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Social vs. Non-Social Measures of Learning Potential for Predicting Community Functioning Across Phase of Illness in Schizophrenia

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Abstract

Studies demonstrate that dynamic assessment (i.e., learning potential) improves the prediction of response to rehabilitation over static measures in individuals with schizophrenia. Learning potential is most commonly assessed using neuropsychological tests under a test-train-test paradigm to examine change in performance. Novel learning potential approaches using social cognitive tasks may have added value, particularly for the prediction of social functioning, but this area is unexplored. The present study is the first to investigate whether patients with schizophrenia demonstrate social cognitive learning potential across phase of illness. This study included 43 participants at clinical high risk (CHR), 63 first-episode, and 36 chronic schizophrenia patients. Assessment of learning potential involved test-train-test versions of the Wisconsin Card Sorting Test (non-social cognitive learning potential) and the Facial Emotion Identification Test (social cognitive learning potential). Non-social and social cognition pre-training scores (static scores) uniquely predicted concurrent community functioning in patients with schizophrenia, but not in CHR participants. Learning potential showed no incremental explanation of variance beyond static scores. First-episode patients showed larger non-social cognitive learning potential than CHR participants and were similar to chronic patients; chronic patients and CHR participants were similar. Group differences across phase of illness were not observed for social cognitive learning potential. Subsequent research could explore whether non-social and social cognitive learning potential relate differentially to non-social versus social types of training and rehabilitation.

Keywords: schizophrenia, social cognition, learning potential, dynamic assessment, WCST, FEIT

1. Introduction

In the schizophrenia literature, the relationship between cognition and functional outcome has been well-studied. The vast majority of studies have examined *static* measures of cognition, as opposed to *dynamic* measures that assess change in performance consequent to instruction. Such dynamic measures of learning potential are viewed as more ecologically valid in rehabilitation contexts than static measures, and they are valuable predictors of vocational and psychiatric rehabilitation success in patients with schizophrenia (e.g., Sergi et al., 2005; Watzke et al., 2008; Wiedl, 1999). This connection to rehabilitation outcomes may be useful for matching patients to type or intensity of rehabilitation (Wiedl, 1999; Wiedl et al., 2001a).

Learning potential refers to the latent capacity to learn new things rather than to actualized ability or to the ability to demonstrate acquired knowledge (Grigorenko and Sternberg, 1998). Assessments of learning potential use a test-train-test approach that involves multiple administrations of a task. Between the two standard administrations, participants receive feedback and/or training designed to improve performance. Learning potential indices assess changes in performance following training to evaluate the potential to learn strategies to increase performance (Grigorenko and Sternberg, 1998). These learning potential measures sometimes are superior to static measures (i.e., scores from a single administration) when predicting response to vocational (Sergi et al., 2005; Watzke et al., 2008; Watzke et al., 2009), psychosocial (Fiszdon et al., 2006), and psychiatric rehabilitation in patients with schizophrenia (Wiedl, 1999; Wiedl et al., 2001a).

Learning potential studies of schizophrenia have largely been limited to examining change in performance on neuropsychological tests like the Wisconsin Card Sorting Test (for review, see Boosman et al., 2016). The prediction of outcome may be improved by also

examining social cognitive learning potential. Along these lines, non-social and social cognitive abilities can provide complementary information about functional rehabilitative outcomes in schizophrenia (Brekke et al., 2007), suggesting that the different types of learning potential may do the same. For example, social cognitive deficits are also key determinants of both vocational achievement and daily functioning in patients (Fett et al., 2011; Horan et al., 2012; Schmidt et al., 2011), and they predict unique variance in functional outcome, independent of non-social cognitive measures (Hoe et al., 2012; Lam et al., 2014; Martínez-Domínguez et al., 2015).

Going beyond a rehabilitation context, some studies have observed a relationship between functional outcome and learning potential (e.g., Fiszdon and Johannesen, 2010; Rempfer et al., 2017), whereas others have not (e.g., Kurtz et al., 2010; Woonings et al., 2002). These mixed findings may be a result of different approaches to quantifying learning potential. There is no consensus regarding the optimal approach for measuring learning potential (Fiszdon and Johannesen, 2010; Weingartz et al., 2008). To circumvent the limitations of any one measure, the present study used multiple approaches to quantify learning potential.

