Shaping Attention Span: An Operant Conditioning Procedure to Improve Neurocognition and Functioning in Schizophrenia

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Abstract

The high prevalence of neurocognitive deficits in schizophrenia, and their association with poorer outcomes, has created interest in treatments that can improve neurocognitive functioning in this illness. While a variety of rehabilitation interventions have been developed, many are not appropriate for the most severely ill patients, whose attention spans are so short that they cannot attend to the material being presented. For this population, the only neurocognitive rehabilitation methods with demonstrated effectiveness are those that involve the operant conditioning technique known as shaping. In this article, we review the rationale for the use of shaping-based methods as neurocognitive retraining techniques for treatment-refractory schizophrenia patients, review published reports using this intervention, and offer suggestions for the future development of this method from both clinical and research perspectives.

Keywords: schizophrenia, attention, cognition, cognitive rehabilitation, psychiatric rehabilitation


Data on the high prevalence of neurocognitive deficits in schizophrenia (Palmer et al. 1997) and their association with poorer outcomes (Green 1996; Silverstein et al. 1998a) has created interest in treatments that can improve neurocognitive functioning in this illness. Because traditional antipsychotic medications have had minimal or sometimes deleterious effects on cognition after the acute phase (Corrigan and Penn 1995; Schwarzkopf et al. 1999), the majority of direct neurocognitive enhancement efforts thus far have focused on psychological interventions. These nonpharmacological treatments are typically grouped together under the rubric "cognitive rehabilitation." To date, this term has been applied to treatments such as practicing of cognitive skills in individual (Spaulding et al. 1986; van Der Gaag 1992) or group (Brenner et al. 1994; Spaulding et al. 1999b) formats, and computer-assisted training (Medalia and Revheim 1999).

Because of the early stage of development of neurocognitive rehabilitation technology for schizophrenia, guidelines have yet to be established regarding which treatments are appropriate for which patients. Thus, treatments have not necessarily been targeted to specific profiles or severity levels of neurocognitive deficits. This lack of specificity is most problematic for chronic, severely ill, and treatment-refractory patients, such as those who are unable to be discharged from state-hospital settings; these patients typically have the most severe attentional and other neurocognitive deficits, and these deficits are related to particularly poor outcomes. Despite the enormity of this problem, scattered reports throughout the literature suggest that one form of neurocognitive rehabilitation, based on the behavioral principle of shaping, has consistently demonstrated effectiveness in increasing the attention spans of such patients. In this article, we discuss issues related to the use of shaping procedures as neurocognitive retraining methods. We begin by providing a rationale for addressing attentional impairment in schizophrenia and for using behavioral techniques to do so. This is followed by a rationale for choosing shaping over other behavioral techniques, a review of published reports using shaping methods to improve attention, and a review of future needs.

Rationale for Addressing Attentional Deficits in Schizophrenia

A growing body of evidence indicates that deficits in sustained attention and verbal memory are associated
Another recent approach utilizes computers to administer tests based on neuropsychological assessments to examine remediation of cognitive deficits in learning disabilities. Data from studies of neuropsychologically oriented computer exercises indicate that improvement in neurocognitive functioning occurs, as assessed via laboratory procedures (e.g., Burda et al. 1994). As with the approach discussed above, there is little evidence that the improvements generalize to other areas of functioning or that they enhance response to other rehabilitation efforts. Studies using a neuropsychological educational approach to rehabilitation (NEAR) have shown promise in improving cognitive abilities, but their effects outside of the laboratory are as yet unknown. While it is likely that these methods will continue to be developed and refined, a problem with using them as severely impaired patients is that they require significant intrinsic motivation on the part of the patient. This has been recognized, and one of the strengths of the NEAR approach is in selecting activities that motivate patients to engage (Medalia and Revheim 1999). However, at this point, it is not known whether this approach would be effective with patients who are unmotivated to participate in rehabilitative treatment.

