SPECIAL REPORT



The empirical basis for the

practice of cognitive remediation for schizophrenia

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Practice points

- Cognitive remediation (CR) for schizophrenia is a behavioral learning-based intervention that aims to improve neurocognitive and social cognitive deficits that significantly impair psychosocial functioning.
- Methods of CR typically include common elements crucial for cognitive learning, such as practice and strategy coaching, with the end goal of durability and generalization.
- CR is founded upon the principle of neuroplasticity that neural connections can be strengthened and/or repaired by repeated exposure to new experiences – to restore cognitive skills that were adversely affected by illness processes.
- CR is empirically supported by a vast literature indicating medium effects on cognition and sustained learning, and moderate effects on daily functioning.
- Treatment effects are greatest when CR sessions are delivered at least twice weekly and when CR is integrated within the context of a broader psychiatric rehabilitation program.
- Effective programs of CR should include practices to generalize cognitive gains and enhance transfer to functional skills, to personalize learning activities with respect to task complexity and individualized learning goals, and to enhance motivation for learning.
- CR learning goals are recovery oriented and may be framed with respect to extrinsic goals, such as vocational and educational attainment and/or intrinsic goals such as personal growth and enhanced self-efficacy.
- Learning activities that include instructional techniques to promote intrinsic motivation are associated with immediate and sustained improvement on task-specific learning and generalized cognition skills.
- Future research needs to delineate the client and treatment characteristics associated with the best treatment outcome, and examine the dissemination practices that will ensure positive treatment outcomes when CR is implemented in the community.

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SPECIAL REPORT Saperstein & Medalia

SUMMARY Cognitive remediation is a behaviorally based training intervention that aims to improve cognitive deficits that impose a significant barrier to everyday functioning. Cognitive remediation for schizophrenia is based on principles of neuroplasticity, and methods of treatment are informed by rehabilitation psychology, neuropsychology and increasingly by theories of motivation. On the whole, cognitive remediation for schizophrenia is shown to improve neurocognition and psychosocial outcomes with effect sizes in the moderate range. Accumulating data indicate that treatment intensity and treatment setting moderate outcomes, and instructional techniques that enhance intrinsic motivation for learning promote engagement, facilitate learning and augment sustained learning outcomes. This article reviews these techniques, drawing from empirical data, and proposes future directions for research in order to further augment treatment outcomes and help people with schizophrenia better achieve their personal goals for recovery.

Cognitive impairment is a core symptom of schizophrenia that is evident at first episode of psychosis and is persistent but stable, throughout the course of illness. While 70-80% of people with schizophrenia show cognitive impairments relative to the general population, close to 100% have cognitive deficits relative to their own premorbid ability level. The magnitude of cognitive deficits is typically in the range of one to two standard deviations below the mean for healthy individuals as measured by standardized neuropsychological tests [1-3]. Neurocognition has been shown to have prognostic value, predicting whether a person with schizophrenia will be able to meet functional goals [4], and thus continues to be an abundant and critical area of continued research. The cognitive symptoms most frequently cited as impacting functional outcome in people with schizophrenia are captured by the acronym, SMART: speed of processing, memory, attention, reasoning, tact/social cognition (Box 1). Impairment in these domains is related to symptom management and participation in psychosocial rehabilitation programs, and to skills integral to community integration, including functioning in social, vocational and educational domains [1,5,6]. Cognitive deficits significantly add to illness burden and thus have increasingly been the focus of developing cognitive remediation (CR) interventions over the last 20 years [7].

CR fundamentals

There are two central tenets underlying all treatments defined as CR for people with schizophrenia: cognition can be rehabilitated through behavioral learning-based interventions that promote neuropsychological and social cognitive skill performance; through targeting specific areas of dysfunction, improvements in cognitive performance are translated to produce changes in real-world functions. These tenets were recently ratified in a meeting of the Cognitive Remediation Experts Workshop (Florence, Italy, 2010), resulting in the first uniform definition of CR: "Cognitive remediation is a behavioral training-based intervention that aims to improve cognitive processes (attention, memory, executive function, social cognition, or metacognition) with the ultimate goal of durability and generalization" [8.9].

