2009

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Schizophrenia Bulletin vol. 35 no. 1 pp. 222–232, 2009
doi:10.1093/schbul/sbm150
Advance Access publication on January 22, 2008

Attention Shaping: a Reward-Based Learning Method to Enhance Skills Training Outcomes in Schizophrenia

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Disturbances in sustained attention commonly interfere with the ability of persons with schizophrenia to benefit from evidence-based psychosocial treatments. Cognitive remediation interventions have thus far demonstrated minimal effects on attention, as have medications. There is thus a gap between the existence of effective psychosocial treatments and patients' ability to effectively engage in and benefit from them. We report on the results of a multisite study of attention shaping (AS), a behavioral intervention for improving attentiveness and learning of social skills among highly distractible schizophrenia patients. Patients with chronic schizophrenia who were refractory to skills training were assigned to receive either the UCLA Basic Conversation Skills Module (BCSM) augmented with AS ($n = 47$) or in the standard format ($n = 35$). AS, a reward-based learning procedure, was employed to facilitate patients' meeting clearly defined and individualized attentiveness and participation goals during each session of a social skills training group. Primary outcome measures were observational ratings of attentiveness in each session and pre- and post-BCSM ratings of social skill and symptoms. Patients receiving social skills training augmented with AS demonstrated significantly more attentiveness in group sessions and higher levels of skill acquisition; moreover, significant relationships were found between changes in attentiveness and amount of skills acquired. Changes in attentiveness were unrelated to level or change in antipsychotic medication dose. AS is an effective example of supported cognition, in that cognitive abilities are improved within the environmental context where the patient is experiencing difficulty, leading to gains in both attention and functional outcome.

Key words: cognitive rehabilitation/outcome/recovery/cognition/attention/neurocognitive deficit

Attention deficits have long been recognized as characteristic of many people with schizophrenia[1–3] and can be found as early as the first illness episode.[4] More recently, researchers have documented that these impairments interfere with the ability to fully engage in, and benefit from, evidence-based psychosocial treatments that can significantly reduce disability (eg, skills training, family psychoeducation, supported employment).[5–10] To date, antipsychotic medications have been found to yield only small improvements in cognition.[11–15] Moreover, currently popular rehabilitative approaches to treating cognitive deficits in schizophrenia do not address attention,[16,17] have not been shown to improve attention,[18–23] have never been tested with more disabled patients,[19,24–26] or have measured attention using tests with unknown ecological validity.[27] For patients with severe attention deficits, therefore, there is a significant gap between the existence of evidence-based psychosocial interventions and their ability to effectively engage in them. However, evidence from several lines of research suggests that an approach that is motivation based, that utilizes an individually tailored gradient of task difficulty, and that is embedded within a meaningful performance context is likely to produce real-world gains in attentiveness via motivational enhancements.

The relationship between motivation and attention deficits in schizophrenia was noted by Kraepelin,[3] who in 1919 wrote that the lack of motivation observed in many patients "is without doubt clearly related to the disorder of attention which we very frequently find conspicuously developed in our patients. It is quite common for them to lose both the inclination and ability on their own initiative to keep their attention fixed for any length of time."(p5–6) More recent experimental work supports the role of motivational deficits in the poor cognitive performance of schizophrenia patients.[28–30]

One method to coordinate motivational functions and attention in schizophrenia involves increasing the

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strength of reinforcers. This can also be viewed as a form of increasing the affective salience of a task, a strategy that has been demonstrated to improve cognitive test performance.[31] Evidence consistently indicates that using monetary rewards and other powerful secondary reinforcers can improve the performance of schizophrenia patients on cognitive tests, including tasks where poor performance has been considered a vulnerability marker of the illness.[32–35] In addition, all past published reports involving the pairing of primary or secondary reinforcers with the behavioral response of attentive behavior have demonstrated significant improvements, even among the most disabled patients in state hospital settings.[36–42] Findings that schizophrenia patients are responsive to operant conditioning procedures,[43] that they are responsive to the motivational significance of ongoing events,[44] that patients attribute motivational importance to relevant events,[45] and that positive social interactions improve cognitive functioning in schizophrenia[31] provide a further rationale for using external reinforcers as a method to increase motivation for engaging in attentive behaviors in the treatment environment.

In this report, we describe the results of a multisite study of attention shaping (AS) for highly distractible, chronic schizophrenia patients. All patients in the study were already engaged in intensive psychiatric rehabilitation, either in a state hospital inpatient or partial hospital setting. All patients also had marked impairments in both social skills and attentiveness and had received multiple forms of skills training without any obvious clinical benefit or significant progress toward being discharged from their respective programs. The specific aim of the study was to determine whether integrating AS into a skills training group would lead to increases in attention and skill acquisition compared with standard presentation of the group. Secondary aims were to determine if AS had effects on psychiatric symptoms and whether any observed effects of AS could be accounted for by medication dose or dose changes. Based on prior studies and case reports of earlier versions of this intervention, we hypothesized that AS would significantly enhance both attentiveness and skill acquisition but that it would not affect symptoms. We also hypothesized that effects of AS would be independent of medication effects.