The most widely reported approach to neurocognitive remediation for schizophrenia has been group-based therapy. The most popular of these treatments is Integrated Psychological Therapy (IPT), developed by Brenner et al. (1994). This intervention targets skills in a hierarchical fashion, beginning with conceptual differentiation (executive functioning) and moving through social perception, verbal communication, basic social skills, and interpersonal problem-solving segments. Skills are targeted through group practice and problem solving using a series of exercises that increase in complexity over time. Results from studies of IPT have been mixed (Brenner et al. 1992; Brenner et al. 1994; Spaulding et al. 1999a). In Brenner’s studies, little evidence of generalizability of the effects to real-world behavior was observed. Spaulding et al. (1999b) reported improvement on a measure of social cognition; however, behavioral effects outside of laboratory-based assessment procedures were not studied. The current status of IPT for schizophrenia remains controversial, with some (e.g., Bellack et al. 1999) suggesting that the effect sizes from published reports are not clinically significant, and others (e.g., Spaulding et al. 1999b) disputing these claims. As discussed below, however, whatever the eventual verdict is regarding IPT, it is clear that it is not an appropriate treatment for patients with severe attentional impairment.

Approaches similar to IPT have been developed for use in individual treatment sessions (e.g., van Der Gaag 1992; Wykes et al. 1999). For example, Wykes and col-
leagues developed an intensive treatment for addressing executive functioning deficits in schizophrenia patients. As with the approaches discussed above, some positive effects were observed on neuropsychological test scores, but no effects were noted on behavioral functioning. In addition, the effects of these interventions outside the treatment context are unknown. Most important, however, as with IPT, it can be argued that treatments targeting high-level cognitive processes are not appropriate for patients with severe attentional impairment (see below).

Because of the lack of consistently convincing effects from prior studies of neurocognitive remediation in schizophrenia, some researchers have suggested utilizing approaches that focus on helping patients manage cognitively demanding tasks in the real world (Flesher 1990; Hogarty and Flesher 1999; Velligan and Bow-Thomas 2000). One such approach is Cognitive Adaptation Training (CAT), which involves the use of cues and compensating features in the patient’s environment (Velligan and Bow-Thomas 2000). As the authors note, CAT has more in common with case management than with traditional cognitive rehabilitation, in that it involves home visits and in vivo supports and is not viewed as a method for strengthening cognitive functions or their neural correlates. Preliminary data on this approach are encouraging. The strength of CAT, however, is clearly with outpatient populations who are already living and working in what is hoped to be a relatively permanent environment for them. For long-stay inpatients in state hospitals and other residential facilities, interventions are needed that can improve basic attentional abilities so that these inpatients can participate more fully in psychosocial rehabilitation and eventually be discharged to the community. Flesher’s (1990) cognitive habilitation intervention is more amenable for use in a hospital setting, although he notes that “Cognitive habilitation will be most useful for ameliorating the residual deficits in relatively stable remitted patients” (p. 226). Similarly, the more recently developed Cognitive Enhancement Therapy (Hogarty and Flesher 1999), while unique and promising, was developed for an outpatient population.

In short, current approaches to treating neurocognitive deficits in schizophrenia do not provide strong evidence of their effectiveness or generalizability, and they do not seem appropriate for patients with severe attentional impairment (see below). In addition, recent remedial and compensatory approaches are clearly meant for use with stabilized outpatients. This situation calls for the development of interventions targeting the severe attentional impairments of chronic schizophrenia patients who continue to reside in long-term institutional settings.

Attentional Requirements for Participation in Traditional Neurocognitive Rehabilitation