Specific methods of treating cognition in schizophrenia are founded upon cognitive psychology and neuropsychology. In addition, CR is inspired by methods of rehabilitation with neurologically impaired populations and is often informed by methods of learning enhancement developed within the fields of educational and clinical psychology. CR for schizophrenia is predicated upon evidence for experiencedependent neuroplasticity - that neurons in the brain adjust their activity in response to new situations or changes in the environment. Given that plasticity is evident throughout the lifespan, cognitive training exercises can be introduced to restore those cognitive skills that have been adversely affected by illness processes. The physiology of experience-dependent neuroplasticity suggests that through practice of critical cognitive processing skills, using adaptive training techniques that stimulate arousal, attention and intrinsic motivation, cognitive impairment may be reversed [10,11]. A systems neuroscience conceptualization of cognitive training frames cognitive learning in terms of the long recognized neuropsychological principal that component cognitive functions do not operate in isolation and that when people use their cognitive skills in real-life situations, parallel engagement of multiple cognitive domains is reflected in activation of multiple brain areas. To the extent that cognitive remediation engages multiple component Box 1. Common neurocognitive deficits linked to functional outcomes.

Speed of processing

The ability to automatically and fluently perform cognitive tasks

Memory

The ability to maintain an accurate representation of information in memory storage for current use and later recall Attention

The ability to focus and attend to target stimuli

Reasoning/problem solving

 A higher-order ability to sort through possible solutions and select appropriate means of approaching a problem Tact/social cognition

The ability to generate appropriate responses within a social context using affect recognition, social perception, attribution and theory of mind

cognitive functions it facilitates improvements across distributed regions of brain activity; evidence supports these models. Randomized controlled trials have indicated CR-specific brain changes in functional connectivity and/or areaspecific activation patterns, paired with changes in cognitive performance and generalized functional outcomes [10,12]. There are also data in schizophrenia samples showing an association between CR and a decelerated loss of and, in some cases, increase in gray matter volume, associated with improved cognition [13].

Cognitive training may target fundamental information processes in the visual and/ or auditory domains, as well as more complex cognitive skills, ranging from simple attention and memory to complex problem solving. Computerized cognitive training is most often employed, although paper-and-pencil or verbal tasks may also be used. At present, there are multiple software programs marketed for CR for schizophrenia and other neuropsychiatric disorders. Some software activities, for example, those that train facial affect recognition and theory of mind, were specifically designed to address the particular social cognitive deficits associated with schizophrenia. Other software exercises were designed to address cognitive disorders in multiple disease states and may vary in cognitive emphasis and scope, depending on the population and purpose for which training was designed. While there have been no head-tohead comparisons of software programs or packages for schizophrenia patients, programs that engage learners and capitalize on motivational properties of cognitive tasks yield more favorable outcomes [11]. Restorative approaches targeting basic neurocognitive skills are commonly paired with cognitive, social cognitive and social behavioral exercises, and/or metacognitive (cognition concerning one's own cognition) exercises to

contextualize cognitive processes, aid abstraction and assist individuals to develop strategies for completing cognitive tasks [14-16]. Data suggest that strategy-based instruction in CR is important for improving functional outcomes, as it has been speculated that this approach supports transfer of training [9]. Given that cognitive deficits in the schizophrenia population are heterogeneous, broad approaches that target multiple domains and levels of cognitive impairment will probably provide the most benefit to the largest number of patients [17].

CR is often considered a variant of cognitive behavioral therapy because it is a behavioral treatment that targets cognition. While CR targets basic neurocognitive skills (e.g., processing speed, attention and memory), other cognitive behavioral treatments target higher cognitive problems such as disordered thinking or thinking (cognitive) errors [18]. Because neurocognitive deficits may negatively impact the ability to benefit from psychosocial treatments, CR is sometimes integrated with vocational training [19,20], social skills and independent living skills training [21], to enhance functional outcome. CR is therefore different from, but complementary to, other cognitive or behavioral therapies [9].

In the clinical community, CR can be found in long-term residential or inpatient settings, and in outpatient clinics that offer psychosocial rehabilitation programming. CR is conducted by mental health clinicians who receive specific training to perform this intervention. Research has guided methods through which CR may be conducted and continues to guide the development of new intervention strategies to optimize cognitive and functional outcomes.

Empirical evidence for CR

Recent meta-analyses of CR for schizophrenia have studied over 2000 patients [9,22] from 40 independent studies meeting the following selection criteria:

- Intervention fulfilling the Cognitive Remediation Experts Workshop definition for CR;
- ≥70% of participants diagnosed with schizophrenia;
- All participants receiving standard care, including medication;
- A comparison group and allocation procedure;
- A cognitive or functional outcome distinct from the trained tasks.

The most recent and largest meta-analysis found no evidence of publication bias or bias of results by trial methodology [9].

