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Cognitive Rehabilitation for Schizophrenia and the Putative Role of Motivation and Expectancies

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Cognitive rehabilitation (CR) approaches seek to enhance cognitive processes or to circumvent cognitive impairments in schizophrenia in an effort to improve functional outcome. In this review we examine the research findings on the 8 evidence-based approaches to cognitive remediation listed in the 2005 *Training Grid Outlining Best Practices for Recovery and Improved Outcomes for People With Serious Mental Illness*, developed by the American Psychological Association Committee for the Advancement of Professional Practice. Though the approaches vary widely in theoretical orientation and methods of intervention, the results are, for the most part, encouraging. Improvements in attention, memory, and executive functioning have been reported. However, many persons with schizophrenia are more impaired in real-world functioning than one would expect given the magnitude of their cognitive deficits. We may need to look beyond cognition to other targets such as motivation to identify the reasons that many persons with schizophrenia demonstrate such marked levels of disability. Although a number of current CR approaches address motivation to varying degrees, treating motivation as a primary target may be needed to maximize CR outcomes.

Key words: cognitive remediation/cognitive rehabilitation/schizophrenia/motivation

Introduction

Cognitive impairment is a core feature of schizophrenia.[1] Deficits in cognitive functioning, including those in psychomotor speed, attention, memory, and executive functions, are thought to underlie the severe functional disability associated with this illness.[2–11] This relationship between cognitive deficits and poor functional outcome has prompted the development of cognitive rehabilitation (CR) approaches focused specifically on treating the cognitive deficits of schizophrenia.[12]

The field continues to struggle to reach agreement in terminology to describe existing CR approaches. The restorative versus compensatory distinction has been popularized in the traumatic brain-injured but not the schizophrenia literature. As not all programs of cognitive rehabilitation aim to ''restore'' the individual to his or her premorbid state or ''restore'' the function of neurons and neural circuits, it may be more accurate to describe such programs as ''cognition enhancing'' efforts, in that they all seek to improve cognitive functioning through a set of specified training interventions. In contrast, compensatory approaches aim to bypass or ''compensate'' for cognitive deficits to promote skill acquisition or functional outcome.

In the schizophrenia literature there are several independent and competing CR approaches being developed concurrently. These approaches vary in their theoretical underpinnings, methodologies, and targets of outcome. An appreciation of the different theoretical approaches and methods of intervention, and their corresponding strengths and weaknesses, may inform future efforts.

Previous Reviews

The CR literature in schizophrenia has been, and continues to be, a difficult literature from which to draw firm conclusions. Studies vary considerably in teaching methods, patient samples and sample sizes, outcome measures, intervention dose (amount of training), inclusion of control or comparison groups, blinded procedures, level of professional education and experience of trainers, and reliance on theoretical models. Even the reviews of this literature vary considerably.[13–20] They differ according to criteria for study inclusion, conceptual organization of studies, and interpretation of findings. These range from highly conservative reviews such as provided by Pilling et al.,[14] which examined 5 randomized controlled trials in schizophrenia, to more liberal efforts such as those by Kurtz et al.,[13] which encompassed the extant literature at the time. Overall, the reviews have been mostly

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positive, with the exceptions of the Pilling et al. review,[14] which was decidedly negative, and Suslow, Schonauer, and Arolt's review[20] of attention studies. We focused our review on 8 evidence-based approaches of CR. The selection was based on their inclusion in the 2005 *Training Grid Outlining Best Practices for Recovery and Improved Outcomes for People With Serious Mental Illness*, developed by the American Psychological Association Committee for the Advancement of Professional Practice.[21] These approaches have been used in clinical trials of schizophrenia and best illustrate the differing emphases in this continually developing area of rehabilitation. To our knowledge, this is the first review article to include a presentation of all 8 approaches. The second aim of this review is to stimulate a discussion on the role of motivation in CR. A section at the end of the article deals specifically with this issue. When appropriate, motivation issues are discussed within the context of the CR approaches presented in this review.

Cognition Enhancing Approaches

Integrated Psychological Therapy

Integrated Psychological Therapy (IPT[22]) was one of the first clinically based CR programs that was specifically designed for persons with schizophrenia. IPT is based on a building-block model that assumes that elementary, basic neurocognitive functions are necessary prerequisites for higher-order complex social functions. Training is conducted in small groups of 5–7 patients in 30–60 minute sessions 3 times per week and proceeds through 5 subprograms arranged in a hierarchical order according to complexity of function. The first 3 subprograms represent the cognitive training component and include training of abstraction, conceptual organization, and basic perception and communication skills. These are named Cognitive Differentiation, Social Perception, and Verbal Communication. These abilities are believed to be prerequisite skills, essential for carrying out effective social interactions. The fourth and fifth components represent the behavioral level of social interaction and are similar to skills training approaches used elsewhere.[23] These are named Social Skills and Interpersonal Problem Solving. Training is highly structured and manual-driven. Completion of the subprograms is accomplished in about a 6-month period though successful completion of a series of graduated activities.

IPT appears to convey benefits compared with less extensive psychosocial treatments on social functioning. However, the beneficial effects of IPT on neurocognition are more equivocal. Further, it is not clear from the studies of IPT whether changes in neurocognition are necessary to produce changes in social functioning.

