapman and Chapman (1988, 1989). In essence, for any two dichotomously scored free-response tasks (A and B) on which guessing makes a minimal contribution to accuracy, there is a curvilinear relation between the size of the (A − B) difference score and the (A + B) overall accuracy score. The (A − B) difference score is maximized when the (A + B) overall accuracy score is at 50% (the point of greatest discriminating power for such tasks) and is attenuated as the (A + B) overall accuracy departs from 50% in either direction. Therefore, higher (A − B) difference scores tend to be found artifactually for subjects with (A + B) overall accuracies nearer 50%, and smaller (A − B) difference scores tend to be found artifactually for subjects with overall accuracies either higher or lower than 50%. Thus the (A + B) overall accuracy level either enlarges or diminishes differences between groups in (A − B). This effect is of practical importance in the entire range of accuracy except when both groups' scores are very close to the 50% point (between approximately 40% and 60% overall accuracy). The design of the ACT did not allow us to control for this artifact, but the results must be interpreted in light of the artifactual effects that are expected from the accuracy levels of the groups.

Inappropriate “Corrections” of Scores for Artifacts of Accuracy Level

Some investigators (P. Green & Kotenko, 1980; P. Green & Kramar, 1983) have used an especially inappropriate “correction” of the (R − L) and (H − B) difference scores in an attempt to remove the artifact of accuracy level. They replaced (R − L) with the quotient [(R − L) ÷ (R + L)] × 100 and replaced (H − B) with [(H − B) ÷ B] × 100. Dividing (R − L) by (R + L) to adjust for differences among subjects in (R + L) is grossly inappropriate because it carries the implicit assumption that (R − L) is artifactually large as a linear function of (R + L), reaching its highest values at the highest (R + L) values. (R − L) instead reaches its maximum at a middle value of (R + L), specifically at about 50% accuracy on a free-response task on which blind guessing makes a minimal contribution to accuracy. The error in the correction is only moderate for (R + L) overall accuracy scores of zero to 50%, but it becomes massive for higher (R + L) values. For values of (R + L) above 50%, the correction consists of dividing by a progressively larger (R + L) value, despite the fact that the artifact being corrected consists of progressively smaller (R − L) values. Thus the correction is opposite to what is needed.

Several writers who have responded to this problem by offering alternative laterality coefficients include Halwes (1969); Marshall, Caplan, and Holmes (1975); Kuhn (1973); Bryden and Sprott (1981); and Repp (1976). Each set of investigators designed the corrections to be in direct proportion to the mathematical limits that are imposed on (R − L) by (R + L)—that is, to make their greatest correction at 50% accuracy—on the assumption that the artifact is proportional to that mathematical limit. Chapman and Chapman (1988) showed that this assumption is wrong and that these indexes overcorrect for scores in the middle range of accuracy. In the usual situation in which (R + L) accuracy scores of both groups are above 50%, the overcorrection understates difference scores of the lower scoring subjects, who are usually the patients, in relation to scores of higher scoring subjects. This follows from the fact that the scores of lower scoring subjects are closer to 50%.

P. Green and Kramar's (1983) replacement of (H − B) with the index [(H − B) ÷ B] × 100 has the same defects as their laterality quotient as well as the additional problems that result from dividing a difference score by one of the components of that difference. The index, rather than being equivalent at all levels of B, tends to have a negative correlation with B simply because B is subtracted from H. Use of either of these two indexes is likely to inflate patients' scores of monaural asymmetry and binaural deficit and enlarge differences between groups or, alternatively, diminish differences, depending on which group has (A + B) scores closer to 50%.

Chapman and Chapman (1988, 1989) described several possible solutions to the problem. One is to maintain overall accuracy at a constant level for all subjects by manipulating a variable so that differences in accuracy cannot affect the difference score. Another solution for the comparison of groups on a free-response task is to ensure that the scores of each group are equidistant from 50% accuracy, even if on opposite sides of 50%, so that the artifact affects scores of each group equally. The results are also interpretable if the accuracy levels are such that the expected artifact, although small, operates in the direction opposite to that of the obtained findings. This was the case in our study for the comparison of groups on the (H − B) score.