Meta-analytic reviews describing schizophrenia samples have characterized the average CR research participant as approximately 36-years old, with 12 years of education, mild-tomoderate psychiatric symptoms and receiving psychiatric treatment on either an inpatient or outpatient basis. In a clinical research setting, CR is delivered, on average, for a total of 32 h, two-to-three times per week over the course of 17 weeks. The average rate of attrition from CR research studies is 11% [9], while in community-based programs, average treatment utilization ranges from 65 to 85% [15]. Drill-andpractice exercises are most frequently employed in clinical research, and target on average approximately three of the following cognitive domains: attention, executive function, working memory, verbal learning and memory, processing speed and affect recognition [9,22]. CR for schizophrenia has a medium effect size (ES) for improving overall cognition (ES: 0.41-0.45) and daily functioning (ES: 0.36), with a small effect on improving psychiatric symptoms (ES: 0.28) [22]. ES for specific domains of cognition are small to medium (ES range: 0.25-0.65),

Box 2. Moderators of cognitive remediation outcome.

Treatment intensity

Cognitive remediation delivered in two or more sessions per week has a larger effect on cognitive outcomes compared with sessions delivered on a less frequent basis

Treatment context

 Cognitive remediation integrated as a component of psychiatric rehabilitation has a larger effect on functional outcome measures than cognitive remediation administered as a stand-alone treatment with the impact on affect recognition, verbal learning and memory typically larger than for other domains. The persistence of effect has been measured in at least 11 studies, showing on average that after 8 months there continues to be a moderate effect (ES: 0.43) for cognitive improvement [9]. Still, there is a range of response with more psychiatric symptoms and motivational compromise associated with less improvement [9,15]. The more psychotic and unmotivated participants may benefit from an additional course of treatment, especially if it includes instructional techniques tailored to their needs.

Although there are a variety of approaches to CR for schizophrenia, the meta-analytic findings have failed to detect any appreciable difference in the magnitudes of effect [9]. However, a number of factors have been shown to significantly moderate the impact of CR, including treatment intensity and treatment context. **Box 2** provides a summary of significant empirical findings which guide how and where CR for schizophrenia is conducted.

Maximizing therapeutic outcome

Evidence gathered across clinical and experimental research studies calls attention to three general treatment approaches to maximize therapeutic outcome. Approaches to enhance generalization, personalize treatment and enhance motivation guide current empirically informed applications of CR in the clinical community, and continue to be researched in order to develop new empirically based techniques that augment learning for people with schizophrenia. **Box 3** provides an integrated summary.

Enhance generalization of cognitive gains

The ultimate goal of CR for schizophrenia is to generalize cognitive gains to enhance psychosocial functioning. There are data to suggest that as cognitive skills are exercised in multiple contexts, generalization of cognitive to functional skills is more likely to occur. While repeated practice on one task may allow for transfer of cognitive skills to new tasks with similar properties, practice of the same skill on an array of tasks or in different modalities will facilitate transfer of training to a wider array of novel tasks and contexts [23–25]. Strategy coaching may be incorporated to encourage self-monitoring, verbalization and the development of compensatory techniques to successfully approach new

Box 3. Treatment strategies that optimize motivation and learning outcomes.
Generalization
Repeated practice of cognitive skills in multiple contexts
Strategy coaching and development of compensatory techniques
Bridging group discussions
Integration of cognitive remediation with psychosocial rehabilitation programs
Personalization
Tailored curriculum of cognitive tasks to target specific cognitive skills pertinent to salient goals
Learning activities adjust in level of difficulty to suit degree of initial impairment
Titration of cognitive exercises (complexity and difficulty) to accommodate gradual improvement
in cognitive functioning
Instructional techniques
Identification of intrinsic and extrinsic goals for cognitive remediation
Motivated goal framing for cognitive learning

- Enjoyable learning context to enhance intrinsic motivation
- Contextualization of learning activities to real-world functions
- Opportunities for choice and learner control to enhance intrinsic motivation
- Enhance self-efficacy for learning tasks to improve motivation

cognitive challenges [14]. In addition, bridging groups are verbal groups that may accompany computerized or paper-and-pencil cognitive exercises, and serve to facilitate the transfer of cognitive skills [15]. Bridging groups promote metacognitive processing, which fosters the integration of lower and higher order cognitive functions, and provide a social learning context to reinforce the link between cognitive learning, everyday life and rehabilitation goals. Similarly, cognitive training is more likely to generalize to psychosocial outcomes when integrated with psychosocial skills training such that learning is placed in a therapeutic context emphasizing vocational skills, skills needed to succeed in an academic setting, healthy/wellness behaviors and symptom management.

