Cognitive Deficits and Thought Disorder: A Retest Study

by Philip D. Harvey, Elizabeth A. Earle-Boyer, and Joyce C. Levinson

Abstract

Manic (n = 26), schizophrenic (n = 26), and normal (n = 25) subjects were examined with a digit span distraction task and with a reality monitoring task. All subjects were tested twice at a 4-day interval, and a clinical assessment of thought disorder was conducted both times on the patients. We found that reality monitoring, distraction task performance, and clinical thought disorder were all quite stable at the retest interval. We further found that different patterns of correlational relationships between cognitive deficits and positive and negative thought disorders were present in the manic and schizophrenic samples. When we conducted a cross-temporal analysis of our data, we found that no cognitive deficits in mania predicted the severity of positive thought disorder over time, although the severity of thought disorder predicted distraction performance over time. In the schizophrenic subjects, distraction performance, but not reality monitoring, exerted a significant cross-temporal influence on positive thought disorder.

Information processing has long been a significant area of schizophrenia research (e.g., Neale and Cromwell 1970), and investigators have recently made a number of methodological improvements. For example, the development of distraction and nondistraction tasks matched for psychometric properties (Oltmanns and Neale 1975), the use of psychotic control groups (Oltmanns 1978), and the application of longitudinal studies (Frame and Oltmanns 1982) have all contributed to a clearer understanding of information processing, particularly as it is affected by the presence of irrelevant information, in schizophrenia. A recent concern, first noted by Bannister (1968) and expanded upon by Neale et al. (1985), is that many researchers in the area of schizophrenic cognition, including information processing, fail to assess the association between cognitive deficits and behavioral referents of schizophrenia. Although information-processing deficits are a component of many theories of schizophrenic symptoms, particularly discourse failure (e.g., Rochester 1979; Maher 1983), little research has been conducted until recently on the correlation between symptoms and deficits.

In our research, we have recently reported several studies of the correlation of various symptoms, particularly communication disorders, and information-processing performance. Walker and Harvey (1986) reported that digit span serial recall performance, in both the presence and absence of distracting information, was negatively correlated with the severity of positive thought disorder in both schizophrenic and manic subjects. Harvey et al. (1986) reported that digit span distraction performance, after the partialling of nondistraction performance, was significantly correlated in a negative direction with the number of reference failures in a sample of schizophrenic subjects. In contrast, performance on both distraction and nondistraction conditions was

Reprint requests should be sent to Dr. P.D. Harvey, Department of Psychiatry, Mt. Sinai Medical School, One Gustave L. Levy Place, New York, NY 10029.
negatively correlated with reference failures in mania. Harvey (1985), following up a hypothesis generated by Rochester (1979), reported that thought disorder in schizophrenia was correlated with the presence of specific deficits in reality monitoring. He observed that thought-disordered (TD) schizophrenic subjects were less able than schizophrenic subjects without thought disorder (NTD), NTD manic subjects, TD manic subjects, and normal subjects to identify the origin of information that they had either said or thought. Thought-disordered manic subjects had a specific deficit in the ability to discriminate the origin of information presented by two external sources.

In addition, Oltmanns et al. (1979) reported that the severity of global ratings of thought disorder was related to susceptibility to distraction in schizophrenia. Similarly, Cornblatt et al. (1985) reported that positive thought disorder was associated with distraction in auditory tasks. Still other studies have indicated that the maintenance of attention and short-term visual processing deficits correlate with negative symptoms of schizophrenia (e.g., Place and Gilmore 1980; Knight et al. 1985; Nuechterlein et al. 1986). All of these studies provide some support for the idea advanced by several theorists (e.g., Rochester 1979; Maher 1983) that information-processing deficits have a causal role in communication disorders in schizophrenia.

A drawback of these studies is that they were cross-sectional in nature, obviously not allowing for any causal inferences about the connection of information-processing performance and communication failures. In the longitudinal study of Frame and Oltmanns (1982), no assessment of communication disorders was presented. Therefore, we decided to examine the performance of manic and schizophrenic subjects and a normal contrast sample on two different information-processing tasks. Using a retest design, we correlated the performance of the patients with severity ratings of positive and negative clinical thought disorder at two assessments at a 4-day interval. As a result, we were able to meet the following goals: (1) to look at a within-subjects replication of the association of thought disorders and cognitive deficits; (2) to examine the temporal stability of information processing; and (3) to explore, in a preliminary way, the cross-temporal association of thought disorder and cognitive deficits.

