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Errorless learning and social problem solving ability in schizophrenia: An examination of the compensatory effects of training

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ABSTRACT

Compensatory approaches to cognitive rehabilitation in schizophrenia aim to improve functioning by bypassing or compensating for impaired areas of cognition. At present, there is little empirical evidence that these approaches actually compensate for neurocognitive impairments in improving community functioning. This study examined the effects of errorless learning (EL), a compensatory cognitive rehabilitation approach, on social problem solving ability in schizophrenia. The study included 60 outpatients who met DSM-IV criteria for schizophrenia or schizoaffective disorder. Participants received a baseline battery to assess explicit and implicit memory functioning. Participants were stratified according to gender and level of memory functioning and then randomized to EL or symptom management training. Training was conducted over two days lasting a total of 6 h for each group. Assessment of social problem-solving ability, using the Assessment of Interpersonal Problem Solving Skills (AIPSS), was conducted after completion of training and at a 3-month follow-up without further intervention. Results from hierarchical multiple regression and analysis of covariance each supported the compensatory effects of training. These findings indicate that EL facilitates learning of new skills across varying levels of memory impairment. Future efforts may aim to explore the specific neurocognitive mechanisms involved in EL.

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1. Introduction

Cognitive rehabilitation in schizophrenia is largely defined by two approaches. Restorative or cognition-enhancing approaches attempt to improve functioning by way of improving impaired areas of cognition. This is typically accomplished through repetitive training exercises such as computer-based drills or paper-and-pencil tasks that directly target abilities associated with the damaged or impaired area of cognition. Compensatory approaches, on the other hand, attempt to improve function by bypassing or compensating for impaired areas of cognition. This is done by using prosthetic environmental aids such as memory workbooks, calendars, manipulation of the individual's environment, or by recruiting relatively preserved areas of cognitive functioning to take over or assume the role of the damaged or impaired areas.

Though widely used, there is little empirical evidence that compensatory approaches improve community functioning by actually compensating for cognitive impairments. In the present study, we examined the compensatory effects of errorless learning (EL). EL is a cognitive rehabilitation approach that putatively compensates for cognitive impairments by recruiting relatively preserved cognitive abilities to compensate for impaired ones. Theoretically, selected aspects of implicit memory are recruited to take over the role of explicit memory processes in the learning of new skills or abilities. In this study, we examined the compensatory effects of EL training on impairments in memory functioning as they relate to social problem solving ability, an area identified as one of the three prominent areas of functional outcome in the three Green reviews (Green, 1996; Green et al., 2000, 2004). The study's primary findings on the efficacy of EL on social problem solving ability were published previously (Kern et al., 2005). The present secondary analyses aimed to test the hypothesis that EL can be beneficial for teaching social problem solving skills irrespective of the level of memory impairment.

2. Method

2.1. Participants

Participants included 60 outpatients who met DSM-IV criteria for schizophrenia or schizoaffective disorder as determined by a diagnostic interview using the Structured

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Table 1
Demographic and clinical characteristics.

Characteristic	Training program			
	Symptom management		Errorless learning	
	(*N*=31)		(*N*=29)	
	N	%	*N*	%
Male	23	74.2	20	69.0
Caucasian	11	35.5	12	41.4
Receiving atypical antipsychotics	26	83.9	25	86.2
	Mean	S.D.	Mean	S.D.
Age (yr)	42.6	11.5	44.6	9.8
Education (yr)	12.7	2.0	12.6	1.6
Years since first hospitalization	15.7	10.0	22.2	6.8
Level of memory impairment[a]	24.1	6.6	22.2	6.8
Brief Psychiatric Rating Scale scores				
Total	45.1	13.2	46.6	14.2
Positive symptoms	7.2	4.3	8.7	4.7
Negative symptoms	6.0	2.6	6.4	3.2

[a] Determined by scores on the first three trials of the California Verbal Learning Test. Lower scores indicate greater memory impairment.

Clinical Interview for DSM-IV Axis I Disorders, Patient Edition (SCID-P) (First et al., 1996). The SCID-P was administered by interviewers trained by investigators from the UCLA Department of Psychiatry specializing in diagnostic and symptom assessment. SCID-P interviewers were certified with a minimum kappa of 0.75 for rating the presence of psychotic and mood symptoms. All participants were clinically stable as defined by having no psychiatric hospitalizations in the past six months and the same psychiatric medication for at least the past three months. Exclusion criteria included substance dependence within the last three months, mental retardation, history of head trauma with loss of consciousness greater than 1 h, and evidence of past or present neurological disorders (e.g., seizure disorder). The study did not control for antipsychotic medication type or dose which was left to the discretion of the participants' treating psychiatrists. Table 1 presents the demographic and clinical characteristics for all participants who were included in the study. After providing a complete description of the study to prospective participants, written informed consent was obtained prior to participation.

2.2. Procedure

2.2.1. Randomization

Participants were randomized to training group (EL vs. a control condition; symptom management, SM). To help ensure baseline equivalency, participants were stratified on gender and level of memory functioning. These variables have been shown to be related to social skill and problem solving ability (Mueser et al., 1990; Addington and Addington, 1999). For memory, stratification was based on the California Verbal Learning Test Trials 1–3 Total Recall score (Delis et al., 1987). A score of 22.5 was selected to yield an approximately even split (high vs. low) based on previous data from a similar sample (Kern et al., 2003). The stratification yielded the following cells: male/high, female/high, male/low, female/low.