Since all forms of psychosocial treatment require some degree of attention span, those patients with the most severe attentional impairment may benefit as little from group-based (Brenner et al. 1994) or computer-assisted (Medalia and Revheim 1999) neurocognitive rehabilitation as they do from more traditional skills training procedures. Research data support this view. For example, Michel et al. (1998) found that failure to benefit from neurocognitive remediation was related to more severe deficits in neurocognitive functioning among schizophrenia patients. In addition, Sohlerberg et al. (2000), in evaluating the effects of a well-validated form of neurocognitive rehabilitation on persons with acquired brain injury, found that the treatment was ineffective for individuals with impaired sustained attention. In contrast, for patients with relatively intact pretreatment levels of vigilance, the treatment effect was highly significant. Two of the measures on which pretreatment vigilance level discriminated treatment responders from nonresponders were measures of executive functioning with demonstrated sensitivity to frontal lobe and cingulate activation (Perett 1974; Deary et al. 1994). The finding that sustained attention deficits have a rate limiting effect on cognitive rehabilitation (as they do for skills training) has implications for the placement of schizophrenia patients in traditional group-based forms of cognitive treatment. For example, the most widely used treatment of this type for schizophrenia patients is Brenner’s IPT (described above, Brenner et al. 1992, 1994). Sohlerberg et al.’s (2000) results imply, however, that patients with severely impaired sustained attention abilities will be unable to benefit from even the initial conceptual-differentiation module.

These data and assertions are consistent with the attentional and rehabilitation models of Sturm et al. (1997). Using earlier work by Posner and Boies (1971), Posner and Rafal (1987), and van Zomeran et al. (1984), Sturm and colleagues conceptualize attention as involving a set of distinct processes. They make an important distinction between intensity aspects of attention and aspects involved in information selection. Subcomponents of the intensity aspect of attention include (1) phasic alertness, defined as those processes involved in enhancing a response to a specific stimulus at a specific time point; and (2) vigilance, defined as the ability to maintain alertness over a prolonged period in order to respond to relevant but infrequently occurring stimuli. Subcomponents of the selection aspects of attention include (1) selective attention, defined as the ability to focus on relevant con-
textual stimulus features while suppressing responses to irrelevant stimuli; and (2) divided attention, defined as the ability to simultaneously monitor two or more sources of information that are relevant for behavioral responses. Sturm et al. studied the effectiveness of a cognitive remediation intervention comprising distinct intervention components targeted separately at alertness, vigilance, selective attention, and divided attention in populations of patients with focal brain damage of vascular etiology. One of their key conclusions was that “specific attention disorders need specific training” (p. 96). This was especially true for the intensity components of alertness and vigilance, where improvement occurred only after specific training of these functions. Other important findings from this study were that adequate functioning of selective aspects of attention required a sufficient amount of alertness, and that among patients with impaired alertness and vigilance, training on selective aspects of attention led to clinical deterioration. On the basis of these data, they stressed that “impairments in a given level can only be approached by training on the same or a subordinate level” (p. 100). On the basis of their findings, Sturm et al. proposed a hierarchical model of attention wherein phasic alertness and vigilance capabilities are required for selective attention, and selective attention is a prerequisite for divided attention.

These findings are relevant for cognitive rehabilitation of schizophrenia because the patients who are most unable to benefit from traditional group-based training approaches are those with severe impairments in the intensity aspects of attention such as phasic alertness (Silverstein et al. 1998e) and vigilance (Nuechterlein 1991; Kern et al. 1992; Silverstein et al. 1998b). Therefore, even though the majority of these patients will also demonstrate deficits in higher level functions, it is critical that cognitive remediation efforts begin by targeting basic intensity functions. To date, efforts to improve cognitive functioning in schizophrenia have focused almost exclusively on remediation of higher cognitive functions such as executive functioning and social cognition (e.g., van Der Gaag 1992; Brenner et al. 1994; Spaulding et al. 1999b; Wykes et al. 1999) while ignoring the more basic aspects of attention. For schizophrenia patients with severe attentional impairment, placement in a traditional neurocognitive rehabilitation intervention such as IPT, which begins with exercises targeted toward higher level cognitive processes such as executive functioning, is likely to lead to, at best, few gains, and at worst, further impairment. We have observed this phenomenon clinically among patients who participated in studies of cognition and skills training outcome (Silverstein et al. 1998e), where no appreciable change was observed among those with the most severe attentional impairments when they were placed in IPT (Pierce et al. 1997). All of this stresses the importance of developing effective interventions for schizophrenia patients who need to improve their basic attentional abilities as a precursor to being introduced to other treatments.