Methods

Subjects. Subjects were selected from consecutive admissions to a State psychiatric center. Subjects with no history noted in their hospital records of substance abuse disorders or organic brain disease were approached and asked to participate in a study of speech and memory competence. Diagnostic data were collected with the Schedule for Affective Disorders and Schizophrenia (SADS) (Spitzer et al. 1978), and DSM-III (American Psychiatric Association 1980) diagnoses were generated independently by two sources: a group of advanced graduate students and a Ph.D. level clinical psychologist. Diagnostic agreement was .82 (Kappa), and disagreements were resolved by consensus. Interviewers also completed the Scale for the Assessment of Positive Symptoms (SAPS) (Andreasen 1982) and the Scale for the Assessment of Negative Symptoms (SANS) (Andreasen 1981). All patients were medicated, with all schizophrenic patients receiving some type of neuroleptic and all manic patients receiving lithium carbonate, neuroleptics, or some combination of the two.

A normal contrast sample was collected from community residents, university employees, and older undergraduate students. The SADS was not completed on the normals, but we tested no normals with a personal or familial history of psychiatric care or hospitalization. Descriptive information on the subjects is provided in table 1. The numbers of subjects were 26 schizophrenic patients, 26 manic patients, and 25 normals. If Andreasen and Olsen's (1982) subtyping scheme had been applied to the patients, nine of the schizophrenic patients would have been “positive,” nine “negative,” and eight “mixed.” Of the manic patients, two would have been “mixed” and 24 “positive.” There were no demographic differences between the manic patients who did and did not receive lithium or neuroleptics. No overall demographic differences existed between the subject samples.

Serial Recall Tasks. Two serial recall tasks were created by randomly selecting trials from the “short” distraction and nondistraction tasks used by Oltmanns and Neale (1975). Four distraction and four nondistraction trials were presented in each task. The distraction trials contained five target digits presented in a female voice, with four irrelevant digits presented in an opposite-sexed voice in the 2-second interval between the presentation of each
target digit. In the nondistraction condition, six target digits were presented at the same rate in a female voice. The distraction and nondistraction trials were intermixed within each subtask and presented in a fixed random order in a tape-recorded format. Each tape contained one practice example of a distraction trial and a nondistraction trial. To reduce practice effects, no trials on the two tapes were identical. Each subject was tested once with each tape; the order of presentation of the tapes was randomized. The coefficient α for nondistraction performance for the normals was .78 for tape number 1 and .82 for tape number 2, with distraction performance at .76 and .80, respectively.

Previous research with these tasks has indicated that no distraction effects are typically found in normals, but that psychotic patients, including those with mania (Oltmanns 1978; Harvey et al. 1986) and schizophrenia (Oltmanns and Neale 1975; Oltmanns 1978; Harvey et al. 1986), typically perform worse in the distraction than the nondistraction subtask. Correlational results have found that both distraction and nondistraction performance tends to correlate negatively with the severity of positive (Walker and Harvey 1986), but not negative, thought disorder in both manic and schizophrenic patients.

**Reality Monitoring Tasks.** Two subtasks are contained in the reality monitoring procedure. Subjects were examined for their ability to discriminate the source of information presented verbally by two external sources (one male, one female) and for their ability to discriminate information that they had either said aloud or had thought about saying. These tasks are referred to, respectively, as the "listen-listen" task and the "say-think" task. The stimulus materials for each condition were two eight-word lists, selected from the list of the 100 most common words in English (Thorndike and Lorge 1943).

Two versions of the say-think and listen-listen task were created, with eight lists of words in total used for stimuli. Four recognition sheets were created, each containing 16 target words (2 of the lists) and 8 recognition foils, also selected from the 100 most common English words. The target lists were randomly rotated throughout the subtasks across subjects.

Previous research with the reality monitoring task has indicated that TD schizophrenic patients manifest specific deficits in the ability to discriminate the source of say-think information (Harvey 1985). Thought-disordered manic patients, in contrast, were found to manifest a specific deficit in the ability to discriminate listen-listen information. Both TD manic and TD schizophrenic patients tended to report that they had said information when they made recognition errors. This response bias was in direct contrast to the typical findings with normals (Raye and Johnson 1980) and the performance of the NTD patients and normals in the Harvey study. Response biases, combined with information-processing problems (i.e., reality monitoring deficits in either say-think or listen-listen modalities), apparently may lead to communication failures.