Our study was an attempt to replicate P. Green's findings of binaural deficit and monaural asymmetry on the ACT in schizophrenic subjects. We also examined the performance of patients with bipolar affective disorder on these two measures.

Method

Subjects

Twenty-five schizophrenic outpatients (19 men and 6 women), 12 outpatients with bipolar affective disorder (9 men and 3 women) and 22 normal control subjects (17 men and 5 women) participated in the study. Clinical subjects were recruited at a Madison, Wisconsin, day center that provides a noontime meal, recreational activities, and social services for former psychiatric inpatients. Persons who were identified by their occupation through a city directory and were solicited by telephone served as a normal control group. Eight additional control subjects were excluded from the study because of the presence of a personal or family history of psychopathology. All subjects were also screened for neurological impairment and for recent substance use. The subjects were paid for their participation.

Diagnoses were made according to the Diagnostic and Statistical Manual of Mental Disorders, 3rd edition—revised (DSM–III–R;American Psychiatric Association, 1987) criteria. Diagnostic information was obtained through extensive clinical interviews with the patients and examination of their inpatient and outpatient treatment records from the various institutions at which they had been treated. The diagnostic information was reviewed by 3 clinicians who arrived at the final diagnoses consensually. The schizophrenic subjects included 4 with diagnoses of disorganized schizophrenia, 9 with paranoid schizophrenia, 5 with undifferentiated schizophrenia, and 7 with residual schizophrenia. Nine of the 12 subjects with bipolar affective disorder had a history of psychotic symptoms. Twenty-one of 25 schizophrenic subjects and 5 of 12 subjects with bipolar affective disorder displayed psychotic symptoms at the time of testing; 6 of the 12 subjects with bipolar affective disorder were manic at that time. None of the schizophrenic subjects were clinically in remission.

Table 1 provides demographic information for the three groups. The groups did not differ significantly on mean years of age, prorated verbal IQ (based on the Wechsler Adult Intelligence Scale–Revised [WAIS-R] Vocabulary, Comprehension, and Similarities subtests; Wechsler, 1981), or class of origin as measured by the socioeconomic status of the highest scoring parent (Hollingshead, 1957). Class of origin, rather than class of the subject, was examined because the effects of schizophrenia tend to lower socioeconomic status. Furthermore, the clinical groups did not differ on duration of illness, age at first treatment for psychosis, number of hospitalizations, or score on the Global Assessment Scale (GAS; Endicott, Spitzer, Fleiss, & Cohen, 1976). Scores on the GAS consist of ratings of overall functioning on a scale from 0 to 100 (on which higher numbers signify better functioning).

Table 1
Characteristics of the Subjects

	Group					
	Control (n = 22)		Schizophrenic (n = 25)		Bipolar (n = 12)	
Characteristic	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age	36.8	6.1	38.4	7.1	38.8	6.7
PVIQ	95.0	12.6	88.4	13.8	94.3	12.8
GAS	—	—	33.5	10.4	44.3	13.4
SES	44.1	15.8	36.3	15.0	36.4	15.1
Duration of illness (years)	—	—	16.2	7.4	16.8	7.1
Age at first treatment for psychosis	—	—	23.6	4.9	22.6	4.5
No. of hospitalizations	0.0	0.0	6.8	6.3	6.8	4.9
Years since previous hospitalization	—	—	4.5	4.2	5.4	3.7
Daily chlorpromazine equivalency	0.0	0.0	90.9	147.2	44.7	32.7

Note. All subjects were right-handed. PVIQ (Wechsler Adult Intelligence Scale prorated verbal IQ) is based on the Vocabulary, Similarities, and Comprehension subtests. GAS = Global Assessment Scale. SES = parent's Index of Social Position scored by the Hollingshead Two-Factor Index System (a high SES index corresponds to a lower social class).