In one of the more methodologically rigorous studies of IPT, Spaulding et al.[24] tested the effects of the cognitive component of IPT on social problem-solving ability in a sample of schizophrenia inpatients. Participants were randomized to 2 groups: a group that received the first 3 subprograms of IPT plus skills training versus a group that received supportive therapy plus skills training. Hence, the primary difference between groups was the IPT cognitive training component. The results from the study showed a differential treatment effect favoring the IPT plus skills training group on the primary outcome measure of interpersonal problem-solving (AIPSS). Interestingly, the study produced relatively few differential treatment effects on cognition. Only 2 out of 13 neurocognitive variables (Span/Continuous Performance Test [CPT] and Wisconsin Card Sorting Test [WCST] random errors) showed a differential treatment effect. However, the IPT plus skills training group did show significant pre-post gains on 7 of the 13 measures compared with 4 out of 13 in the control group. Somewhat paradoxically, the results suggested that participation in the neurocognitive component was necessary to enhance gains in social problem-solving ability, yet there was little evidence of a differential treatment effect on neurocognition. A failure to find support for the ‘‘building block’’ model of IPT has been found in other studies as well.[25]

Cognitive Enhancement Therapy

Cognitive Enhancement Therapy (CET) is based on a neurodevelopmental model of schizophrenia that proposes that disturbances in neurodevelopment result in delays in social cognition. Social cognitive milestones such as perspective taking are the focus of treatment. According to the model, the brain's neuroplasticity reserve can be enriched through cognitive experiences provided through training. The conceptualization of training within CET was influenced by Ben-Yishay and colleagues'[26] work with traumatic brain-injured patients, Brenner's IPT,[22] and contemporary theories of human cognitive development. The emphasis in training is to shift from concrete cognitive processing of information to ‘‘gistful’’ spontaneous abstraction of social themes. There are 2 main components to training: (1) computer-based cognitive exercises that focus on attention, memory, and problem-solving abilities and (2) small group training of social cognition. CET involves social interaction at every stage. The computer sessions are conducted in pairs of patients with the therapist providing oversight. Patients take turns using the computer software programs and assist each other by providing strategies and offering encouragement. The curriculum for the social cognition groups consists of categorization exercises, formation of gistful, condensed messages, solving real-life social dilemmas, abstraction of themes from newspaper articles (eg, *USA Today*), appraisal of affect and social contexts, initiating and maintaining conversations, playwriting, and center stage exercises (eg, introducing oneself or a friend). The groups involve structured but unrehearsed in vivo social interactions. Sessions include a homework review, a psychoeducation topic, an exercise by a patient or pair, feedback from other patients and coaches, and a new homework assignment based on the education topic. Training is individualized to the cognitive-processing style deficit of the participant.

CET is one of the more time and resource demanding of the CR programs in schizophrenia. In a 2-year randomized trial of CET,[27] participants in the CET group received 75 hours of computerized training on attention, memory, and problem-solving exercises combined with 56 sessions (1.5 hours per week) of training on social cognition exercises. Participants were selected based on meeting criteria for cognitive disability, which consisted of impairments, functional disabilities, and social handicaps associated with 1 of 3 dysfunctional cognitive styles, and the criteria for social cognitive disability. At the 12-month follow-up assessment, differential treatment effects of CET compared with enriched supportive therapy (EST) were found for composite indices of neurocognition and processing speed, and marginal differences were found for the behavioral composites of cognitive style, social cognition, and social adjustment. At the 24-month assessment, differential effects were found on all composite indices. The control group was not matched to the experimental group for amount of training exposure, which makes it difficult to interpret the contribution of participation in a structured rehabilitation activity. Also, the neurocognitive battery used to assess outcome shared similar methods with the computerized training tasks. Hence, the study's findings could be due to shared method variance and not the training per se. Still, the reports from this group over the years have been highly encouraging. The conceptual model underlying CET is well developed, and the approach targets a deficit highly relevant to the overall well-being of persons with schizophrenia.

Neurocognitive Enhancement Therapy

The Neurocognitive Enhancement Therapy (NET) program of Bell and colleagues[28] is similar to CET, except that the focus is on work rehabilitation. Like CET, NET includes computer-based cognitive training. NET uses software programs developed specifically for this group by Odie Bracy, which are similar to that used by Hogarty and colleagues[27] and were specifically designed for use in the treatment of persons with compromised brain function. They have been widely used in the rehabilitation of persons with traumatic brain injury, and in more recent years they have been used with persons with schizophrenia. The software programs include a number of specific training exercises that differ by cognitive target and difficulty level. Training begins with relatively simple exercises and proceeds to more complex ones. During training, participants work at their own pace and move from one training exercise to another. Once a participant attains 90% accuracy at a given difficulty level, the parameters of the task are changed to make the task more challenging and enhance the motivation to perform optimally. Training focuses on attention, memory, and executive functions. The other components of NET include biweekly feedback based on results from an on-the-job assessment, using the Cognitive Functional Assessment scale, and participation in a weekly social processing group. The Cognitive Functional Assessment scale is a measure of cognitive function that consists of ratings of attention, memory, and executive functioning while the participant is performing his or her job. Feedback is provided to participants during their weekly work therapy support group.