**Procedure.** Consecutive admissions to an acute treatment unit at a State psychiatric center were approached 10 days after their admission and asked to participate. The research assistant first con-
duced a 15-minute nonclinical interview, explicitly avoiding any discussion of clinical topics, and then completed the SADS. The nonclinical interview was structured by the areas into which the interviewer steered the conversation (e.g., hobbies, recreational activities, family factors). The nonclinical interview and the SADS were both tape-recorded for reliability assessment and clinical ratings.

Subjects were tested that day with one of the digit span distraction tasks and with the two reality monitoring subtasks. They were retested 4 days later with the other versions of the tasks, at which time another nonclinical interview, following the same format with different content area prompts, was collected. For the digit span tasks, subjects were instructed to attend to the female voice only and to ignore any male voices. Subjects were given ordered recall instructions and responded verbally to the tester, who recorded their recall verbatim. The tester stopped the tape between trials, until the subject produced his/her recall of the stimulus materials.

For the listen-listen reality monitoring tasks, subjects heard a tape in which male and female voices read eight word lists in an alternating fashion at a 2-second rate. Subjects were instructed to attend to the source of presentation for a later recognition task. In the say-think subtask, subjects were presented words written on cards, with one list designated the “say” list and the other the “think” list. A tester presented the cards to the subjects, alternating “say” and “think” words. Subjects were instructed to read the “say” words aloud and to think about saying the “think” words to themselves. Presentation of the say words ended as soon as subjects read the word aloud, with presentation of the think words ending after subjects provided an eye contact signal that they had finished processing the word.

After the completion of each subtask, subjects received a recognition sheet with all of the presented words and eight recognition foils. Subjects were asked to identify the words as presented by one source, the other, or neither, guessing if they were unsure.

Clinical Ratings of Thought Disorder. Clinical ratings of thought disorder based on the two nonclinical interviews, using the Scale for the Assessment of Thought, Language, and Communication (TLC) (Andreasen 1979), were completed by trained raters without knowledge of the identities and diagnoses of the subjects and the order of collection of the speech samples. We used the nonclinical interviews to maintain blindness about diagnoses, and to maintain consistency of interview content, since the SADS was only administered once. Raters generated ratings of five positive signs of thought disorder (pressure of speech, derailment, tangentiality, incoherence, and illogicality) and the two negative signs of thought disorder (poverty of speech and poverty of content of speech).

Two raters evaluated each interview, with reliability examined by comparison of a randomly sampled 20 percent of their overlapping ratings. Reliabilities (Kappa) of the individual signs ranged from .24 (incoherence due to infrequency) to .91 (pressure of speech). The average for all signs was .78, and all of the positive and negative thought disorders were then averaged to generate composite scores (see table 1). No changes in thought disorder severity occurred over the 4-day retest interval. Manic and schizophrenic patients showed equally severe positive thought disorder ($F = .87; df = 1.50; p > .1$), but the schizophrenic patients had a higher level of severity in negative thought disorder ($F = 34.77; df = 1.50; p < .01$).

Results

Between-Group Differences. Performance over the two assessments was compared across both the distraction and reality monitoring tasks. The dependent variables for distraction task performance were the total performance in both the distraction and nondistraction conditions. For the reality monitoring tasks, three separate analyses were conducted. We examined the discrimination ratios for the two subtasks, and the reality monitoring errors and false recognitions in the say-think subtask. The discrimination ratio (Foley et al. 1983) is an index that ranges from .0 to 1.0 and gives the proportion of correct attributions to the respective source, as a function of all words correctly

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1 For both the manic and schizophrenic patients, only three thought disorders contributed variance to the composite thought disorder rating: pressure of speech, derailment, and tangentiality. The item to scale correlations of these variables ranged from .74 (tangentiality) to .91 (pressure of speech) for the manic patients and from .65 (pressure of speech) to .94 (derailment) for the schizophrenic patients. For the manic patients, no poverty of speech was detected.
Table 2. Cognitive task performance for all groups at both assessments