2.2.2. Training

Below is a description of the EL and SM training. For more complete details of the training methods see Kern et al. (2005). The training groups were equivalent in structure and format and total training time. For both groups, there was one instructor and two assistants with six to eight participants. Likewise, both groups included didactics, videotapes, modeling, role-play exercises, in-class written assignments, and social reinforcement. Training took place over two days totaling 6 h. Checks were conducted during each session to monitor fidelity to training procedures and curb potential drift over the course of the study.

2.2.2.1. Errorless learning. Training encompassed the principles of EL. Targeted skills were broken down into their smaller components with training beginning on simpler elements where there was a high expectation for performance success, and then proceeded stepwise gradually introducing more complex elements or combined elements, and fading instructor involvement to facilitate self-mastery. Training was conducted under a rich schedule of social reinforcement with success at each step determined by pre-defined criteria. These procedures were used to teach three core components of social problem solving ability: receiving, processing, and sending skills (Bellack et al., 1994; Mueser and Bellack, 1998).

2.2.2.2. Symptom management. Symptom management training was implemented using the Symptom Management module from the UCLA Social and Independent Living Skills series (Liberman et al., 1993). Participants were taught to identify warning signs prior to symptom exacerbation, how best to manage their illness in the context of involvement in a multidisciplinary treatment team, and then how to problem-solve obstacles to management success. This module, like the other UCLA skills training modules, is behaviorally based (e.g., using modeling and role-play exercises along with didactic instruction) and has a strong problem-solving emphasis.

2.3. Assessment

Assessment included measurement of the following areas: memory functioning, social problem-solving ability, and psychiatric symptoms.

2.3.1. Memory functioning

A broad-based battery of explicit and implicit memory tests was administered to all study participants at baseline prior to participation in training.

2.3.1.1. Explicit memory

2.3.1.1.1. Verbal learning. Verbal learning was assessed using the Logical Memory I subtest from the Wechsler Memory Scale-III (WMS-III) (Wechsler, 1997). The WMS-III Logical Memory subtest includes two brief paragraphs (Story A and Story B) that were read aloud to the participant and recall was assessed after each one. To assess verbal learning, Story B was reread and recall was assessed a second time. The dependent variable was a total score combining recall scores for both administrations of Story B.

2.3.1.1.2. Working memory. Working memory was assessed using the Letter–Number Sequencing test (Gold et al., 1997). Participants were presented a series of letters and numbers in a random order at the rate of one item per second. Participants were then asked to repeat back each string by reordering them, first with numbers in ascending order then with letters in alphabetical order. An additional condition was included which did not require reordering. The dependent variable was the total number of correct trials for each condition.

2.3.1.1.3. Semantic memory. Semantic memory was measured using a category fluency test (Spreen and Strauss, 1991) in which participants were asked to generate as many names of animals as possible in a 60-s epoch, and then as many names of grocery items as possible in a separate 60-s epoch. The dependent variable was the total number of acceptable responses across both categories.

2.3.1.1.4. Remote memory. Remote memory was assessed using two subtests from the revised version of M. Alpert's Remote Memory Battery (Famous Faces and Famous Events; Albert et al., 1979; Beatty et al., 1988). In Famous Faces, participants attempted to identify 56 different famous individuals portrayed in black-and-white photographs from the 1920s to 1980s (eight per decade). For Famous Events, participants answered 56 multiple-choice questions about significant historical events spanning the same decades (eight per decade). The dependent variable was the total number correct on each task.

2.3.1.1.5. Verbal retention. Verbal retention was assessed using the WMS-III Logical Memory subtest (Wechsler, 1997). Retention was measured by subtracting the Delayed Recall score (20-min delay) from the Immediate Recall score. The dependent variable was a difference score subtracting Delayed Recall from Immediate Recall.

2.3.1.2. Implicit memory

2.3.1.2.1. Procedural learning. Procedural learning was measured using the pursuit rotor task (Kern et al., 1997). Displayed on a turntable, the task involves tracking a lighted target area that moves in a clockwise direction at a speed of 45 rpms. Participants were instructed to track the moving lighted area using a stylus with a light sensitive tip in six blocks of four trials, each trial lasting 20 s. According to the standard procedures (Heindel et al., 1989) 5-min breaks were inserted between Blocks 2 and 3 and between Blocks 4 and 5. The dependent variable was a difference score derived by subtracting the mean time-on-target for Block 1 from Block 6.

2.3.1.2.2. Priming. Priming was assessed with a word-stem completion task which included two lists of 40 words and two corresponding lists of 40 three-letter stems (Graf and Williams, 1987). Each stem list included 18 targets corresponding to items on the word list, 18 non-targets corresponding to words on the other word list, and four stems that did not correspond to words on either list. Each word list was always administered with its corresponding stem list, and stems that served as targets on one list served as non-targets for the other list.

During administration, participants were instructed to rate each word from the 40-item list on a 5-point Likert scale based on "pleasantness" (Koh et al., 1976). After completion of the ratings, participants were then immediately presented a list of 40 word stems and asked to write down the first word he/she could think of to complete the stem. The two lists were counterbalanced across participants in each group. The dependent variable was a percentage score that represented the difference between target hits and baseline expectancies on the word stem completion task. Baseline expectancies were derived from a sample of community residents (Kern et al., 2010).

2.3.2. Assessment of social problem-solving ability

Social problem-solving ability was assessed using the Assessment of Interpersonal Problem-Solving Skills (AIPSS; Donahoe et al., 1990; Bowen et al., 1994). AIPSS