Another limitation is that there is no information on whether learning potential predicts functioning across phase of illness. Cross-sectional and longitudinal studies generally indicate stable impairment of non-social (Bonner-Jackson et al., 2010; Rund et al., 2015) and social cognition across phase of illness (Green et al., 2012a; McCleery et al., 2016; Pinkham et al., 2007), and these impairments predict community functioning (Ayesa-Arriola et al., 2013; Horan et al., 2012; McCleery et al., 2016; Meyer et al., 2014; Stouten et al., 2014). Given this consistent impairment across phase of illness, it would be expected that learning potential would show similar stability.

The aim of this study was to determine whether social cognitive learning potential would predict concurrent community functioning across phase of illness. To investigate social cognitive learning potential across phase of illness, we recruited participants who were putatively prodromal for psychosis (i.e, meeting criteria for a prodromal risk syndrome, or clinical high risk; CHR; Cannon et al., 2016), first-episode, and chronic schizophrenia patients. We predicted that within each clinical group those who have greater social cognitive learning potential were expected to show better community functioning, and learning potential was expected to explain variance in community functioning above static scores.

2. Method

2.1. Participants

Study enrollment included 43 CHR participants, 63 first-episode schizophrenia patients, and 36 chronic schizophrenia patients (see Table 1). Participants were part of the Center for Neurocognition and Emotion in Schizophrenia at the University of California, Los Angeles (UCLA). The research was approved by the UCLA Institutional Review Board, and all participants provided written informed consent or assent (parental consent was also obtained for minors). Psychiatric diagnoses were assessed using the Structured Clinical Interview for the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (SCID; First et al., 1996b) and SCID-II (First et al., 1996a). Interviewers were trained to establish interrater reliability. All interviewers obtained a minimum kappa of .75 for key psychotic and mood items and a minimum kappa of .85 for diagnostic accuracy. Exclusion criteria for all participants included evidence of a neurological disorder (e.g., epilepsy), head injury, any physical disorder that could impact brain functioning, an intelligence quotient (IQ) below 70, and limited fluency in English.

CHR participants were between the ages of 13 and 28 years and did not meet diagnostic criteria for schizophrenia, schizophreniform disorder, or schizoaffective disorder. They did meet criteria for one of three prodromal syndrome categories as assessed by the Structural Interview for Prodromal Syndromes (SIPS; McGlashan et al., 2001; Miller et al., 2003). The three categories were participants with symptoms of brief intermittent psychotic state, participants in an attenuated positive symptom state, and participants characterized by a genetic risk and deterioration state with a decline of functioning (see supplementary material for a description of each category).

First-episode patients were between 18 and 36 years of age and met DSM-IV diagnostic criteria for schizophrenia, schizoaffective disorder, or schizophreniform disorder. These patients were part of a clinical trial in the UCLA Aftercare Research Program, which recruits patients from local hospitals and from referrals from the community. First-episode patients were included if they had their first psychotic episode within 2 years prior to study participation, did not have an alcohol or substance use disorder within 6 months prior to their first psychotic episode that might account for their psychosis, had an adequate response to a previous trial of oral or long-acting injectable risperidone, and lived within commuting distance of UCLA. Women who were pregnant, nursing an infant, or planning to get pregnant in the near future were also excluded.

Chronic patients were between 22 and 50 years of age, had a diagnosis of schizophrenia or schizoaffective disorder, and were previously part of the Aftercare Research program as first-episode patients. Inclusion criteria required the first psychotic episode to have occurred at least 5 years prior to study participation.

2.2. Learning Potential Assessment

The assessment of learning potential involved test-train-test versions of the Wisconsin Card Soring Test (WCST; Heaton, 1993) and of the Facial Emotion Identification Test (FEIT; Mancuso et al., 2011; see Kerr and Neale, 1993, for a similar paradigm) within the same testing sessions, and all participants received training regardless of initial performance. The WCST assesses executive functioning and problem solving. Participants are instructed to match individually presented response cards to one of four key cards. Response cards are matched to one of the key cards according to one of the three features: color, geometric form, or number. A 64-card computerized version of the WCST was administered three times. The first and third administrations (i.e., testing administrations) of the WCST followed the standard assessment procedures, which consisted of feedback about the accuracy of the match between the response card and one of the key cards. The second administration (i.e., training administration) followed previous procedures (Goldberg et al., 1987; Green et al., 1992; Sergi et al., 2005). Detailed information about the training is provided in the supplementary materials. Two CHR participants did not complete the WCST.