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<thead>
<tr>
<th></th>
<th>Schizophrenic</th>
<th>Manic</th>
<th>Normal</th>
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<tbody>
<tr>
<td></td>
<td>Time 1</td>
<td>Time 2</td>
<td>Time 1</td>
</tr>
<tr>
<td>Say-think discrimination</td>
<td>.64</td>
<td>.20</td>
<td>.61</td>
</tr>
<tr>
<td>Listen-listen discrimination</td>
<td>.63</td>
<td>.19</td>
<td>.56</td>
</tr>
<tr>
<td>Say-report-think errors</td>
<td>2.88</td>
<td>2.36</td>
<td>3.06</td>
</tr>
<tr>
<td>Think-report-say errors</td>
<td>3.06</td>
<td>2.89</td>
<td>3.44</td>
</tr>
<tr>
<td>New-report-think errors</td>
<td>2.59</td>
<td>2.95</td>
<td>2.35</td>
</tr>
<tr>
<td>New-report-say errors</td>
<td>2.26</td>
<td>3.19</td>
<td>2.08</td>
</tr>
<tr>
<td>Distraction(^1)</td>
<td>.54</td>
<td>.32</td>
<td>.57</td>
</tr>
<tr>
<td>Nondistraction(^1)</td>
<td>.74</td>
<td>.25</td>
<td>.77</td>
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\(^1\) Expressed as proportion correct.

recognized as old (i.e., presented). This ratio correlates well with \(d'\) as a measure of discrimination sensitivity. The scores for these dependent variables are presented in table 2.

Our first step was to correlate the demographic variables, including medication dosage, with performance on the laboratory tasks. No correlations were significant for either group at either assessment. For the schizophrenic patients, the correlation between laboratory measures and neuroleptic dosage ranged from a low of .04 (listen-listen discrimination) to a high of -.21 (distraction performance). For the manic patients the correlation of neuroleptic dosage and performance were also very low (ranged from .05 to -.12).

The scores were examined with a 3 (Diagnosis) x 2 (Time) repeated-measures design. No effects of time or interactions involving time were significant for any variable. For the reality monitoring task, across the discrimination scores and both types of reality monitoring errors, the same pattern of results was detected: manic and schizophrenic patients were more deviant than normals and did not differ from each other.

For false recognition, both manic and schizophrenic patients made more new-report-say errors than normals and did not differ from each other. For the distraction task, the analysis of variance (ANOVA) revealed a significant Diagnosis x Distraction-Nondistraction interaction \((F = 13.97; df = 2, 74; p < .001)\). This interaction was followed up with three repeated-measures simple effects tests (Winer 1962), where distraction-nondistraction was examined within diagnosis. For both the manic and schizophrenic patients, performance was significantly worse in distraction. For the normals, there was no difference in performance.

Correlational Analyses. In this set of analyses, we correlated the clinical thought disorder scores with the various laboratory performance variables using Pearson product-moment correlations. We were interested in the stability of these correlations at the 4-day retest interval. Another reason for the correlations was to develop empirical bases for exploratory cross-temporal analyses by selecting the variables that were more strongly correlated with thought disorder at both assessment periods to use in other analyses. These correlations were computed separately for the manic patients and the schizophrenic patients. No correlations between negative thought disorder and performance were significant for either group, so the correlations between positive thought disorder and performance are presented in table 3.\(^2\)

For the manic patients, distraction performance correlated negatively \((p < .05, \text{two-tailed})\) with the severity of positive thought disorder at both assessments, as did nondistraction performance at time 2 (time 1 was significant at \(p < .05, \text{one-tailed}\)). Among the reality monitoring variables, only say-report-think

\(^2\) We compared the variance of the laboratory variables across groups within assessments and across assessments within groups. No differences were found. Positive thought disorder did not differ in variance across groups or assessments either.
errors at time 1 correlated with positive thought disorder. For the schizophrenic patients, both distraction and nondistraction performance at both assessments correlated negatively with the severity of positive thought disorder. Say-think discrimination competence was also negatively associated with the severity of positive thought disorder, as was listen-listen discrimination performance at time 1. In the reality monitoring errors, think-report-say errors were significantly correlated with the severity of positive thought disorder, although say-report-think errors were independent of thought disorder. False recognitions of the new-report-say type at both assessments were significantly correlated with the severity of positive thought disorder, although the new-report-think errors were only correlated with thought disorder severity at time 1.