Personalize treatment

The remediation methods employed and functional contexts in which CR is conducted are guided by theory and empirical data, but are adaptable to suit the needs of the population with whom the program is implemented. A fundamental element of effective programs of CR for schizophrenia is that a treatment plan may be tailored to suit the specific needs of the individual [15]. Baseline and continuous assessment of cognitive functioning, goal setting and tracking of goal attainment are crucial. Based on cognitive skill level, training activities may be selected to target specific cognitive abilities or areas of functioning in the context of an individual's personal strengths, weaknesses and one's unique rehabilitation goals. To some extent this can be accomplished within computer-based CR by software programs that use adaptive tasks that automatically calculate the appropriate menu of activities or adjust in level of difficulty based on current performance. Effective software programs utilize an algorithm to achieve maximal engagement in a cognitive activity. Engagement is maximized by identifying the success rate that keeps learners continuously challenged but minimally frustrated. Many programs utilize a set success rate of 80%, but some programs allow for titration, which has the potential to personalize treatment for people with performance anxiety. In addition, scaffolding is a prevalent training technique that ties task complexity to the individual's level of competence. This may initially entail employing learning tasks with clearly defined aims and proximal goals, and gradually moving towards more challenging tasks with increasingly distal goals [25], thus ensuring that the participant continues to be simultaneously challenged and successful. Personalization of a CR program is thus achieved by adjusting the curriculum and difficulty level to suit the needs of every individual and by linking learning to personally relevant goals.

Promote motivation

In as much as CR is a training activity, it relies on principles of learning, which include the role of motivation in the learning process. Since motivation is fundamentally compromised in schizophrenia [26], the prospect of identifying methods to enhance motivation to engage and persist on learning tasks is important to improve response to cognitive intervention and overall psychiatric rehabilitation. Self Determination Theory is a widely accepted theory of motivation that articulates a broad framework guiding an understanding of the individual differences and contexts that facilitate or undermine motivated behavior [27]. The theory distinguishes between intrinsic and extrinsic motivation. While intrinsically motivated behavior stems from one's enjoyment, interest in, and perceived utility value of a task, extrinsically motivated behavior is driven by pursuit of outcomes separate from the task, in relation to rewards or punishments linked to the behavior or task. Motivated goal framing is a technique that may be used in CR to link in-session activities to real-world experiences. Learning may be enhanced when goals are salient to the individual. Motivated goal framing can be incorporated into a CR program by identifying:

- Personal rehabilitation goals (e.g., educational, vocational, social, illness management or independent living);
- The role of cognition in relation to extrinsically oriented goals (e.g., enrollment in a work training program) and/or extrinsic rewards (e.g., obtaining a job or improving school performance);
- The role of cognition in relation to intrinsically oriented goals (e.g., learning or personal growth) and/or intrinsic rewards (e.g., self efficacy, social interaction or community integration).

Experimental data indicate that both intrinsically and extrinsically motivated goals can influence learning behavior and outcomes, although data suggest a relative beneficial effect of intrinsic motivation on learning [28]. When cognitive learning employs instructional techniques that provide an enjoyable learning environment, contextualize learning activities in reference to real-world scenarios and personal goals, and provide opportunities for choice, emphasizing personal control and supporting self-efficacy, intrinsic motivation and learning outcomes are enhanced [29-33]. In schizophrenia samples, cognitive learning paradigms that enhance intrinsic motivation are associated with deeper information processing, greater task persistence,

enhanced learning outcomes and greater maintenance of learned material over time [29]. The benefit of incorporating motivational enhancement techniques into CR for schizophrenia is given by ES for learning outcomes, including improvement on task-specific learning (ES: 0.7) and generalized cognition-attention (ES: 0.4) [29.33].

Strategies used to enhance generalization and to personalize treatment also serve to increase intrinsic motivation for learning. Contextualization of learning activities entails exercising cognitive skills in varied contexts, including those that simulate real-world scenarios. Contextualization not only enhances generalization, but also reinforces the link between cognitive skills and real-world functioning, thus making salient the utility value of cognitive tasks in reference to personalized goals. Opportunities for choice during learning allow for learner control with respect to self-initiation and self-direction during the session. Providing a menu of learning options from which the individual may choose, as well as employing personal goal tracking, tailors CR to the individual as well as supports feelings of autonomy and self-competency, and in turn, intrinsic motivation. A learning climate perceived as being autonomy-supportive, as opposed to controlling, is associated with greater task engagement, persistence and learning over time [27]. Perceived competency for learning tasks is a strong predictor of cognitive gains in people with schizophrenia, as those who anticipate being competent on learning tasks tend to choose more difficult tasks persist more, and thereby achieve a high level of success [33].