Method

Study Design

Patients were assigned either to receive the UCLA Basic Conversation Skills Module (BCSM) augmented by AS or the BCSM in its standard format. Prior to, and then after, group treatment, all patients had their conversation skills and symptoms assessed. Attentiveness was measured in every group session using an observational, interval sampling, coding method described in the outcome measures section below.

Subjects

All study participants met *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision*, criteria for schizophrenia, as determined either by structured clinical interviews or review of the extensive, long-term, medical records that were available. In addition, all subjects were between the ages of 18–55 years, without a history of head trauma with loss of consciousness, neurologic illness, or active substance abuse during the 3 months prior to study entry. The final sample consisted of 82 people (50 men, 32 women). Data were collected from 3 study sites: (1) the Second Chance Program at the Westchester Division of the New York Presbyterian Hospital-Weill Medical College of Cornell University,[46] a social learning-based, long-term inpatient rehabilitation program at a private hospital for state hospital patients considered to be treatment refractory and with a continuous state hospital stay of at least 3 years prior to transfer ($n = 38$; 74% male; 50% African American, 1% Asian American, 13% Hispanic); (2) the Community Transition Program at the Lincoln Regional Center, an academically affiliated state hospital program that uses a psychiatric rehabilitation model[47] ($n = 23$; 52% male; 10% African American; 4% Hispanic); and (3) a partial hospital program at the University of Illinois at Chicago (UIC) Hospital ($n = 21$; 48% male; 81% African American; 5% Asian American).

At all sites, potential subjects were identified by program nurses as being among the most disabled third of people in the program in terms of attentional disability. As a check on these lists, at the Cornell site, the program's recreational therapist completed, for each patient, an observational measure of attentiveness[48] that was a modified form of the Rating Scale of Attentional Behavior.[49] Reliability in terms of concordance between the 2 methods for identifying subjects as being in the bottom third of functioning level was high, with a kappa coefficient based on all pairs of ratings of 0.78.

Subjects were randomized into either of 2 treatment conditions: AS plus BCSM or BCSM alone. However, during the final round of groups, all sites only ran groups using AS in order to maximize data on correlates of AS treatment response and potential medication effects (see below, Results). Therefore, the final enrollment numbers by condition (AS = 47, comparison = 35) reflected a deliberate recruiting strategy and not subject dropout. All subjects who completed the initial baseline assessment attended enough group sessions so that statistics on changes in attentiveness could be calculated. However, not all subjects were available to complete the posttreatment assessment measures because of subject dropout or planned discharge from the larger treatment program. The number of subjects available at posttreatment did not differ between the treatment conditions, with 79%

and 77% completing the posttests from the AS and comparison conditions, respectively.

Interventions

Basic Conversation Skills Module. All subjects participated in the BCSM,[50] a manualized, structured, skills training program that is one of the interventions of the UCLA Social and Independent Living Skills series.[51,52] The BCSM contains 5 skill areas: recognizing verbal and nonverbal cues, starting a friendly conversation, keeping a conversation going (eg, changing topics, asking questions, determining context-appropriate levels of self-disclosure, using active listening skills), ending a conversation, and putting all the skills together. Each skill area is taught using 7 standard learning activities that are based on behavioral principles and that include abundant positive reinforcement, in the form of verbal praise for effort and appropriate responses. Six patients were enrolled in each group in each treatment condition during each round of groups. The BCSM was run twice per week at all sites for 1-hour sessions. The median number of sessions to complete each round of the BCSM, across all sites for the 2+ years of data collection, was 34.

Shaping. Shaping refers to the application of reward-based learning techniques to bring about new behavior or to modify an existing behavior. The primary technique involved is differential reinforcement of incremental changes that represent successive approximations toward a target behavior. For example, rather than waiting for a desired behavior (eg, a 20-minute attention span) to occur before offering reinforcement, reinforcement is provided for successive approximations or steps toward the final behavior, beginning at a point where the person is already able to succeed. When the initial step toward a behavior (eg, 2 minutes of continuous attention) has been reinforced and occurs fairly regularly, the criterion for reinforcement is advanced to the next step (eg, 3 minutes of attention). This sequence of reinforcing, changing the criterion for reinforcement, fading reinforcers for previous versions of the behavior, and limiting reinforcers to behavior meeting the new criterion is then repeated until the behavior resembles the desired response. A strength of shaping therefore is that it can be used to develop and strengthen behavior that does not normally occur or else occurs at a very low frequency (eg, attentiveness).