**Preliminary Cross-Temporal Analyses.** Despite the short 4-day retest interval, we were interested in the possibility of examining the cross-temporal associations between laboratory performance and clinical thought disorder. To do so, we computed path analyses between laboratory performance and thought disorder (see figures 1 and 2). We computed separate analyses for distraction and reality monitoring tasks for each subject group. The variables for the distraction task were distraction performance and an index designed to measure susceptibility to distraction: the difference of nondistraction and distraction performance. For the reality monitoring task, we selected the correlational variables empirically. First we took the variables that were most strongly and consistently correlated with thought disorder in the schizophrenic sample: say-think discrimination and think-report-say errors. We computed a stepwise regression within the schizophrenic sample and compared the predictive influence of say-think discrimination competence, think-report-say errors, and their statistical interaction for their ability to predict positive thought disorder. The interaction term was used because of Harvey's (1985) hypothesis that both discrimination deficits and monitoring bias were required to generate confusion of the type likely to cause speech disorder. The interaction term proved to be the best predictor of positive thought disorder at time 1 ($r$ partial = .39, $F = 6.43; df = 3.22; p < .05$). With the interaction term in the regression equation, neither of the other variables predicted significant variance in positive thought disorder at time 1.

We then used a regression design to predict the cross-temporal correlations, with the criterion variable itself at time 1 and the other predictive variable simultaneously entered into a regression equation, with the resulting standardized regression coefficients presented in the figures. The synchronous correlations were computed with nonpartialed Pearson correlation coefficients. The index of susceptibility to distraction accounted for no variance in positive thought disorder at time 2 for either sample, so it is not presented in the figures.

For the schizophrenic patients, distraction performance at time 2 was predicted by distraction at time 1 ($F = 6.61; df = 2.23; p < .05$) and by positive thought disorder at time 1 ($F = 4.50; df = 2.23; p < .05$). Positive thought disorder at time 2 was also predicted by both positive thought disorder ($F = 5.25; df = 2.23; p < .05$) and by distraction ($F = 6.84; df = 2.23; p < .05$) at time 1. For reality monitoring performance, a sub-
Figure 1. Cross-temporal influence coefficients for schizophrenic patients

Table: Cross-temporal influence coefficients for schizophrenic patients

<table>
<thead>
<tr>
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<th>Time 1</th>
<th>Time 2</th>
</tr>
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<tbody>
<tr>
<td>Distraction performance</td>
<td>-0.57</td>
<td>-0.48</td>
</tr>
<tr>
<td>Positive thought disorder</td>
<td>0.48</td>
<td>0.48</td>
</tr>
<tr>
<td>Reality monitoring interaction</td>
<td>0.31</td>
<td>0.57</td>
</tr>
</tbody>
</table>

For the manic patients, both positive thought disorder ($F = 4.28; df = 2.23; p < .05$) and distraction ($F = 5.78; df = 2.23; p < .05$) at time 1 predicted distraction at time 2, although distraction at time 1 had a 0 predictive relationship with positive thought disorder at time 2. Only positive thought disorder at time 1 ($F = 8.80; df = 2.23; p < .05$) predicted positive thought disorder at time 2. None of the predictors that were significantly greater than chance differed significantly from each other. Reality monitoring at time 1 was the only significant predictor of reality monitoring at time 2 ($F = 5.65; df = 2.23; p < .05$), and thought disorder at time 1 was the only effective predictor of thought disorder at time 2 ($F = 8.80; df = 2.23; p < .05$). The intercorrelations of the two laboratory predictor variables were $r = 0.17$ at time 1 and $r = 0.09$ at time 2.

Discussion

The results of this investigation replicate earlier findings (Cornblatt et al. 1985; Harvey 1985; Harvey et al. 1986; Walker and Harvey, in press) about the correlation of positive thought disorder and certain types of information-processing performance. We have also demonstrated that cognitive deficits (serial recall/distraction deficits and reality monitoring
performance), positive thought disorder, and their associations are all relatively stable during the middle of an acute admission for both manic and schizophrenic patients. Certain reality monitoring variables were more stable than others in their association with positive thought disorder, but those were also the variables with the most theoretical importance. Reality monitoring and serial recall performance were relatively independent predictors. Again, we have found that negative thought disorder is unassociated with serial recall performance in schizophrenia. This lack of association cannot be a function of low variability, infrequency, or low reliability in the assessment of negative thought disorder in schizophrenic patients. While negative symptoms appear to correlate with certain types of laboratory-measured deficits (e.g., continuous performance test: Nuechterlein et al. [1986]; short-term visual information processing: Place and Gilmore [1980]; Knight et al. [1985]; Nuechterlein et al. [1986]), most of those deficits have been measured in the visual modality and have not reflected verbal information processing. Taken together, these results suggest that positive and negative symptoms have quite divergent laboratory correlates.