In a study of 65 schizophrenia or schizoaffective disorder patients, participants were administered a baseline cognitive assessment and then stratified by level of cognitive impairment and randomly assigned to NET plus work therapy versus work therapy alone.[28] Participants received up to 5 hours of computerized cognitive training each week over the 26-week protocol. At the end of training, the NET plus work therapy group showed significantly greater gains than the work therapy alone group on measures of executive functioning, working memory, and affect recognition. Approximately 60% of participants in the NET plus work therapy group showed improvement in neurocognitive performance and were 4 to 5 times more likely than participants in the comparison group to show improvements in neurocognitive function of a large effect size (Cohen's $d > .80$). Improvements in working memory were, perhaps, most impressive. The percentage of patients showing working memory performance within the normal range changed from 45% to 77% in the NET plus work therapy group, compared with a decrease from 56% to 45% in the work therapy alone group. Moreover, Bell et al.[28] found that patients participating in NET plus supported employment had better vocational outcomes than those in supported employment alone.

This group has conducted 2 long-term studies to evaluate the effects of adding NET to vocational programs. The first study, described above, was conducted in a VA setting with participants placed at jobs within the VA.[28] A second study,[29] which is ongoing, used a community-based supported employment program. Training in the second study was twice as long (12 months). Preliminary data on 54 participants who completed training revealed the NET plus supported employment group to show significantly greater improvement on executive functioning and trends in the expected direction on the other cognitive factors (working memory, thought disorder, and visual and verbal recall). Employment data attained from these 2 studies showed that participants assigned to NET either maintained or increased the number of hours they worked during the follow-up period. Participants receiving only work therapy or supported employment showed a decrease in hours worked. Results were similar when considering the percentage of participants employed. The group differences were more modest in the VA-conducted study perhaps because of the high rates of employment with veterans placed in noncompetitive jobs. In the supported employment study with preliminary data on 43 participants who completed the 12-month follow-up period, the differences were more marked. Twelve months after training, 57.5% of participants in the NET plus supported employment group were still employed compared with only 21.0% of participants in the supported employment alone group. The results from the latter study provide preliminary evidence that the beneficial cognitive and vocational effects of NET can be extended to competitive jobs in community settings.

Individual Executive Functioning Training/Cognitive Remediation Therapy

Another approach to cognitive rehabilitation in schizophrenia is based on an understanding of the cognitive processing deficits common to persons with schizophrenia and how these are linked to deficits in complex behavior such as social functioning. An example of a formal clinical program using this approach was developed in Australia by Ann Delahunty and Rod Morice (1993)[30] and has been adopted for use in the United Kingdom by Til Wykes and colleagues, and it is now referred to as Cognitive Remediation Therapy (CRT).[6,31,32] The training program targets deficits in executive processes and consists of 3 modules: cognitive flexibility, working memory, and planning. This program places a strong emphasis on teaching methods and uses procedural learning, principles of errorless learning, and other evidenced-based methods. In contrast to CET and NET, this program uses paper-and-pencil exercises for training instead of computerized tasks, and there is greater emphasis placed on the trainers' role in working with patients during the cognitive exercises. Similar to CET and NET, training proceeds through a series of exercises, graduated in level of difficulty, beginning with simpler exercises and progressing to more complex ones. Training is individualized and proceeds at each subject's own pace. The exercises share conceptual features with neurocognitive tests, but they are methodologically different to reduce shared method variance between training exercises and outcome measures. For example, during training for cognitive flexibility, participants are asked to cross out all even numbers, then odd numbers. This requires maintenance and then shifting of cognitive set, similar to that required on the WCST but distinctly different from training to the test.

Results of this approach have been mostly positive. In a study using only the cognitive flexibility module, Delahunty et al.[30] found improvements in WCST performance immediately after training, and the gains were maintained at a 6-month follow-up assessment. In a separate study using all 3 training modules, Wykes et al.[33] found evidence for a differential treatment effect favoring the cognitive training group over a control group that received intensive occupational therapy. Training was conducted 1 hour per day, 3 to 5 days per week, over 40 sessions. A differential training effect was found on measures from the WCST and a planning test (modified 6 elements). An interesting secondary analysis of the data showed that participants who met a certain threshold for improvement on cognitive flexibility showed improvements in social functioning within the 3-month duration of the trial. In a 6-month follow-up study of 33 outpatients to address the durability of CRT effects, Wykes et al.[32] examined stability of gains on 3 primary cognitive outcome measures (WCST, Digit Span, and Tower of London) and a number of secondary cognitive outcome measures. Of the primary outcome measures, only Digit Span performance showed durable gains with CRT over the 6-month follow-up. For the secondary outcome measures, there was a differential treatment effect favoring the CRT group on measures within the memory domain, but not the cognitive flexibility or planning domains. The results suggest good durability for improvements in memory but not for the other 2 targeted domains.

Neuropsychological Educational Approach to Rehabilitation

The manualized Neuropsychological Educational Approach to Rehabilitation (NEAR) program developed by Medalia[34] is founded on teaching techniques developed within educational psychology that are designed to promote intrinsic motivation and task engagement. The NEAR conceptual model favors a top-down approach that emphasizes higher-order, strategy-based methods of learning over drill-and-practice exercises that focus on learning of elementary cognitive skills (bottom-up approach). Training involves participation in computer-based cognitive exercises that are designed to be engaging, enjoyable, and intrinsically motivating and that require the recruitment of several cognitive skills within a contextualized format.