Attention Shaping. Beginning in the third session, initial, individualized, attentiveness goals were established for each subject in the AS condition, based on the median length of observed attentiveness intervals for that patient during the first 2 group sessions. These individualized goals and operational criteria for attentiveness and inattentiveness (which were displayed on a poster used during AS sessions only) were reviewed at the beginning of this and each subsequent AS session. Goals were expressed in 2 parts: (1) duration of attentiveness (ie, "subtarget") (eg, 2 consecutive minutes of attentiveness) and (2) how many times the subtarget had to be met during the session (ie, "class target") (eg, 4 times). Each time a patient met an attentiveness duration goal, he/she received 2 forms of reinforcement: (1) verbal praise that included a mention of the subtarget that was met and (2) a shaping ticket that indicated that one subtarget was met. At the end of each AS session, shaping tickets were collected and each patient's performance relative to his/her class target was reviewed in front of the group. Patients who received enough shaping tickets to meet their individualized class target received a tangible reinforcer in the form of $2 and a reminder that this was being given to them because they successfully met their goal in the session that day. Subjects who met their class target for 2 consecutive sessions were moved to the next goal in a prespecified hierarchy. Subjects who failed to meet their targets for 2 consecutive sessions had their attentiveness criteria reduced to the next lowest goal in the series.

Group sessions for both treatment conditions had 2 trainers. BCSM groups without AS had a group leader and a cotherapist. AS groups had a group leader and a change agent. The role of the change agent was to observe subjects during the session and to briefly interact with them around their attentive and/or inattentive behaviors. These interactions were of several prespecified types. For example, each time a patient met a subtarget, the change agent would verbally reinforce the person with specific feedback (including praise and identification of the subtarget that was met) and hand him/her a shaping ticket. Verbal positive reinforcement could also occur part-way through subtarget periods. For example, if a patient's subtarget was 10 minutes, and he/she had been paying attention for 5 consecutive minutes thus far, the change agent might verbally praise him/her for 5 minutes of continuous attention and note that another 5 minutes of continuous attention would lead to earning the next shaping ticket. Inattentive behaviors were addressed with specific prompts and extinction to ensure that attentive behavior was reinforced by staff more than inattentive behavior. Instances of inattentive behavior were addressed using a negative-positive prompt sequence. This included a specification of the inattentive behavior that occurred and a statement that this was an example of not paying attention that is interfering with the ability to earn the next shaping ticket. This negative prompt was followed by a positive prompt, reminding the patient that engaging in specific personally relevant behaviors from the "attentive behaviors" portion of the chart (see table 1) would help the person earn the next shaping ticket. If the patient resumed attentive behavior, this was reinforced with specific verbal praise, commenting on the attentive behavior. Continued

Table 1. Attention Span was Operationally Defined as Engaging in Behaviors from the First 2 of the Following Categories and Not Engaging in Behaviors From the Third Category

A. Attention focused on class
1. Head up
2. Eyes open
3. Looking at trainer/video/role-play
B. Active participation in class
1. Verbally responds to questions, requests, instructions within 5 seconds
2. Verbal responses are relevant (i.e., on topic)
3. Verbal responses consist of more than one or two words when indicated
4. Participates in role-plays (may not get everything just right, but tries)
5. Makes spontaneous comments or comments/asks questions when trainer addresses whole group.
C. Participation interfering behaviors
1. Making irrelevant verbalizations/gestures, including talking out loud or to self or gesturing not in response to anyone in the room
2. Arguing, yelling, screaming, etc
3. Staring off into space
4. Getting out of chair or leaving group

inattention was not responded to (ie, not reinforced) in order to extinguish the behavior. For subjects in the comparison condition, verbal reinforcement also occurred after giving correct answers or other efforts at participation but neither specific feedback about duration of attentive behaviors nor shaping tickets were given. Inattentive behaviors were commented on by staff in the comparison condition as well, but the specific prompting sequences used in the AS groups for redirecting patients toward attentive behavior, including mentioning of reinforcers for attentive behavior, were not used in this condition.

The trainers for this study included both research staff and existing agency staff, including nurses, social workers, occupational therapists, recreational therapists, and mental health workers. In-person training at sites in New York and Illinois in both the BCSM and in AS was provided by the first author. Training at the Nebraska site was provided by the second author, with 2 observational visits during the course of the study by the first author. In addition, the third author visited each of the sites during the study period to train, observe, and provide feedback to staff on their delivery of the AS intervention. All staff conducting the BCSM exceeded 80% criteria on the UCLA Therapist Fidelity Checklist for Modules[51] as rated by the site PI. In addition, a Therapist Fidelity Checklist for AS was developed at the beginning of this project. All staff who served as change agents were given copies of this checklist, and it was reviewed during regular supervision meetings for the study. Manuals describing all AS and rating procedures are available from the first author.