At the time of testing, 27 of the clinical subjects were receiving psychotropic medications (18 schizophrenic subjects and 9 with bipolar affective disorder). Of the schizophrenic subjects, 7 were taking fluphenazine decanoate, 3 each were taking thiothixene and haloperidol, 2 each were taking chlorpromazine and trifluoperazine, and 1 was taking thioridazine. Ten schizophrenic subjects were also taking anticholinergic drugs (4 each were taking benztropine mesylate and trihexyphenidyl, and 2 were taking diphenhydramine hydrochloride). Of the patients with bipolar affective disorder, 5 were receiving lithium carbonate and 1 was taking carbamazepine. Eight of these patients were receiving neuroleptic drugs (4, thiothixene; 2, fluphenazine decanoate; and 1 each, chlorpromazine and thioridazine). Three of the bipolar subjects receiving neuroleptic drugs were also taking anticholinergic drugs (2, trihexyphenidyl, and 1, benzotropine mesylate). All of the remaining patients, except 1 schizophrenic subject, had previously received neuroleptic drugs, and several had received prescriptions for medications at the time of the study but were reported by either treatment agencies or themselves to be noncompliant. None of the control subjects had any history of using psychotropic medications.

Materials and Procedure

All of the subjects were tested individually in a sound-protected room at the University of Wisconsin—Madison Department of Psychology. The subjects were given a 1½-hr test battery that included, in the following order, (a) P. Green and Kramar's (1983) ACT; (b) Chapman and Chapman's (1987) Handedness Scale; (c) the WAIS-R Vocabulary, Similarities, and Comprehension subtests (Wechsler, 1981); (d) a brief class of origin screening questionnaire; and (e) auditory screening. In addition, the control subjects were given a brief mental health screening questionnaire at the completion of the session, whereas the clinical subjects received an extensive psychiatric interview during a separate session.

The Auditory Comprehension Test

The ACT is composed of 30 tape-recorded short stories presented through headphones alternately to the right ear, the left ear, and binaurally, so that 10 stories are presented in each of the three conditions. Each story consists of two to four sentences and lasts approximately 10–30 s. The 30 stories are grouped into five subtests of six stories each and increase in length, across the five subtests, from 22 to 56 words. Each story is divided, for scoring purposes, into 10–25 pieces of information. Examples of the stories are as follows (slashes represent scorable pieces of information):

Subtest A (Story 4):A 15 year old / girl / stole / some jewelry / from a department / store. / A detective / followed her / into the street / and arrested her. /

Subtest D (Story 3):The drug / caffeine / which is present / in coffee / can lead to / loss of sleep, / headaches, / and depression. / These symptoms / can last / up to 2 days / after the last drink / of coffee. / Caffeine / is also found / in chocolate, / some cola drinks, / headache tablets / and frozen / puddings. /

The administration of the ACT followed the test procedures specified in P. Green and Kramar's (1983) unpublished manual. High-quality monaural recordings of the ACT stories were played on a Sony 5000 EV cassette recorder through Realistic Nova 65 stereo headphones at approximately 65 decibels sound pressure level (A). Sound levels were measured with the use of a Bruel-Kjoer Type 1613 sound meter. These recordings minimized the effects of static described by Broks et al. (1984). A simple switching apparatus allowed the experimenter to present the stories to either ear or to both ears simultaneously (binaurally). Within each of the five subtests, presentation was counterbalanced across the six stories: left ear, right ear, binaural, binaural, left ear, right ear.

Subjects were instructed to repeat back as much as they could remember about each story as soon as it was finished. After the subject finished recalling a story, there was a 5-s delay before the onset of the next story, and there were 2-min breaks after the second and fourth subtests. Administration of the ACT required approximately 30 min.

Scoring of the Auditory Comprehension Test

We adhered closely to P. Green and Kramar's (1983) scoring rules but expanded their manual to resolve scoring ambiguities. Our detailed manual, 1 which was developed while we scored the responses of 104 undergraduate pilot subjects, provides numerous examples designed to clarify scoring ambiguities in P. Green and Kramar's briefly presented scoring principles. Contrary to P. Green and Kramar's procedure, our examiners did not score the subjects during the test administration. Instead, we tape-recorded the sessions and printed a transcript that was scored by two independent raters unaware of the subject's identity and group membership. Subjects' scores were computed as the number of pieces of information correctly recalled in each of the three conditions: left ear, right ear, and binaural. The maximum score in each condition was 160. An additional score of “higher ear” was the higher of the two monaural scores for each subject.