The Use of Behavioral Techniques to Enhance Neurocognitive Functioning

Data from a number of older and more recent studies provide a rationale for using behavioral techniques to improve cognition. One group of studies used monetary reinforcement for correct responding to improve performance on laboratory tests of attention (Rosenbaum et al. 1957; Karras 1962, 1968; Wagner 1968; Meiselman 1973; Kern et al. 1995), or tests of other neurocognitive functions (e.g., Summerfelt et al. 1991). A second group of studies used operant procedures to increase attention span during brief, structured social interactions (e.g., Wallace and Boone 1983; Massel et al. 1991). All of these studies describe increased attentional functioning after appropriate responding was consistently reinforced with money or consumables. They therefore can be viewed as precursors to neurocognitive rehabilitation interventions. These demonstrations diverge from modern rehabilitation efforts in that their time span was brief and individual differences in attentional functioning were not taken into account when delivering the reinforcers. As will be described below, tailoring reinforcement schedules and contingencies to patients’ baseline levels of functioning, and proceeding with a systematic and gradual approach, can achieve real-world results that exceed and are more meaningful than past laboratory demonstrations. The use of shaping procedures as neurocognitive rehabilitation methods allows the clinician/researcher to achieve these goals.

Shaping

Shaping is the application of several fundamental techniques of learning to bring about new behavior or to modify a certain aspect of an existing behavior. As such, shaping can be viewed as a method to achieve operant conditioning, with attention being the response that is targeted. The primary technique involved is differential reinforcement of successive approximations. Rather than waiting for the complete behavior (e.g., a 20-minute attention span) to occur before offering reinforcement, reinforcement is provided for successive approximations or steps toward the final behavior. When the initial step toward a behavior (e.g., 4 minutes of continuous attention) has been reinforced and occurs fairly regularly, the
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Shaping procedures can target the form, intensity, or duration of a behavior. An example of shaping the form of a behavior was provided by Isaacs et al. (1960), who shaped verbal behavior in two patients with schizophrenia who had each been mute for over 14 years. Chewing gum was chosen as a reinforcer and was used to successively reinforce lip movement initially, followed by reinforcement of simple vocalization (initially grunts), then simple understandable verbalizations ("gum"), and finally verbal responses to questions. To have reinforced the intensity of behavior, these investigators could have provided reinforcement for verbalizations that gradually approached a specified loudness. For example, they could have started by offering reinforcement for a whisper and gradually requiring increased loudness of verbalizations until they were reinforcing verbalizations of only a reasonable conversational volume. Duration is often a target of shaping procedures directed toward neurocognitive functioning, specifically attentional functioning. In such cases, the behavior of interest is how long a patient can direct attention to a particular task.

Two remaining issues regarding shaping should be noted prior to reviewing studies of its use in improving attention span. One concerns the choice to use shaping rather than other conditioning techniques. It is clear that operant techniques, rather than classical conditioning procedures, are most appropriate for treating attention span in schizophrenia. This is because on-task behavior (i.e., attention span) is a voluntary behavior (or operant) comprising distinct temporal units of engaging with the environment. Within the field of operant conditioning itself, many procedures can be employed to modify behavior. Some of these, such as modeling and vicarious learning, assume that the target behavior is either already in the person’s behavioral repertoire or can be quickly learned. Neither of these conditions are met in the case of severe attentional deficits in schizophrenia. In this case, the target behavior or criterion (i.e., a period of sustained attention of sufficient duration to enable learning in other treatment modalities) is clearly not part of the current repertoire, and the criterion is unlikely to be reached by watching others. Similarly, simply making reinforcers contingent upon meeting the target behavior is unlikely to be effective, because the target behavior occurs at an extremely low frequency. That is, if the strategy that is used is to reinforce patients every time they, for example, pay attention for 20 minutes, this strategy is unlikely to be effective because this behavior will occur infrequently, leading to low levels of reinforcement and therefore little behavior change. What is needed in schizophrenia, therefore, is an approach that involves a long-term goal of an adequate attention span but that also aims to reach that goal gradually over time by reinforcing similar behaviors, or approximations to the behavior, until the target behavior occurs spontaneously and can be reinforced frequently. It is for this reason that shaping approaches have been adopted for use with patients with severe attentional impairment.