Outcome Measures

The primary outcome measures for this study were the (1) parameters characterizing attentive behavior displayed by subjects during group sessions for both treatment conditions and (2) pre-post change in scores on the Comprehensive Module Test for the BCSM.[51] The latter is a structured interview for assessing knowledge of information taught in the group, social problem–solving skills, and ability to demonstrate social skills in brief, structured role-plays. Symptom levels were assessed before and after the BCSM using the Positive and Negative Syndrome Scale (PANSS),[53] which was scored using a 5-factor model.[54] Interrater reliability was calculated across all symptom ratings for all pairs of raters at each site. The average intraclass correlation was .89. At the Lincoln site only, symptom data were also available from the Nurses Observational Scale of Inpatient Assessment (NOSIE).[55]

Attentiveness Ratings. For subjects in both conditions, interval-sampled, observational ratings of attention were begun in the initial BCSM session. A noninteractive rater observed each subject for 10 consecutive seconds (using a stopwatch) each minute and coded each segment as either attentive or inattentive, based on specific, operationalized criteria for attentiveness and inattentiveness (see table 1). Each subject was observed during the same 10-second interval each minute. For a subject to be coded as attentive, he/she would have to meet criteria for attentiveness, with no instances of inattentive behavior, for the entire 10-second interval.

Reliability of Attentiveness Ratings. Reliability of attentiveness ratings was ensured through several procedures. First, a training videotape and a rating manual were created. The videotape contained part- or full-session close-up views of 3 patients participating in skills training group sessions. The manual contained detailed instructions for attentiveness rating procedures and explanations of coding decisions for each of the four hundred sixty-six 10-second intervals on the training tape. Scores for each rater were compared with the gold standard ratings in the manual (developed by SMS, AM, and HS) to determine kappa coefficients. All attentiveness raters for this study and an outside consultant (AM) observed and rated this tape each year of the study to minimize rater drift. The average kappa coefficient across all pairs of raters (42 pairs of ratings in total) for the duration of the study was .75, indicating adequate interrater reliability. Second, each rater at each site created a tape each year that was sent to the first author and consultant and these ratings were compared. The average kappa

Table 2. Means (SDs) for Baseline, and Treatment Response Data, by Condition

	AS[a]	Comparison
Age	38.17 (11.15)	40.20 (10.19)
Years of education	11.55 (1.88)	11.13 (2.41)
Daily antipsychotic medication dose, in chlorpromazine equivalents	964 (586)	1131 (537)
Mean number of study group sessions missed	6.15 (7.39)	7.69 (7.86)
Total minutes of attentiveness per session in first 2 sessions	15.73 (10.50)	14.99 (10.26)
Total minutes of attentiveness per session in final 2 sessions[b]	24.84 (11.80)	16.94 (9.40)
Improvement in total minutes of attentiveness from first 2 to last 2 sessions, in minutes[b]	9.11 (10.40)	1.96 (7.20)
Slope of change in total minutes attentiveness per session across all sessions, in degrees[b]	19.60 (16.70)	1.70 (1.23)
Mean duration of attentiveness episodes in first 2 sessions, in minutes	2.87 (3.94)	2.78 (2.70)
Mean duration of attentiveness episodes in final 2 sessions, in minutes[b]	6.39 (7.55)	3.41 (2.41)
Improvement in mean duration of attentiveness episodes from first 2 to last 2 sessions, in minutes[b]	3.52 (7.52)	0.63 (3.17)
Slope of change in mean duration of attentiveness episodes, across all sessions, in degrees[b]	13.10 (24.7)	1.80 (3.80)
Pretreatment score on Comprehensive Module Test for BCSM[c]	12.24 (6.68)	13.94 (8.15)
Posttreatment score on Comprehensive Module Test for BCSM[c]	24.94 (9.23)	23.14 (10.51)

[a]AS, attention shaping.
[b]Statistically significant (see Results section).
[c]BCSM, UCLA Basic Conversation Skills Module. The treatment group × time (pre-post) interaction was statistically significant.

coefficient for these 6 pairs of ratings was .78. It is important to note that attention raters were not blind to subject condition because it is not possible to observe the shaping and control groups without being aware of which condition is being observed.

Medication. Total daily dosage of antipsychotic medication was recorded for each day a group was conducted, for 70% of patients (randomly determined), to examine the potential effects of medication on attentive behavior. Chlorpromazine (CPZ) equivalent doses for second-generation antipsychotic medications were derived using published equivalence ratios available at the start of the study.[56]

Data Analysis

Change in attentiveness over time was analyzed in 2 ways. First, the average total minutes of attentiveness per group during each subject's first 2 (attended) group sessions was compared with this average for their final 2 sessions. Second, each patient's time series of attentiveness scores (across all sessions attended) was characterized by 3 parameters: (1) the mean of the dataset, (2) the slope of the regression line through all data points, with the first-order autoregressive component removed, and (3) the root mean square error (RMSE), representing the average daily deviation of each patient from his/her own corrected regression line. These parameters are ideal to characterize variability in dynamic systems over time[57] and have been useful in analyzing treatment response to psychiatric rehabilitation interventions.[58] In addition to examining the variable of total minutes of attentiveness in each group, we examined the average duration of discrete periods when attentiveness was demonstrated. Effects of medication on attentiveness were examined by calculating the correlation between daily attentiveness ratings and daily CPZ equivalent dose for each subject. The 2 groups were then compared on the mean values of these correlations. For all analyses related to the study's specific aims, effect sizes are reported using Cohen *d*.