Medalia et al.[35] investigated a component of the NEAR program in a sample of 54 inpatients with schizophrenia. Participants were randomly assigned to problem-solving remediation, memory remediation, or a control group. CR participants worked with either problem-solving or memory-enhancing computer games in 2 weekly 25-minute sessions for 5 weeks. The group assigned to problem-solving training worked with the "Where in the USA is Carmen Sandiego?" software program. This program is colorful, cognitively challenging, and provides strategy-oriented feedback. Memory training involved a less engaging computer-based program (Memory Package software) that emphasized verbal and visual memory. Participants in the problem-solving group improved to a greater extent in problem solving than those in the memory or control groups. However, participants in the memory training group did not show any differential training effect on memory. The effects of remediation on problem solving persisted 4 weeks after training.[36]

In an earlier study Medalia et al.[37] examined the effects of individual computer-based training of attention using a software program developed out of Ben-Yishay's lab.[26] The study included 54 inpatients with schizophrenia who were randomly assigned to computer-based cognitive training using the Orientation Remedial Module or a control condition that involved the viewing of video documentaries. Training within each module followed a test-train-test sequence and lasted approximately 20 minutes. The tests administered at the beginning and end of each session measured visual reaction time. In between, participants worked on 1 of 5 training modules. Progression through 1 module was believed to build skills necessary for successful mastery of later ones. After 18 sessions the results showed significantly greater improvement in the cognitive training group compared with the control group on the primary outcome measure, a computerized continuous performance test. Results of the studies conducted by Medalia et al. suggest that intrinsic motivation may be an important consideration for promoting rehabilitation success.

In an interesting extension of their work, Medalia and Richardson[38] reported on moderating variables of rehabilitation outcome. Data were collected from 3 of their studies (total N = 117) that used NEAR or elements of it. Three broad categories were examined: patient characteristics, illness characteristics, and treatment characteristics. Patients were dichotomized as "improvers" or "non-improvers" according to whether they showed reliable improvement in at least 1 cognitive domain. The change index was calculated by dividing change scores on each dependent measure by its standard error of measurement. The results showed that illness factors were least related to training outcome. However, patient and treatment factors differentiated improvers from non-improvers. Specifically, treatment intensity, type of cognitive remediation program, therapist qualifications, patient's motivation for treatment, and baseline work habits differentiated improvers from non-improvers. These findings suggest that a host of variables, including motivation and dosing, may be important considerations in formulating CR training.

Attention Process Training

Attention Process Training (APT) was developed by Sohlberg and Mateer[39] as an approach to CR for persons with traumatic brain injury. Four areas of attention are targeted for training: sustained, selective, dividing, and alternating attention. Four different types of material (auditory and visual cancellation tasks, mental control tasks, and daily life tasks) are used. The training exercises are arranged in hierarchical difficulty; participants progress through training exercises after establishing mastery at each stage. Like CET and NET, APT follows a building block approach. Skills acquired in earlier stages are viewed as prerequisite for skill development in later training stages.

Though APT has been used successfully in studies of brain-injured patients, there is little data on its efficacy with schizophrenia patients. Lopez-Luengo and Vazquez[40] examined the efficacy of APT in a sample of 24 schizophrenia patients. Participants were randomly assigned to APT or treatment as usual. Participants in the APT group received training twice per week; however, the number of weeks of training varied considerably across patients (range = 8 to 76). Training sessions were on the average less than 1 hour. A large number of attention measures were included in the battery. These were specifically designed to capture the 4 areas of attention that were targets of training in APT. Measures of memory and executive functioning were also included. Despite the number of measures, the study yielded only 1 significant finding on attention, and it was in the unexpected direction (the control group showed greater pre-post improvement than the APT group). The APT group did show a differential treatment effect on the measure of executive functioning (WCST) but not on the Spanish-translated version of the California Verbal Learning Test (CVLT) (the measure of memory). There was no statistical control for the number of comparisons in the study, so the WCST results have to be viewed somewhat cautiously. In sum, the findings are largely negative from this study.

There is a small study of APT in schizophrenia that examined APT and Prospective Memory Training (PROMT).[41] Three patients were assigned to cognitive rehabilitation training using APT and PROMT; data for 3 other patients were drawn from the University of Pennsylvania Schizophrenia Center database. APT preceded PROMT training. Training was conducted 2 times per week in 1-hour sessions over a 5 to 7-month period. The 3 subjects who received training were administered an attention battery before and after training. There were no formal analyses of the data. Subjects #1 and #3 were described as showing improvement on measures of sustained attention (cancellation tasks). Subjects #1 and #2 were described as showing improvement on the measure of divided attention (auditory consonant trigrams). There were no other noteworthy observations of pre-post differences for any of the three patients on the other attention measures (Digit Span, Stroop, CPT).