A further rationale for using shaping procedures in schizophrenia is that there is a long history of the successful use of shaping to change behavior in schizophrenia patients. For example, shaping procedures have been used to increase spontaneous speech and improve conversation skills in severely withdrawn patients (Massel et al. 1991). Moreover, shaping procedures have been shown to be effective in increasing a wide range of appropriate behaviors in institutionalized schizophrenia patients (Paul and Lentz 1977).

Shaping Attention Span as a Form of Neurocognitive Rehabilitation for Schizophrenia

Spaulding et al. (1986) examined the effects of shaping on the continuous work performance of nine inpatients with severe and persistent schizophrenia. At baseline, all subjects demonstrated an inability to focus their attention on a simple work task for more than 5 minutes. Training consisted of three 30-minute sessions per week in which subjects performed a simple paper-manipulation task, such as folding, cutting, stapling, or sorting. A target time was established for each subject at the beginning of each session, and verbal feedback, prompting, and praise were provided by a trainer throughout the session.

Seven of the original nine subjects graduated from training, having achieved continuous work performance scores of 30 minutes for five consecutive sessions. Considerable individual differences were noted in the patients' response to treatment, with the time to achieve graduation ranging from a low of 12 sessions for one...
These data support accumulating evidence on the relative independence of cognitive deficits and symptoms in schizophrenia (Green 1998). Consistent with the findings of Spaulding et al. (1986), no changes in brief psychiatric rating scale scores were observed for on-task behavior increasing to 45-55 minutes. One patient had an IQ within the mentally retarded range and another had borderline intellectual functioning. Similar individual differences were found for these seven patients in overall psychiatric status, as improved continuous work performance scores did not appear to be systematically related to scores on the nurses' observation scale for inpatient evaluation, 30 items (Honigfeld, Gillis, and Klett 1966).

Menditto et al. (1991) used shaping procedures to increase the attention span of seven forensic inpatients with severe and persistent schizophrenia or schizoaffective disorder. Average length of stay for these patients was 10.4 years, and they were considered to be among the most ill and least responsive patients in the hospital. Shaping classes were held three times daily during weekdays. Assignments consisted of paper and pencil tasks focusing on practical language and mathematics skills. Target times for on-task behavior were initially quite brief (30-60 seconds), and 2-3 trials were typically required per session. Patients received prompting and encouragement as necessary throughout the session, and upon successful completion of each trial they received specific verbal praise, a shaping chip, a small food snack, and a token specifying the requirements for the next trial. After successful completion of the last trial, a participation token was awarded. Tokens were used to “purchase” a variety of goods or privileges, such as snacks, coffee, grounds passes, and TV time, from the ward “token store.” As patients demonstrated success with each target for several sessions, targets were gradually increased, typically in increments of 30-60 seconds, until the patient consistently completed two consecutive 10-minute trials. After 12 months of training, six of the seven patients had demonstrated substantial improvements in attentional functioning, with four of these graduating from shaping classes and progressing to more traditional academic classes on the ward. They continued to perform quite well in those classes, with 1-year followup showing successful completion of academic class assignments an average of 84 percent of the time.

Silverstein et al. (1999) compared the academic skill performance of seven lower functioning patients in shaping classes to a group of seven higher functioning patients in traditional academic classes over a 9-month period. Most, but not all, patients in the Bellus et al. study had chronic psychotic disorders. In shaping classes, feedback was given at varying temporal intervals across patients, consistent with their individualized goals, while in academic classes, feedback was given at fixed 10-minute intervals. Additionally, in shaping classes, shaping chips were paired with a choice of a consumable reinforcer (e.g., penny candies, 1-ounce cups of juice), while no consumable reinforcers were used in traditional classes.

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Silverstein et al. (1999) sought to determine the effectiveness of integrating shaping and skills training procedures. It was thought that such an integration could potentially increase the efficiency of treatment and reduce length of hospital stay. This is because patients would no longer need to wait until months of shaping classes were completed before they entered several more months of skills training. The method used in this shaping–skills training integration was to identify inattentive behaviors characteristic of each patient and then use shaping techniques to improve these behaviors and facilitate acquisition of new knowledge and skills during group sessions.