Results

Means and SDs for pretest and posttest values are found in table 2. The 2 treatment conditions did not differ in age ($t_{76.6}) = -0.86$, $P = .39$) or education level ($t_{54.9} = 0.81$, $P = .42$). At baseline, the AS and comparison groups did not differ on daily antipsychotic medication dose ($t_{56} = -1.18$, $P = .25$). The AS and comparison conditions also did not differ on number of sessions missed by group members ($t_{79} = -0.90$, $P = .37$). AS condition subjects missed a median of 2 groups (range = 0–25), and comparison condition subjects missed a median of 4 sessions (range = 0–28).

Effects of AS on Attentiveness

Total Attentiveness. The 2 conditions did not differ on baseline attentiveness, as reflected in observational

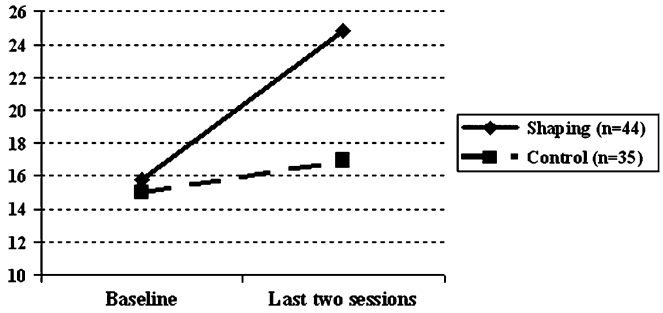

Fig. 1. Pre- to Posttreatment Changes in Total Number of Minutes of Attentiveness per Session, by Treatment Condition.

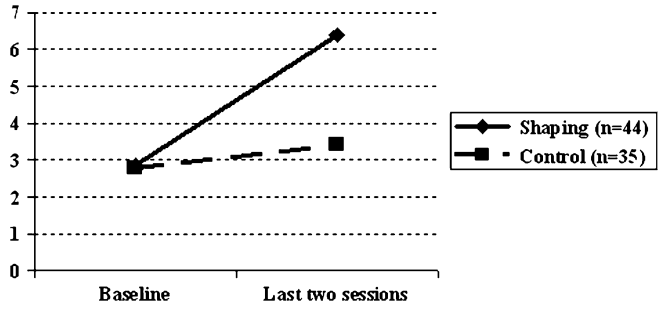

Fig. 2. Pre- to Post-Treatment Changes in Average Duration of Continuous Attentiveness Episodes (in Minutes), by Treatment Condition.

ratings of attentiveness during the first 2 BCSM sessions (a total of 90 observations per patient): $t_{77} = 0.32$, $P = .75$. However, during the final 2 sessions, the AS condition demonstrated a significantly higher degree of attentiveness: $t_{77} = 3.31$, $P = .001$, $d = 0.74$ (see figure 1). A mixed-model analysis of variance (ANOVA) indicated a significant main effect of time (ie, pre- to posttreatment) on attentiveness ratings ($F_{1,77} = 28.70$, $P < .001$) and a significant group × time interaction effect ($F_{1,77} = 11.99$, $P = .001$). There was a 4.65 times greater degree of change for the AS condition compared with the comparison condition, $t_{75.7} = 3.61$, $P = .001$, $d = 0.89$.

The most sensitive index of change is the slope of change over time, across all sessions, corrected for the first-order autoregressive component. The AS condition demonstrated a significantly steeper slope of improvement over time than the comparison condition, an 11.53 orders of magnitude difference, $t_{77} = 5.28$, $P < .001$, $d = 1.51$. The 2 groups did not differ in the extent to which individual patients varied around their corrected slopes, as indexed by the RMSE of the daily attentiveness ratings, $t_{77} = 0.60$, $P = .55$.

Duration of Attentiveness Episodes At baseline, the 2 groups did not differ on their average duration of attentiveness episodes: $t_{75.5} = 0.12$, $P = .91$. However, during the final 2 group sessions, the AS group demonstrated significantly longer durations of attentiveness: $t_{53.6} = 2.46$, $P < .05$, $d = 0.53$ (see figure 2). A mixed-model ANOVA indicated a significant main effect of time on attentiveness ratings ($F_{1,77} = 9.31$, $P < .005$) and a significant group × time interaction effect ($F_{1,77} = 4.51$, $P = .05$). There was a 5.59 times greater degree of change for the AS condition compared with the comparison condition, $t_{60.5} = 2.30$, $P < .05$, $d = 0.50$.

As with the total attentiveness index, the AS condition demonstrated a significantly larger corrected slope of change over time, $t_{77} = 2.66$, $P < .01$, $d = 0.64$. The groups also differed in their day-to-day variability in duration of attentiveness episodes, as reflected in RMSE scores, with AS subjects demonstrating more variability around their individual corrected regression lines, $t_{53.5} = 2.71$, $P < .005$.