Attention Shaping

Behavioral-based approaches for modifying behavior, even cognition, are not new.[42,43] Shaping involves the differential reinforcement of successive approximations toward a target behavior. Behaviors that approach the desired target are reinforced; nondesired behaviors are not. Initially, training focuses on behaviors that have a high likelihood to occur within an individual's existing behavioral repertoire (eg, sitting up for 30 seconds). Once that behavior becomes established (ie, occurs regularly), the criterion for reinforcement is advanced so that the individual must perform a behavior that is closer to the end goal. The new behavior is then selectively reinforced, and these steps are repeated until the target behavioral goal is attained. Behavioral shaping procedures share methodological procedures with other training approaches such as errorless learning. One key difference is that in shaping, training is not explicitly designed to prevent mistakes or undesired behaviors from occurring, whereas in errorless learning the trainer takes active steps to prevent them.

Silverstein et al.[44,45] demonstrated that a group of 6 treatment-refractory schizophrenia inpatients' attention span during participation in a skills training group could be improved by pairing primary or secondary reinforcers (such as tokens) with the desired behavioral response. A set of individualized verbal and nonverbal behaviors was targeted for training. Nonverbal behaviors included behaviors such as keeping eyes open, keeping head up, and making eye contact with the group leader. Verbal behaviors included responding within 5 seconds and making spontaneous comments. After a baseline assessment and identification of individualized attention goals, shaping procedures were initiated during the group. Two observers who were not involved in conducting the group recorded the frequency of target behaviors during 15-minute intervals. After each interval, patients who met or exceeded their target goal received a token that could later be exchanged for 25 cents. Shaping procedures initially targeted relatively simple attention goals (eg, eyes open for 30 seconds) that were easily met, and they increased in difficulty as mastery was attained over time. Results indicated that all participants in the study showed significant pre-post gains in attentive behavior. Similar positive findings are reported from earlier studies with severely impaired schizophrenia patients.[42,46]

Behavioral shaping is the only evidence-based cognitive rehabilitation treatment for severely impaired, treatment-refractory schizophrenia patients. One concern with behavioral shaping procedures is that training gains are lost once reinforcement is discontinued. However, there is some data to suggest that gains may be more durable in clinical settings than would be anticipated.[42] The durability may be due to the fact that in treatment settings the reinforcing qualities of the originally trained-on reinforcer (a token) are transferred to other, perhaps more potent reinforcers (eg, social praise for engaging in the desired behavior, increased self-efficacy on the part of the patient). In the Silverstein et al. studies, patients may attain greater mastery and sense of success as they are able to meet behavioral goals through proscribed shaping procedures. Interestingly, though the behavioral shaping program initially begins with primary and secondary reinforcers aimed at gaining traction on the target behavior (ie, attention span), a secondary outcome of training may be improvement in self-efficacy and self-esteem. Arguably, promoting self-efficacy through training success is a goal in virtually all cognitive rehabilitation training programs.

In an interesting study with a complicated design, Silverstein et al.[47] examined the efficacy of individually administered APT (described above) followed by attention shaping administered within a skills training group. Participants were schizophrenia patients randomly assigned to APT plus attention shaping versus a control condition. The 2 groups were matched for training time. For the experimental group, training included 6 weeks of APT followed by 16 sessions of skills training with attention shaping. For the control group, training included 6 weeks of group treatment followed by 16 sessions of skills training without attention shaping. The behavioral outcome measure was a summary of the daily ratings of attentiveness for each participant. Neuropsychological measures included the Digit Span Distractibility Test, Sustained Attention Test, California Verbal Learning Test, and the Micro-Module Learning Test. The study yielded rather fascinating results. The experimental group showed dramatic improvement on the behavioral observational data of attention versus the control group. After training, the experimental group showed periods of attentiveness of an average duration of approximately 19 minutes compared with approximately 2 minutes for the control group. There were no group differences on the neuropsychological measures of attention, perhaps because of the lack of sensitivity of these measures at detecting behavior change. The study design did not allow for a direct comparison of the specific contributions of APT versus attention shaping, although relatively low levels of attentiveness were observed after APT that increased substantially with attention shaping. The slope of attentional improvement during the attention shaping phase was similar to that observed in previous studies.[45]

These findings underscore a key conceptual dilemma in cognitive rehabilitation, namely, "What are the most appropriate CR outcome measures?" Wilson,[48,49] in her work with brain-injured patients, has noted the poor relationship between cognitive impairment measured by neuropsychological tests and cognitive disability reflected in reduced ability to perform real-world tasks. Similarly, she has noted that reductions in cognitive disability occur in the absence of improvement on neuropsychological tests in patients involved in CR. These observations bring into question the selection of outcome measures used in studies of CR and warrant a reexamination of the field's goals for treatment (ie, disability reduction versus cognitive impairment reduction). Neuropsychological measures were not specifically designed to assess treatment changes in behavioral outcome. Hence, they may lack the necessary sensitivity to assess improvements in cognitive disability.

Compensatory Approaches

Unlike the approaches reviewed above that attempt to enhance cognition, compensatory approaches place primary emphasis on bypassing cognitive impairments to improve broader aspects of function. Impairments in cognition are circumvented either by recruiting relatively intact cognitive processes or by utilizing environmental supports and adaptations to cue and sequence target behaviors. Two illustrative compensatory programs are described.