For each patient in the Silverstein et al. (1999) study, the most problematic verbal and nonverbal inattentive behaviors were identified. Nonverbal behaviors (e.g., eyes open, head up, eye contact with speaker) were rated each minute using interval-sampling procedures, while verbal behaviors (e.g., responding within 5 seconds, making spontaneous relevant comments) were rated using event-sampling procedures. Two noninteractive observers recorded the individualized target behaviors and reported their frequency at 15-minute intervals. Patient goals initially reflected an average of 4 weeks baseline, presupposing performance. After initiation of shaping procedures, for each 15-minute review period, patients who met or exceeded their goal (e.g., 60% of that period with their head up) received a token. Patients turned in tokens at the end of the group and received 25 cents for each token earned. As patients began to exceed their goals consistently, the criteria were increased to facilitate continued progress. Two findings were noteworthy from this project. First, all patients demonstrated significant increases in attentive behavior using this procedure. Second, for one patient who did not respond initially to the 15-minute reinforcement schedule, a continuous reinforcement...
schedule was implemented wherein he was given 5 cents and a piece of candy each time he opened his eyes. This eventually led to increases from 10 percent to over 80 percent of the time in keeping his eyes open, with subsequent greater spontaneity and participation, and responses that were more relevant to the group.

Interpretation of Effects

An important issue that is rarely addressed in the literature on neurocognitive rehabilitation in schizophrenia concerns the nature of the treatment effects. Simply stated, the issue is this: Do the observed improvements in neurocognitive performance represent maximization of functioning or do they reflect actual regaining of lost functions? In the case of shaping, it could be argued that by making the pairing between the stimulus (i.e., the task), the response (i.e., on-task behavior), and the reinforcement highly salient, competing stimuli (internal and external) are made relatively less salient, and the likelihood of responding to other internal or external stimuli (i.e., the response of “distractibility”) is reduced. On the other hand, it could be argued that the shaping procedures are having the effect of strengthening those neural circuits involved in sustained attention. The data available do not allow for a resolution of these two positions, and both effects may be operating. Thus, determining the relative contributions of these effects is an important goal for better understanding the mechanisms of shaping and other forms of neurocognitive rehabilitation. We would caution, however, that since the schizophrenia literature is replete with examples of environmental stimuli influencing behavior (e.g., Zarlock 1966; Salzinger 1984), the contribution of the stimulus field should not be ignored in designing rehabilitation interventions. Indeed, it represents a fertile area for further development of these treatment techniques. This is because, in theory, the combining of optimal training tasks (i.e., those that activate relevant neural structures and circuits) with optimal learning conditions should lead to the greatest gains.

Limits of the Literature

Enough reports have now appeared in the literature to indicate that shaping is an effective method to increase attention span and work performance among chronic, severely ill schizophrenia patients. Despite these encouraging data, however, there are important limitations to those reports that have appeared thus far. One limitation involves sample size. All published reports of shaping as a form of neurocognitive rehabilitation have included small numbers of patients. What is now needed is a study that utilizes a standardized variant of the shaping technique with a larger number of patients.

A second limitation of past studies is that they were not controlled. In essence, all past reports, with the exception of Bellus et al. (1999), were a series of case studies. This raises the possibility that nonspecific factors may be responsible for all or part of the gains made by patients receiving shaping interventions. Controlled studies that vary critical intervention components (e.g., amount, nature, and frequency of reinforcement) are necessary to rule out this possibility. Such studies will also lead to greater efficiency and effectiveness of shaping treatment by identifying its most critical parameters. Another design that may be useful is a multiple-baseline design. This was used by Massel et al. (1991) in their study of shaping to improve conversation skills. Multiple baseline designs use patients as their own controls and allow for assumptions to be made regarding relationships between time of treatment initiation and treatment effects.