Effects of AS on Skill Acquisition

The AS and comparison conditions were equivalent in their scores at baseline on the Comprehensive Module Test for the BCSM ($t_{79} = -1.03$, $P = .30$). After treatment, the groups also did not differ significantly on their test scores, although the relative ordering of means was reversed ($t_{61} = 0.72$, $P > .47$]. A 2-way mixed-model ANOVA (group × time) indicated that there was a significant main effect of time, indicating that scores improved from pre- to posttesting ($F_{1,61} = 139.60$, $P < .001$) and a significant group × time interaction effect, with the AS condition demonstrating greater improvement than the comparison condition on the Comprehensive Module Test from pre- to posttesting ($F_{1,61} = 8.70$, $P = .005$, $d = .72$). Increases relative to baseline were 104% and 66.7% for the AS and comparison conditions respectively, and the group differences in pre-post difference scores was significant, $t_{61} = 2.95$, $P = .005$.

Relationships between Changes in Attentiveness and Learning of Behavioral Skills

Change in observational ratings of attentiveness from the first 2 to final 2 sessions was significantly correlated with change in social skill and recall of group content, as measured by the Comprehensive Module Test, $r_{62} = .36$, $P < .005$. This indicates that improvement in attentiveness over time was associated with improved skill acquisition.

Effects on Symptoms

The conditions did not differ at baseline on positive, negative, excitement/hostility, or anxiety/depression scores on the PANSS. However, the AS condition had a higher level of disorganized symptoms at baseline, $t_{78} = 2.13$, $P < .05$. The same pattern was observed at the end of the study groups; for disorganized symptoms, $t_{61} = 2.23$, $P < .05$. Analysis of pregroup and postgroup NOSIE data from the Lincoln site ($n = 23$) indicated that the AS ($n = 12$) and comparison conditions ($n = 11$) did not differ at either baseline [AS = 137.29 (38.38), comparison = 150.14 (15.45), $t_{14.7} = -1.07$, $P = .30$] or after treatment [154.25 (38.33) vs 159 (19.54), $t_{21} = -0.46$, $P = .64$].

A 2 (group) × 2 (time) mixed-model ANOVA indicated a significant main effect of time ($F_{1,21}$ = 7.98, P = .01), but the group × time interaction effect was not significant ($F_{1,21}$ = 0.78, P = .39). These data indicate not only that AS did not have a significant differential effect on symptoms, consistent with past evidence of independence of cognitive and symptom treatment effects[16] but also that despite a higher level of disorganized symptoms at baseline and after treatment for the AS condition there was still significantly greater change in attentiveness and skill acquisition for these patients.

Medication and Treatment Response

Of the 58 patients on whom medication data was available, 38 (46% of the total enrolled sample) demonstrated change in both attentiveness and medication dose across sessions, allowing for a statistical analysis of relationships between change in each variable over time. For this subsample, change in daily CPZ equivalent dose was not significantly correlated with change in attentiveness: AS (n = 20), mean r = −0.04, comparison (n = 18), mean r = 0.06, $t_{33.5}$ = −0.95, P = .35. For the 20 patients for whom there was no change in antipsychotic medication dose during study participation, changes in attentiveness were, by definition, independent of CPZ equivalent (all patients demonstrated variability in attentiveness over time).

Site Effects

The 3 sites did not differ on education level ($F_{2,71}$ = 2.05, P > .13) or age ($F_{2,80}$ = 0.30, P > .74). There was a significant difference at baseline on PANSS positive symptom ratings ($F_{2,78}$ = 12.93, P < .001), with post hoc Tukey Honestly Significant Difference (HSD) tests indicating that patients at the Cornell site had significantly greater symptomatology than patients at both other sites whereas patients at the Lincoln and UIC sites did not differ from each other. A similar pattern of main effects and post hoc between-group differences was observed with PANSS negative symptom ratings ($F_{2,78}$ = 4.75, P < .05), PANSS cognitive symptom ratings ($F_{2,78}$ = 30.73, P < .001), and PANSS excitement symptom ratings ($F_{2,78}$ = 7.76, P = .001). For PANSS depression ratings, there was a main effect of group ($F_{2,78}$ = 8.44, P < .001). Post hoc Tukey HSD tests indicated that patients at the Cornell site had significantly greater symptomatology than patients at the Lincoln but not the UIC site. Patients at UIC also had significantly greater depressive symptomatology than patients at the Lincoln site. On baseline levels of social skill, as rated by the Comprehensive Module Test for the BCSM, there was a significant site difference ($F_{2,79}$ = 9.88, t < .001). Post hoc Tukey HSD tests indicated that patients at the Cornell site demonstrated lower scores on this measure than patients at the other 2 sites, who did not differ from each other. On baseline levels of attentiveness, as indicated by the total number of minutes of attentiveness during the first 2 group sessions (before AS was introduced), there was a significant main effect of site ($F_{2,77}$ = 20.09, P < .001). Post hoc tests indicated that the Cornell group was rated as the least attentive, followed by patients at Lincoln and then at UIC. All between-site comparisons were significant. On the variable of mean duration of attentiveness episodes for the 2 baseline group sessions, there was a significant main effect of site ($F_{2,77}$ = 5.88, P < .005). Post hoc tests indicated that the Cornell group demonstrated significantly briefer durations of attentiveness than patients at Lincoln or UIC, who did not differ from each other. Taken together, the results of site comparisons on baseline variables indicate that patients at Cornell were a much more symptomatic and disabled group than patients at the other 2 sites, while patients at the UIC partial hospital program were the least symptomatic and least impaired, although not significantly so compared with patients at Lincoln in some respects.