Handedness

Chapman and Chapman's (1987) Handedness Scale contains 13 items, and the scores range from 13 (complete right-hand dominance) to 39 (complete left-hand dominance). We used an exclusion criterion of scores >17, so that only right-handed subjects were included to reduce the likelihood of testing subjects in whom speech is localized in the right hemisphere. Branch, Milner, and Rasmussen (1964) suggested that in approximately 90% of right-handed persons, speech is localized in the left hemisphere. Seven additional subjects (2 with bipolar affective disorder, 1 schizophrenic subject, and 4 control subjects) did not meet our criterion and were excluded from the study.

Auditory acuity

The subjects were screened to ensure that there was no gross asymmetry of hearing acuity between the two ears. The subjects were asked whether they had any history of hearing loss or treatment and then given a brief screening task modeled after that of Broks et al. (1984). By an exclusion criterion of more than a 10-dB discrepancy between ears, 2 additional schizophrenic and 2 additional control subjects were omitted from further analyses. None of the remaining subjects reported any history of treatment for hearing loss.

Diagnostic interview

We interviewed all of the clinical subjects by using portions of the Schedule for Affective Disorders and Schizophrenia—Lifetime version (Spitzer & Endicott, 1977), the Diagnostic Interview Schedule (Robins, Helzer, Croughan, & Ratcliff, 1981), and the Folstein Mini-Mental State (Folstein, Folstein, & McHugh, 1975). In addition, all of our clinical subjects gave us permission to examine their records from other treatment facilities. The interviews were conducted by 2 advanced graduate students with extensive interview experience. The interviews and records were used for diagnoses and also for assessing positive and negative symptoms (Andreasen, 1981, 1983; Andreasen & Olsen, 1982), paranoid and nonparanoid symptoms (Tsuang & Winokur, 1974), premorbid adjustment (Cannon-Spoor, Potkin, & Wyatt, 1982), medication status, age at first clinical treatment for psychosis, and global assessment of functioning (Endicott et al., 1976).

Results

Interrater Reliability of the Auditory Comprehension Test

The interrater reliability (determined from Pearsonian correlation) between the 2 scorers was .99 for accuracy on each of the three conditions: left ear, right ear, and binaural. The reliability was .94 for the (H − B) difference score and.96 for the (R − L) difference score. Accordingly, the scores from the 2 raters were averaged for all further analyses.

Monaural Asymmetry and Binaural Deficit

Table 2 contains the mean accuracy scores in each condition and the mean binuaral deficit (H − B) and monaural asymmetry (R − L) difference scores for each group. The groups did not differ on either the (H − B) difference score, $F(2, 56) = 0.50$, or the (R − L) difference score, $F(2, 56) = 1.07$. Power analyses, based on the results reported by P. Green (1987), indicated that our power was higher than .90 for measuring binaural deficit and was .75 for measuring monaural asymmetry.

Table 2
Mean Percentage Accuracy for the Three Groups

Test	Control (*n* = 22) *M*	Control (*n* = 22) *SD*	Schizophrenic (*n* = 25) *M*	Schizophrenic (*n* = 25) *SD*	Bipolar (*n* = 12) *M*	Bipolar (*n* = 12) *SD*
Binaural	63.8	10.7	43.9	15.2	50.7	8.9
Right ear	61.5	11.6	42.9	14.0	49.8	8.3
Left ear	55.7	13.2	37.9	12.4	41.6	10.6
Higher ear	62.0	11.8	43.6	13.4	50.2	8.4
R − L	5.8	6.4	5.0	6.2	8.2	6.0
R + L	58.6	12.0	40.4	12.8	45.7	9.1
H − B	−1.8	6.0	−0.2	5.8	−0.5	5.9
H + B	62.9	10.9	43.8	14.0	50.5	8.1

Note. R − L = monaural asymmetry, percentage accuracy for the right ear minus percentage accuracy for the left ear; R + L = overall accuracy for both ears; H − B = binaural deficit, percentage accuracy in the higher scoring ear minus percentage accuracy in the binaural condition; H + B = overall accuracy in the binaural condition.