Errorless Learning

Errorless learning is a training approach based on the theoretical belief that the commission of errors adversely affects learning in certain neurologically impaired groups. Two reports provide evidence that the commission of errors during learning is particularly problematic for persons with schizophrenia.[50,51] In an errorless learning approach, the task to be trained is broken down into small component parts with the simplest tasks trained first, followed by more complex ones. During training, a wide variety of teaching methods and instructional aids are implemented to prevent errors from occurring. Each component skill is then overlearned through repetitive practice. In errorless learning 2 procedural principles are emphasized: (1) prevention of errors during learning and (2) automation of perfect task execution.

Kern et al.[52] found that cognitive deficits were not related to vocational task performance in patients who were trained using errorless learning methods, but that cognitive deficits predicted performance in those trained by conventional means. This finding provides some evidence that errorless learning may in fact compensate for deficits in cognitive functioning in patients with schizophrenia. Kern et al. speculate that by utilizing this approach, the patient is not called upon to monitor mistakes and correct them. In addition, errorless learning may make use of implicit memory processes that may be relatively spared in schizophrenia patients in comparison to explicit memory processes. In a study of 65 clinically stable outpatients, Kern et al.[53] found errorless learning to improve performance of entry-level job-training tasks relative to conventional training. Moreover, Kern et al.[54] have extended the use of errorless learning to more complex tasks, such as social problem solving, with positive results.

Cognitive Adaptation Training

Cognitive Adaptation Training (CAT) is a compensatory approach using environmental supports and adaptations such as signs, checklists, medication containers with alarms, and the organization of belongings to prompt and sequence target behaviors such as taking medication and taking care of living quarters. Treatment strategies are based on a comprehensive assessment of cognitive functioning, behavior, and environment. CAT is based on the idea that impairments in executive functioning lead to problems in initiating and/or inhibiting appropriate behaviors. Using behavioral principles such as antecedent control, environments are set up to cue appropriate behaviors, discourage distraction, and maintain goal-directed activity. In addition, adaptations are customized for specific cognitive strengths or limitations in attention, memory, and fine motor control (eg, changing the color of signs frequently to capture attention, using Velcro instead of buttons for someone with fine motor problems). In 2 studies Velligan et al.[55,56] randomized a total of 90 medicated individuals with schizophrenia to 1 of 3 treatment groups: (1) CAT, (2) a control condition involving home visits and environmental changes not related to functioning (eg, bedspreads), and (3) treatment as usual. Participants in CAT improved in severity of symptoms and level of adaptive functioning compared with the other treatments groups. Effect sizes for improvements in adaptive functioning were large (Cohen's $d > 8.0$).

Summary

In general, the results from the review of these cognition enhancing and compensatory approaches to CR are encouraging. Improvements in cognition have been found using different theoretical and conceptual approaches and using computer- and noncomputer-based methods. The findings are not uniformly positive, but one would not expect them to be so at this stage of CR development. Few approaches have more than 3 data-based studies supporting their efficacy in schizophrenia. With respect to broader outcomes, more data is needed, but there is evidence that participation in CR can lead to improvements in social and vocational functioning.

One issue that remains to be clarified concerns dosing—that is, how often and how long does a participant need to be involved in training to show meaningful gains. This appears particularly germane given the recent findings from Medalia's lab concerning the relationship between training intensity and training outcome. At present, there are no agreed upon guidelines for levels of intensity and duration of training.

Looking Beyond Cognition: Motivation and Expectancies

The preceding review reflects a diverse and ever-growing movement aimed at addressing cognitive dysfunction in schizophrenia. Given the robust literature showing a relationship between neurocognition and functional outcome (see reviews[2–4]), most would argue that cognition is a worthwhile treatment target. However, despite its attractiveness, it is by no means obvious that the extent of disability that is prototypical of schizophrenia would be expected simply on the basis of the extent of cognitive impairment. That is, the functional disability of schizophrenia appears to be more severe than would be expected solely on the basis of general cognitive impairment on the order of 1–1.5 standard deviations below the normal mean (as revealed in the meta-analysis of Heinrichs and Zakzanis[10]). Clearly multiple factors contribute to this ''excess'' disability, including the burden of residual symptoms, the social stigma of mental illness, and illness onset disrupting the acquisition of the education, vocational skills, and normative experience needed to navigate the transition to adult independent role functioning, among others. Insofar as these ''noncognitive'' variables contribute to disability, it stands to reason that they will also likely limit the direct translation of gains in cognitive performance achieved through rehabilitative techniques into enhanced functional status. However, even after considering the contribution of the above social and symptomatic factors, it is our clinical view that the illness typically includes a compromise in motivation that is responsible for some of the ''excess'' disability and is therefore a critical treatment target.

Motivation can be defined as an internal state or condition that serves to activate or energize behavior and give it direction. Clinical observation of many patients suggests a profound lack of active, adaptive engagement with the environment. Although many patients possess certain cognitive skills and routines when assessed formally, these skills are often not brought to bear on events and challenges encountered in daily life. In essence, standard environmental cues do not appear to reliably activate the effort of patients, and many fail to adjust their performance in the face of changing contingencies. Similarly, the experience of success, and of failure, often does not lead to behavioral adaptation as one might expect in a non-ill group. Thus, the essential impairment in schizophrenia appears to be focused at the intersection of cognitive and motivational processes, where the consequences of actions serve to shape changes in behavior leading to more successful adaptation.