Potential effects of site on treatment outcomes were explored by comparing the 3 study sites on the 3 critical variables from this study: slope of change in total minutes of attentiveness per group, slope of change of mean duration of attentiveness episodes per group, and skill acquisition (defined as posttreatment minus pretreatment scores on the Comprehensive Module Test for the BCSM). See table 3 for means and SDs of these variables by site and group (AS vs comparison). All analyses involving main effects of site and group, site by group interaction effects and within-site between-group effects are reported below, although note that within-site effects for Lincoln and UIC are underpowered. For the "slope of total attentiveness" variable, there were main effects of site ($F_{2,73}$ = 3.09, P < .05) and group ($F_{1,73}$ = 44.00,

Table 3. Means (SDs) for Critical Study Variables, by Site

	AS	Comparison
Slope—total minutes of attentiveness[a]		
Cornell[a]	11.8 (15.4)	1.5 (9.4)
Lincoln[a]	27.4 (15.4)	4.3 (13.4)
UIC[a]	31.1 (16.6)	−0.8 (15.2)
Slope—mean duration of attentiveness episodes[a]		
Cornell	3.2 (6.1)	0.9 (2.3)
Lincoln[a]	14.7 (14.8)	3.2 (5.4)
UIC[a]	40.1 (46.0)	1.6 (3.5)
Skill acquisition[ab]		
Cornell[a]	14.40 (7.72)	5.67 (5.99)
Lincoln	11.27 (6.80)	5.57 (7.16)
UIC	12.20 (4.92)	13.25 (5.15)

[a]Statistically significant (see Results section).
[b]Skill acquisition is operationally defined as posttest scores on the Comprehensive Module Test for the UCLA Basic Conversation Skills Module minus pretest scores on the same measure.

$P < .001$), and the site × group interaction was significant ($F_{2,73} = 3.96$, $P < .05$). Inspection of table 3 reveals that the AS patients at the Cornell site (who had been considered to be treatment refractory at local state hospitals) had the smallest improvement, although it was still over 6 times greater than the improvement in the comparison group at this site. AS patients at the state hospital in Lincoln demonstrated the next highest level of improvement, followed by the partial hospital patients at UIC. The mean slope values for the comparison groups at all 3 sites were close to zero. At all 3 sites, the effect of treatment condition was significant (Cornell: $t_{36} = 2.26$, $P < .05$; Lincoln: $t_{21} = 4.50$, $P < .001$; UIC: $t_{16} = 4.24$, $P = .001$).

For the "slope of the mean duration of attentiveness" variable, there were main effects of site ($F_{2,73} = 8.27$, $P = .001$) and group ($F_{1,73} = 21.08$, $P < .001$), and the site × group interaction was significant ($F_{2,73} = 7.69$, $P = .001$). Again, the Cornell patients demonstrated the smallest degree of change (although still 3 times greater than the comparison group), followed by Lincoln and then UIC. At the Cornell site, the difference between groups approached significance ($t_{32.2} = 1.67$, $P < .11$), whereas at the Lincoln ($t_{14.1} = 2.51$, $P < .05$) and UIC ($t_{7.1} = 2.37$, $P = .05$) sites, the differences between groups were significant.

For skill acquisition, only the main effect of group was significant ($F_{1,57} = 5.72$, $P > .23$), in contrast to the main effect of site ($F_{2,57} = 1.47$, $P > .23$) and the site × group interaction effect ($F_{2,57} = 2.31$, $P > .10$). Both the Cornell and Lincoln sites demonstrated large differences between the AS and comparison conditions. The effect of group was significant at the Cornell site ($t_{30} = 3.35$, $P = .002$) but was not at Lincoln ($t_{16} = 1.70$, $P < .11$). At the UIC site, the means were not significantly different, and in contrast to the other sites, the comparison group demonstrated a similar degree of change to the AS group ($t_{11} = -0.36$, $P > .72$).

Discussion

This multisite effectiveness study of AS in chronic schizophrenia demonstrated that it significantly improved attentiveness in group sessions and increased overall skill acquisition. Moreover, the effect sizes associated with these changes were medium to very large (0.50–1.51) and were unrelated to medication changes or overall dose during study participation. These data indicate that, just as impaired attention is a rate-limiting factor for learning in skills training interventions,[5] improvements in attentiveness produced via AS mediate enhanced learning of skills in skills training.