Both significant and nonsignificant findings concerning difference scores should be viewed in light of the statistical artifact of overall accuracy previously described. Both the group with bipolar affective disorder and the schizophrenic group were somewhat closer to 50% overall (H + B) accuracy than were the normal control subjects, although all three groups were in the middle range (see Table 2). The differences in closeness to 50% imply that the control group's difference scores would be slightly more constrained by the artifact than would the difference scores of the other two groups. Because the patients' (H − B) difference scores did not exceed those of the control subjects despite the small artifactual contribution to such a finding, the results can be interpreted as not attributable to the artifact of overall accuracy level. The schizophrenic and control subjects' (R + L) overall accuracy was approximately equidistant from 50% overall accuracy, and so their monaural asymmetry scores were not differentially constrained by the statistical artifact.

We also reanalyzed our data, using P. Green and Kotenko's (1980) laterality quotient, [(R − L) ÷ (R + L)] × 100, and a binaural quotient, [(H − B) ÷ (B)] × 100. Even though use of these quotients is inappropriate, we wished to determine whether the differences in findings between our study and previous studies might be attributable to their use of these indexes. The results were substantially unchanged in that the groups did not differ on the binaural quotient, $F(2, 56) = 0.81$, or on the laterality quotient, $F(2, 56) = 1.37$.

Subtype Comparisons

In Tables 3 and 4, we present the accuracy scores for each condition, difference scores, and overall accuracy for the schizophrenic subtypes. Using Andreasen and Olsen's (1982) criteria, we divided the schizophrenic subjects into those with positive symptoms ($n = 11$), those with negative symptoms ($n = 4$), and those with mixed symptoms ($n = 10$). These groups did not differ on the (H − B) difference score, $F(2, 22) = 0.43$, or on the (R − L) difference score, $F(2, 22) = 1.70$. The schizophrenic subjects were also divided into paranoid ($n = 9$) and nonparanoid ($n = 16$) groups according to DSM–III–R (American Psychiatric Association, 1987) and Tsuang and Winokur's (1974) criteria (both criteria identified identical subgroups). The subgroups did not differ on the (H − B) difference score, $t(23) = 0.01$, but did differ on the (R − L) monaural asymmetry difference score. Scores of the paranoid subjects exceeded those of the nonparanoid subjects, $t(23) = 2.09$, $p < .05$. However, the overall accuracy for the paranoid schizophrenic subjects (46%) was closer to 50% than was the overall accuracy of the nonparanoid schizophrenic subjects (37%). The difference in overall (R + L) accuracy between the groups was not significant, $t(23) = 1.72$, $p < .10$.

Table 3
Mean Percentage Accuracy for the Positive-, Negative-, and Mixed-Symptom Schizophrenics

	Group					
	Positive (n = 11)		Mixed (n = 10)		Negative (n = 4)	
Test	*M*	*SD*	*M*	*SD*	*M*	*SD*
Binaural	45.7	14.4	40.5	17.9	47.3	11.3
Right ear	45.5	15.8	39.4	14.1	44.5	8.3
Left ear	38.6	14.2	37.1	11.5	37.8	12.2
Higher ear	45.9	15.2	40.8	13.4	44.5	8.3
R − L	6.9	6.3	2.3	6.2	6.7	4.4
R + L	42.0	14.7	38.3	12.5	41.2	10.2
H − B	0.2	3.5	0.3	8.1	−2.8	4.8
H + B	45.8	14.7	40.7	15.3	45.9	9.6

Note. R − L = monaural asymmetry, percentage accuracy for the right ear minus percentage accuracy for the left ear; R + L = overall accuracy for both ears; H − B = binaural deficit, percentage accuracy in the higher scoring ear minus percentage accuracy in the binaural condition; H + B = overall accuracy in the binaural condition.