Two of the biggest unresolved issues regarding shaping involve posttreatment maintenance of gains and generalizability. Specifically, do the performance improvements from shaping classes generalize to other environments, and do they persist after shaping treatment is discontinued (and if so, for how long)? Limited data are available on these issues. Spaulding et al. (1986) reported that seven of nine patients reached the 30-minute criterion and then continued to progress in subsequent stages of vocational rehabilitation. Menditto et al. (1991) found that after shaping groups ended and patients were transferred to regular academic classes, patients successfully completed assignments and earned participation tokens in these classes an average of 84 percent of the time during a 12-month followup period. In addition, the four patients in that project who met the most stringent improvement criterion subsequently earned promotions to higher step levels in the social-learning program following their graduation from shaping classes.

While these data are encouraging, they are no substitute for controlled longitudinal studies and systematic assessments of generalization to other environments. An important issue for such future studies involves the nature of the outcome variables. While generalizability to other forms of treatment is an important index, it will be critical to evaluate factors such as spontaneous participation in voluntary activities, length of conversations, ability to gain and maintain employment, and other real-world outcomes.

Future Directions

One of the most important tasks in the continued study of shaping is to better characterize those patients who require shaping interventions as well as those patients...
who benefit most from the treatment. Regarding the first issue, patients have typically been chosen based on clinical judgment. For example, patients have been chosen for shaping on the basis of being the most "regressed" patients in a treatment program (Menditto et al. 1991) or being "low functioning" and having made little or no gains in prior efforts at more traditional skills training approaches (Silverstein et al. 1998d). It is possible that efficiency of treatment would be improved if there were methods to identify relevant candidates and place them in shaping interventions prior to extended periods of treatment failures. One potential method to identify appropriate candidates is via neurocognitive testing on admission. Data now exist indicating that specific neurocognitive deficits are associated with poorer psychiatric rehabilitation outcomes (Green 1996; Silverstein et al. 1998e), thereby highlighting the need for development and dissemination of a neurocognitive screening battery. Efforts at the development of both test batteries (Ashbrook et al. 1988; Silverstein et al. 1998a; Silverstein et al. 1998e) and new neurocognitive measures (Silverstein et al. 1998b) that may be effective in the screening of candidates for different levels of psychiatric rehabilitation interventions have already begun. Much more work needs to be done, however, before treatment decisions based on test data can be made with high levels of confidence.

Another important issue is the integration of shaping procedures with other forms of neurocognitive rehabilitation. The benefits of this would be to systematize the delivery of reinforcement that patients receive as they are engaged in the training. As noted at the outset, data from laboratory studies of neurocognitive functioning under conditions of reinforcement indicate that performance improves relative to typical test-taking conditions. Thus, there is reason to believe that the systematization of reinforcement delivery, in addition to the usual focus on task content and difficulty level, would have a synergistic effect. One area in which this integration would appear to be relatively simple is with the training technique known as errorless learning. Errorless learning involves beginning training on tasks for which there is a high expectation of success and proceeding through a graded series of tasks that become increasingly more complex. The goal of this procedure is to minimize the commission of errors while at the same time achieving performance mastery. Once performance mastery without errors is achieved at a given level, tasks at the next level of complexity are introduced. Errorless learning has demonstrated effectiveness in the treatment of developmentally disabled and neurologically impaired individuals (Baddeley 1992; Kern 1996). Moreover, it has been used as a technique to improve the performance of people with schizophrenia on neuropsychological tests (Summerfelt et al. 1991; Benedict et al. 1994; Stratta et al. 1994; Vollema et al. 1995; Bellack et al. 1996; Wexler et al. 1997) and to treat executive functioning impairments within the context of a larger neurocognitive rehabilitation program (Wykes et al. 1999). The success of errorless learning strategies in the cognitive rehabilitation of schizophrenia raises the issue of whether systematically pairing reinforcement with errorless learning procedures might lead to increased gains in neurocognitive rehabilitation. Similar pairings can be tried with computer-assisted forms of neurocognitive training. A related but unexplored issue is the extent to which shaping attentive group behaviors, as demonstrated by Silverstein et al. (1999), within the context of group-based forms of neurocognitive rehabilitation such as IPT (Brenner et al. 1994) would lead to increased treatment effects.

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