The patients in this study came from 3 different sections of the country, were both inpatients and partial hospital patients, were primarily racial and ethnic minorities, were trained in private and public facilities, and received training primarily from "front line" staff working at the facilities. In addition, the patients were on very high doses of antipsychotic medication, attesting to their complex and refractory clinical presentations. Thus, the results of this effectiveness study suggest that AS is a viable procedure that can be broadly implemented by clinicians treating schizophrenia patients in a variety of settings. That AS was effective with patients who were severely disabled leads one to believe that the procedure would also be effective with similar types of patients elsewhere and also with distractible patients who are acutely ill and even patients with higher initial levels of attentiveness.

Analysis of site effects indicated large effects of AS on attentiveness at all 3 sites: a specialized treatment unit at a private hospital for patients who were transferred from state hospitals due to their being considered treatment refractory, a psychiatric rehabilitation inpatient unit at a state hospital, and a partial hospital program. In general, the magnitude of the between-condition differences at each site increased as a function of the level of functioning of the patient. In contrast, the effects of AS on skill acquisition were noted at the 2 inpatient sites only, not in the partial hospital program. This may reflect a ceiling effect on the Comprehensive Module Test for the BCSM for the UIC group, who achieved the highest pretreatment scores, or the greater effect of the BCSM than AS on skill acquisition for noninpatients, despite the large effects of AS on attentiveness at this site. The small number of subjects at the UIC site precludes a definitive interpretation of this result. We are currently conducting a large effectiveness trial solely in partial hospital settings to directly address the issue of the effects of AS on skill acquisition in community settings.

There were several limitations to this study. One is that attention raters were not blind to subject condition. This raises the possibility of rater bias. As noted above, in Methods, it was not possible to observe the shaping and control groups without being aware of which condition was being observed. However, unbiased ratings could be obtained through assessment of generalizability. In our current effectiveness study of AS, generalizability data are being obtained via blind rater observations of study patients concurrently in nonstudy groups and via clinical staff ratings of study patients in nonstudy groups. A second limitation of the study was that we did not collect data on the durability of the AS-related gains. In our current effectiveness study, we are collecting observational data at 6-month follow-up in nonstudy groups. Convergence of blind generalizability and durability ratings with the nonblind in-study group ratings will provide a stronger set of findings regarding the effects of AS. A third limitation of this study is that it is not known whether the improved attentiveness levels of patients in the AS condition reached the level of patients who were not considered to need this intervention. Obtaining data on the overlap between patients considered to have minimal attentional impairment (and therefore

not needing AS), and patients who received AS would help clarify the functional significance of the effects of the intervention. A fourth limitation of this study is that while most of the treatment was delivered by permanent staff at the agency (ie, no new treatment staff were hired for the study), at the UIC and Lincoln sites in particular, graduate students in clinical psychology and predoctoral psychology interns (who regularly rotate through those programs on a yearly basis) were involved in delivering the interventions. Therefore, it is still not known what the effects of AS would be when delivered solely by regular agency staff, not including trainees. This question will be also answered in our current effectiveness study.

An important feature of AS is that it is embedded within a meaningful activity in the patient's environment. Evidence from the fields of behavioral treatment, social skills training, academic intervention, and cognitive rehabilitation of TBI patients on training and transfer of behavioral and cognitive skills suggests that interventions are effective to the extent that they are embedded within activities and settings that are meaningful to the person receiving them.[59] This has led to an increased emphasis on *supported cognition* interventions that integrate neuropsychological and behavioral approaches.[59–61] The successful integration of AS with skills training suggests that it might also augment gains in other interventions requiring sustained attention, such as supported employment and supported education. Recently, strategies that incorporate shaping have been used informally to address attentional barriers to success in supported employment among outpatients with schizophrenia.[62] In addition, an attention-shaping program was developed collaboratively between an outpatient with schizophrenia and treatment providers to successfully increase time spent reading.[63] These demonstrations suggest that AS can be incorporated into a variety of settings to improve performance. Consistent with a recovery orientation, the long-term goal of supported cognition interventions such as AS is to move patients from a low base rate of attentive and participatory behaviors, to a state of self-determined engagement in rewarding and necessary activities that is maintained by self-administered, personally chosen rewards and intrinsic motivation.[64,65] To help achieve this goal, the effects of AS itself might be augmented by combining it with cognitive behavioral techniques such as activity scheduling and recording and tracking of pleasure ratings[66] and cognitive remediation techniques such as monitoring selective and sustained attention successes and lapses in natural environments.[48]

Funding

National Institute of Mental Health (R21MH063967 to S.M.S.).

Acknowledgments

The authors thank the staff of the Second Chance Program (New York Presbyterian Hospital), the Community Transition Program (Lincoln Regional Center), and the partial hospital program at the University of Illinois-Chicago hospital for their participation as therapists, cotherapists, and change agents for this study. We also thank the students who served as attention raters for the study at the above institutions. Finally, we wish to thank Robert Heinssen for his assistance during preparation of the grant application that subsequently funded this research. The authors do not have financial interests in the use of, or products associated with, the attention-shaping technique.

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