Table 4
Mean Percentage Accuracy for the Paranoid and Nonparanoid Schizophrenics

	Group			
	Paranoid (n = 9)		Nonparanoid (n = 16)	
Test	*M*	*SD*	*M*	*SD*
Binaural	50.3	12.8	40.3	15.6
Right ear	50.2	13.9	38.8	12.7
Left ear	41.9	13.8	35.6	11.3
Higher ear	50.2	13.9	40.0	11.9
R − L	8.3	5.4	3.2	6.0
R + L	46.1	13.6	37.2	11.6
H − B	−0.1	4.0	−0.3	6.8
H + B	50.3	13.2	40.1	13.5

Note. R − L = monaural asymmetry, percentage accuracy for the right ear minus percentage accuracy for the left ear; R + L = overall accuracy for both ears. H − B = binaural deficit, is percentage accuracy in the higher scoring ear minus percentage accuracy in the binaural condition; H + B = overall accuracy in the binaural condition.

Correlations were computed between both the (H − B) and (R − L) difference scores and overall score on the Premorbid Adjustment Scale (Cannon-Spoor et al., 1982), the GAS score (Endicott et al., 1976), age at first clinical treatment for psychosis, daily chlorpromazine equivalency (Davis, 1985), and prorated verbal IQ. None of the correlations reached statistical significance.

Discussion

The results did not corroborate P. Green's findings of more monaural asymmetry and higher binaural deficit in schizophrenic subjects than in normal control subjects. Furthermore, the subjects with bipolar affective disorder did not differ from either the schizophrenic or control subjects. The differences between our findings and those of P. Green and colleagues do not appear to be attributable to the type of schizophrenic subjects that we tested, inasmuch as those researchers reported both binaural deficit and monaural asymmetry in subjects with both acute and chronic schizophrenia and in medicated and unmedicated schizophrenic subjects, as well as in the nonpsychotic offspring of schizophrenic parents. Furthermore, our testing equipment and testing procedures closely followed P. Green and Kramar's (1983) manual. The power analyses indicated that our failure to replicate P. Green's findings was not the result of insufficient statistical power. The groups in our study were as large as or larger than those in most of the previous studies of binaural deficit.

The major difference between our study and studies by P. Green and colleagues appears to be our rigorous scoring method. The development of the scoring manual and the use of independent raters, who were unaware of subjects' group membership, should have eliminated any systematic scoring bias. P. Green and colleagues' use of incomplete scoring rules that were applied during the test administration by nonnaive judges appears to call into question the validity of their findings.

In previous studies in which the ACT or similar tasks were used to assess monaural asymmetry and binaural deficit, investigators failed to take into account the effects of overall accuracy on the difference score. Unfortunately, it is often not possible to assess the effects of the artifact in their studies because the investigators did not provide mean accuracy scores for the component conditions.

The finding that monaural asymmetry of paranoid schizophrenic subjects exceeded that of nonparanoid schizophrenic subjects is consistent with the findings of Lerner, Nachshon, and Carmon (1977), Gruzelier and Hammond (1980), and Bruder (1983), who found that on dichotic listening measures of monaural asymmetry, scores of paranoid schizophrenic subjects exceeded those of nonparanoid schizophrenic subjects. However, the overall accuracy for the paranoid schizophrenic subjects was closer to 50% than was that of the nonparanoid schizophrenic subjects. This difference in overall accuracy would be expected on psychometric grounds to yield an artifactual contribution toward a higher (R − L) difference score by the paranoid patients than by the nonparanoid patients. Thus it is not possible in these data to separate monaural asymmetry of the paranoid patients from the effects of the statistical artifact.

In conclusion, our findings suggest that previous findings of differences between schizophrenic and normal control subjects in monaural asymmetry and binaural deficit may have resulted from scoring artifact or from the statistical artifacts of differences between groups in overall accuracy. The ACT does not appear promising as a measure of schizophrenic defect.

Footnotes

1 The modified scoring manual for the Auditory Comprehension Test is available on request from Thomas R. Kwapil. Department of Psychology, University of Wisconsin—Madison, 1202 West Johnson Street, Madison, Wisconsin 53706.

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