Recent basic neuroscience research has suggested that the dopamine system plays a critical role in precisely this type of ongoing behavioral activation and regulation.[57] Two lines of research are particularly germane for the clinical phenomenology of schizophrenia and a consideration of rehabilitation. Based on a large body of animal research, Berridge and Robinson[58] have argued that the dopamine system plays a critical role in the generation of reward-seeking behavior rather than of hedonic experience itself. That is, dopamine is involved in how much an animal ''wants'' a reward, not how much they ''like'' a reward, as shown in studies where the administration of dopamine-blocking drugs reduces the amount of effort/work that an animal will make to receive a reward but does not alter actual reward consumption. This conceptualization of the role of dopamine has been captured in the term ''incentive salience,'' suggesting that dopamine cell firing serves to increase the salience or desirability of a stimulus or action that is associated with a rewarding outcome. This notion is particularly relevant for schizophrenia, as a large body of research clearly demonstrates that patients experience surprisingly normal responses to a wide array of emotionally evocative stimuli.[61–66] In essence, many patients with schizophrenia are not truly anhedonic: the observable muted emotional expressiveness and lack of goal-directed behavior cannot be attributed to an actual decrease in emotional experience or pleasure. Instead, it appears that many patients do not ''want'' the things that they ''like.'' The extent to which this is intrinsic to the illness versus an adverse outcome of treatment with dopamine-blocking drugs is a critical issue for future research.[67–69] However, this basic science highlights an important clinical challenge: insofar as the ''wanting'' system is compromised in patients, it can be expected that positive outcomes and experiences achieved in rehabilitation settings will drive learning in a less than optimal or expected fashion. Indeed, it is possible to conceptualize the efficacy of behavioral treatment approaches through the use of the salience framework. One of the hallmarks of social learning and token economy approaches is that these interventions serve to highlight the ''value'' associated with various behaviors. This explicit and externally provided mapping of action outcomes may well compensate for a patient deficit in the ability to use internal representations to serve this function. The success of these approaches demonstrates that the reward system in schizophrenia is not completely shut down and unavailable; the system can be activated with vigorous external cueing.

The incentive salience line of pharmacological research is complemented by single cell recording studies of behaving nonhuman primates that have detailed the role of dopamine cell firing patterns in ongoing behavioral regulation and learning. Studies in behaving nonhuman primates have shown that phasic increases in dopamine cell firing occur when events are better than expected or predicted.[57,70–72] Similarly, transient decreases in dopamine cell firing occur when events are worse than expected. These phasic increases and decreases in dopamine cell activity have been shown to correspond with those generated by temporal difference error learning algorithms widely used in the area of machine learning and computational modeling.[57,73,74] In these models the error signal is used as a means of optimizing ongoing behavioral performance, and applied to behaving primates or humans, it is hypothesized that the dopamine error signal (DA) is broadcast to multiple striatal and frontal areas and serves to guide reinforcement learning and activate cognitive control. This reinforcement learning ''system'' is obviously relevant in the case of highly salient rewarding stimuli and experiences. However, several recent computational modeling and event-related potential studies have suggested that this same basic mechanism is involved in mediating human cognitive control, error monitoring, decision making, and managing the contents of working memory.[75] McClure et al.[76] have argued that the different emphases of temporal difference error models versus the salience model of Berridge and Robinson are more apparent than real and can be reconciled within a unified computational approach. In essence, this is a transactional system, where learning occurs in relationship to both external outcomes and expectancies, and which deals with extended sequences of behavior. If schizophrenia were to compromise the functioning of this system, the results would be profound (a notion addressed from a different perspective 35 years ago by Stein and Wise[77]). In essence, patients would have difficulty initiating behavior to pursue valued goals, leading to a failure to develop the competencies needed to achieve them. Further, they would fail to make behavioral adjustments in the face of negative outcomes.

If the functional disability of schizophrenia is caused, at least in part, by dysfunction within this cognitive/motivational system, this system may be a critical, explicit target for remediation efforts. CR interventions are often designed in an effort to attenuate the negative impact of motivational deficits on the task at hand—improving cognitive skill. For example, many approaches use high levels of positive social feedback or actual token reinforcers for on-task cognitive performance. Another design strategy includes manipulating expectancies for success. It will be important to identify which types of external manipulation of reinforcement contingencies best address the underlying systems' level of dysfunction.

One model, the NEAR program,[34] has been designed with a specific focus on motivational issues, building on a large body of educational research that has emphasized the importance of intrinsic motivation. Intrinsic motivation occurs when task performance, in and of itself, is rewarding. Such tasks elicit high levels of engagement and active interest on the part of the learner. Indeed, there is a large, and somewhat controversial, literature that suggests that extrinsic rewards may actually serve to decrease intrinsic motivation, at least in specific task environments. Three aspects of the NEAR model are designed to enhance intrinsic motivation. First, the program utilizes educational software packages that are highly engaging. Thus, rather than the repetitive "drill and practice" of cognitive routines that is common to other computer software programs, the NEAR software is chosen to engage cognitive routines in a visually interesting, interactive context. Second, patients are encouraged to choose the programs and activities that are the focus of the rehabilitation sessions. Although the leader can be helpful in assisting the patient to make a selection, the patient is free to choose what he or she may like to do best, thereby increasing the role of intrinsic motivation. Further, the NEAR leader serves as more of a coach than a teacher; rather than teaching a specified curriculum, the leader provides prompts and tips that serve to help the patient get further along the path he or she has chosen. Thus, the overall clinical model is designed to enhance the motivational salience of the activities and the role of the patient as an independent agent in the rehabilitation process.