Future perspective

The wealth of data supporting the efficacy of CR for schizophrenia has generated considerable interest in bringing CR to the community, and dissemination is therefore the primary challenge that lies ahead. Many questions remain to be answered in order to facilitate widespread dissemination (**Box 4**). Broadly speaking, these questions fall into two categories:

- What are the client and treatment characteristics associated with the best treatment outcome?
- What are the dissemination practices that will ensure a positive treatment outcome?

In regard to the first question, there is still

Box 4. Future perspectives: issues for research on cognitive remediation in schizophrenia.
Treatment outcomes research
Role of age and cognitive profile in treatment response
Efficacy of booster sessions to sustain treatment gains
Role of adjunctive medications
Relative merits of top-down versus bottom-up approaches to remediation
Role of motivation-enhancing techniques
Consensus on essential cognitive remediation practices
Identify broad parameters that constitute a cognitive remediation exercise
Develop standards for evaluating new software programs
Dissemination practices
Advocate for reimbursement for cognitive remediation services in community mental health
Develop empirically supported methods of clinician training

- Develop empirically supported methods of clinician training
- Standardize evaluation of clinician competency to conduct cognitive remediation
- Measure implementation fidelity with a reliable and valid measure of fidelity
- Integrate cognitive remediation into recovery-oriented programs
- Conduct effectiveness research on implementation of cognitive remediation in the community

much to learn about dosing, use of booster sessions, use of adjunctive medications, the role of motivationally enhancing techniques, and the relative merits of top-down or bottom-up approaches for various clinical situations [34]. There is also a need to have some consensusdriven rubric for identifying the broad parameters that constitute a CR exercise. CR exercises are constantly being developed by software companies and as clinicians and consumers confront a charged and lucrative marketplace with companies competing to sell their software, it will be essential to have guidelines to evaluate the new products. Some have argued that the solution is to obtain US FDA approval for software to be registered as a therapeutic device, while others have asserted that it is premature to involve government regulation, particularly for a product that has no known harmful effects [35]. Practitioner and research-derived rubrics for evaluating CR exercises do exist. For example, the utility of software programs may be evaluated with respect to the cognitive abilities exercised and the motivational properties of the learning activities, such as contextualization (i.e., relevance to daily life), availability of choice (i.e., flexibility of the program features), opportunities for self-perceived competence (i.e., provision of feedback and experience of success) and opportunities for personalization [15]. Routine use of evaluative procedures may facilitate the development of standards by which CR for schizophrenia is implemented across treatment settings.

In regard to the second question about

dissemination practices, the first challenge relates to fiscal policies. To date, New York is the only state in the USA that reimburses for CR provided to psychiatric patients. Following a research-informed policy implementation protocol, the New York State Office of Mental Health recently approved reimbursement of CR when it is provided in the context of a psychiatric recovery program unique to New York -Personalized Recovery Oriented Services. This reimbursement policy was informed by the evidence from meta-analytic studies supporting greater treatment effects when CR is provided in the context of a recovery program. Outside the USA, CR is typically recognized as a variant of cognitive behavioral therapy and reimbursed accordingly. Clearly, until there is more widespread reimbursement for CR available in the USA, dissemination efforts will be stymied.

In addition to the challenges to dissemination posed by fiscal policies there are other challenges. Given initiatives to integrate CR into routine clinical practice, now is a critical time to develop empirically supported and feasible methods of clinician training and, in parallel, come to a consensus on standards for provider competencies for conducting CR in a community setting. Along the same lines, it is crucial to study fidelity to CR. Research on implementation fidelity has been published with respect to other treatments and may thus be drawn upon to operationalize core treatment components that are crucial for implementing CR with integrity to an empirically based treatment model. Thus, a logical next step for

research on CR for schizophrenia is to deconstruct CR programs, and examine the relative effects of CR practice components in order to guide dissemination and the implementation of CR in the community with maximal effectiveness. The end goal of this research is to disseminate an effective, feasible program of CR in the community, to better help people with schizophrenia achieve their personal goals for recovery.

Financial & competing interests disclosure

A Medalia receives royalties from Oxford University Press (Oxford,UK) for the book she co-authored, Cognitive Remediation for Psychological Disorders. The authors have no other relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript apart from those disclosed.

No writing assistance was utilized in the production of this manuscript.

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