Our own cross-temporal assessment, although extremely preliminary and limited by short duration, has suggested (1) that there is considerable difference in the association between serial recall deficits and reality monitoring performance and positive thought disorder and (2) that these associations vary considerably by diagnosis. In the manic patients, all of the cognitive deficits appeared to be a function of the severity of positive thought disorder. In the schizophrenic patients, in contrast, distraction performance contributed significant variance to the severity of positive thought disorder. Even though the path between distraction thought disorder was not significantly greater than the path between thought disorder distraction, the fact that a significant amount of cross-temporal variance in positive thought disorder was predicted differentiates distraction performance's association with clinical thought disorder from that of reality monitoring performance. Our earlier linguistic (Harvey and Brault 1986) and laboratory (Harvey et al. 1986) research has suggested that similar linguistic performance in manic and schizophrenic patients is associated with different clinical thought disorders and different patterns of serial recall performance. These data suggest that omnibus impairment factors, either leading to or following from the stability of clinical symptoms, do not account for all of the association between cognitive factors and clinical symptoms. Although tentatively due to the short followup duration and general stability of both clinical symptoms and laboratory performance, these data suggest the potential of antecedent influence on thought disorder by certain cognitive factors.

Worthy of note is the fact that susceptibility to distraction, although a salient feature of schizophrenic recall performance, does not appear to be correlated with clinical thought disorder. As a result, all that we can conclude is that general serial recall ability is somewhat more predictive than reality monitoring competence of the severity of positive thought disorder over a short time interval. The discovery of more specific laboratory predictors would be a reasonable goal for future research. We should also note that the sample size in the present investigation is relatively small for the meaningful interpretation of path coefficients or for the application of other multivariate techniques (although it is not a small sample by standards of psychopathology research) and may limit the interpretation of our results, particularly in the detection of differences in magnitude of correlation coefficients. Finally, medication effects were negligible. Earlier research (e.g., Hurt et al. 1983) has suggested that most medication-related improvement in thought disorder takes place early in admission. Since we began testing at 10 days after admission, medication likely had already exerted its greatest influence on clinical state and cognition, and the correlations were reduced for that reason.

Our results lend some credence to models of schizophrenic discourse problems (e.g., Rochester 1979; Maher 1983) that postulate a causal role to information-processing failure. One untested alternative hypothesis, however, is that some third variables such as biochemical deviations, general information-processing capability, motivation, or other clinical symptoms play a role in the findings. As noted above, our results suggest a molar association between serial recall and communication disorder that is temporally stable and hints at cross-temporal influence. A reasonable resolution would be use of experimental designs that manipulate distraction concurrently to the measurement of discourse failures, in addition to longer followup durations.
possibly allowing for more variation in laboratory and clinical variables.

References


Announcement

The Psychosocial Rehabilitation Journal has published a special issue on "Supported Employment for Persons With Severe Mental Illness." The following articles are included in the issue: "Supported Employment for Persons Who Are Psychiatrically Disabled: An Historical and Conceptual Perspective" by William A. Anthony and Andrea Blanch; "Systems Barriers to Supported Employment for Persons With Chronic Mental Illness" by John H. Noble, Jr. and Frederick C. Collignon; "Supported Employment for Individuals Who Are Mentally Ill: Program Development" by Fred Isbister and Gary Donaldson; "Supported Work as a Modification of the Transitional Employment Model for Clients With Psychiatric Disabilities" by Gary Bond; "Early Lessons From the Marin County Demonstration in Integrating Vocational and Mental Health Services" by Frederick C. Collignon, John H. Noble, Jr., and Linda Toms-Barker; and "Training and Personnel Issues for Supported Employment Programs Which Serve Persons Who Are Severely Mentally Ill" by Karen Danley and Vera Mellen.

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LeRoy Spaniol, Ph.D.
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