Available data to date suggest that the NEAR model does yield measurable significant cognitive benefits. These benefits are largest in the participants who were most actively engaged in the program as reviewed by Medalia and Richardson.[38] Patients who completed the same number of sessions over a much longer period demonstrated much more modest cognitive benefits. Two hypotheses are suggested by these data. First, it is possible that the results simply reflect an effect of more "massed" rather than spaced practice. Alternatively, it is the activation of intrinsic motivational processes that serves to enhance the cognitive benefits of NEAR. While speculative, the latter idea can be seen as consistent with the role of dopamine in enhancing learning through the selective reinforcement of successful cognitive routines.

Other models of CR, though not designed around the issue of intrinsic motivation, address motivation in different ways. For example, in Cognitive Adaptation Training it is possible that the environmental supports that prompt and sequence appropriate behavior may bypass deficits in intrinsic motivation, as they tend to rely more on basic stimulus-response learning. All the models described herein provide a great deal of positive reinforcement for participation, including social support and praise. In addition, some offer money for time spent in remediation. The extent to which such externally mediated rewards serve to increase the level of intrinsic motivation that can persist after withdrawal of the treatment sessions is an important issue. That is, the question of interest may not be the persistence of trained cognitive/behavioral response repertoires but the likelihood that such responses are likely to be elicited on the basis of internal representations and goals. Silverstein and Wilkniss[18] and Silverstein et al.[78] have suggested that this process can be aided by making the goals of treatment more personal and making the process of therapy more goal-directed and understandable for the participant. Silverstein et al.[78] describe a model of increasing the base rate of a desired behavior through extrinsic reinforcement, which then leads to a positive gain spiral of improved self-efficacy, intrinsic motivation to perform the behavior, and increased task engagement and performance. While evidence for simple durability of training effects is scant, the question of the persistence of motivational gains has not been investigated explicitly.

The issue of expectancies appears to be addressed to some extent by many of the models described herein. Standardized computer tasks allow for very precise alteration of the level of task difficulty based on an individual's performance. As performance improves, the difficulty of the task is increased, keeping expectations for success fairly constant and at a high level. Similarly, with errorless learning and environmental supports, the expectations for success are kept high. With errorless learning in particular, training is designed to minimize and if possible eliminate the occurrence of errors during the learning of new tasks and skills. These procedures function to bypass the need to make adaptive changes to environmental feedback (eg, developing an alternative response following a mistake). As noted above, there is reason to suspect that the usage of negative feedback may be an important area of deficit in schizophrenia linked to dysfunction of the dopamine system, where such error information is encoded as a transient cessation of dopamine cell firing. In addition, increasing patients' expectancy of success in the performance of these tasks may help motivate patients to continue task performance and develop competencies that he or she would be unable to develop in an unstructured environment with a higher probability of failure.

Though this discussion is speculative, it is clear that issues of motivation and expectancies have potentially important implications for conceptualizing the conduct and targets of CR. Targeting cognition alone may restrict the ability to see meaningful gains from rehabilitation efforts. For example, if the target of remediation is verbal memory, but a patient's functional disability is not in the capacity to remember information but in the ability to use memory in the pursuit of goals, enhancements in memory per se, while welcome, may be insufficient to produce clinically meaningful change in behavior. Second, the role of affective and motivational factors, particularly in how these intersect with cognitive processing, may need to be more deliberately addressed in CR interventions. These processes are briefly discussed in a recent review by Silverstein and Wilkniss.[18] Simply providing salient stimuli (perhaps as in social, role-playing-type exercises) may be useful in the conduct of CR sessions, but it is unknown if this results in increased responsiveness to the salience of events outside of CR. We concur with the recommendation made by Barch 2005[79] that the field focus its energy on defining motivation and on the development and testing of assessments for use with patients with schizophrenia. Perhaps utilizing a measure of treatment engagement or working alliance would help to clarify the relationship between motivation to engage in CR and outcomes from cognitive rehabilitation. Third, if part of the essential deficit in the illness is a form of disengagement from the environment, the emphasis on a trainer-driven curriculum of exercises, as is typical of the field, is also open to question. That is, such approaches may not challenge the passivity that is characteristic of the illness, unless care is taken to engage the patient in a fully collaborative fashion. It is possible that the extent to which models are trainer-driven versus driven by the individual may be related to the variation in effect sizes between studies. Some evidence suggests that studies that adopt a more strategic approach to learning versus drill and practice seem to produce larger treatment effects.[19,80] As should be clear, we are far more certain that motivational deficits are a critical part of the illness that need to be targeted by CR than we are confident that we know how to treat them at present. Current intervention approaches all acknowledge the importance of these problems in the conduct of CR. We suggest that the cognitive gains achieved through CR are likely to be consequential for functional outcome to the extent that these underlying motivational and self-regulatory mechanisms are altered in the context of CR.

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