The FEIT assesses emotion perception and requires participants to identify facial expressions of emotions using photographs from the stimulus set developed by Ekman (Young et al., 2002). The task includes 56 digitized photographs of faces showing happy, sad, angry, fearful, surprised, disgusted, and neutral expressions. On each trial, a photograph and a list of the seven possible facial expressions are presented for 5 seconds. The participant verbally indicates the emotion expressed on the face, and an examiner records the response. The faces used for the testing administrations were different from the ones used for the training session. The training session was individually administered using a computer program that divided the training into three sections (Baron-Cohen, 2004; Ekman, 2004). Detailed information about the training is

provided in the supplementary materials. One first-episode and four chronic patients did not complete the FEIT.

2.2.1. Measures. We collected cross-sectional data on clinical and functional scales, including the Global Functioning Scale: Role (GFS:Role) and the Global Functioning Scale: Social (GFS:Social; Cornblatt et al., 2007). The GFS:Role assesses performance as a student, an employee, or a homemaker. The GFS:Social assesses the quantity and quality of peer relationships, of peer conflict, of intimate relationships, and of involvement with family. Scores from GFS:Role and GFS:Social have demonstrated high inter-rater reliability and construct validity in CHR participants (Cornblatt et al., 2007) and outpatients with schizophrenia (Piskulic et al., 2011). Clinical symptoms were assessed using the 24-item Brief Psychiatric Rating Scale (BPRS; Ventura et al., 1993), which assesses psychotic and affective symptoms reflecting a two-week period. Symptom and functional ratings were done by members of the treatment team who were familiar with the participants. For additional details, see supplementary materials.

2.3. Data Analysis

As mentioned above, there is no consensus regarding the gold standard for quantifying learning potential. The present analyses used the most common approaches to measuring learning potential that have demonstrated adequate test-retest reliability and relationships with community functioning in outpatients with schizophrenia or schizoaffective disorder (see Fiszdon and Johannesen, 2010). The following static scores and learning potential indices were calculated separately for the WCST and FEIT. 1) Pre-training scores and 2) post-training scores were calculated based on the number of correct responses from the first and third administrations, respectively. 3) Residualized scores were obtained by regressing pre-training scores on post-training scores (Weingartz et al., 2008). 4) Difference scores were calculated by

subtracting pre-training scores from post-training scores. 5) Gain scores were computed by dividing difference scores by the potential gain scores (perfect performance minus pre-training scores; Sergi et al., 2005). Scores of 58 and 56 were considered perfect performance for the WCST and FEIT, respectively. 6) Lastly, a categorical approach was used to classify participants as “high scorers”, “learners”, or “nonlearners” (Schottke et al., 1993; see supplementary methods for classification procedure). Summary data for all scores are shown in Table 1.

Group differences in demographic and clinical variables were first examined using univariate analyses of variance (ANOVAs). Significant ANOVAs were followed up with independent *t* tests between the three groups. A chi-square test of independence was used to assess the gender distribution across groups. 3-Group (CHR, first episode patients, chronic patients) x 2-Time (pre-training, post-training) repeated measures ANOVA were used to examine group differences in pre- and post-training scores and the changes between administrations (see supplementary materials for an examination of group differences).

To test the hypothesis that within each clinical group those who have greater social cognitive learning potential would show better community functioning, the relationships between static scores and learning potential indices and role/social functioning scores were examined. Bivariate correlations were computed between static and dynamic scores and scores on the GFS:Role/GFS:Social. Kendall’s tau-b was used to examine relationships with the categorical learning potential index, and zero-order correlations were used to examine the remaining scores.

To test the hypothesis that learning potential would explain variance in community functioning above static scores, separate hierarchical linear regression models for predicting GFS:Role/GFS:Social scores were conducted. In the first block, GFS:Role/GFS:Social scores were predicted using only pre-training scores. The second block included the additional three

learning potential indices as predictors: post-training scores, gain scores, and the categorical classification measurement. Difference scores and regression residuals were not included in the regression models due to linear dependence on both pre- and post-training scores, resulting in singularity (see supplementary materials for analyses using difference scores and regression residuals in place of post-training scores).

We next conducted two separate regression analyses that regressed GFS:Role/GFS:Social scores on pre-training scores from the WCST, pre-training scores from the FEIT, and their interaction. To reduce collinearity among first-order predictors with the interaction term (Cohen et al., 2003; Cronbach, 1987), pre-training scores were *z*-score transformed. Variance inflation factors (VIFs) were used to examine potentially problematic multicollinearity among predictors, and a VIF below 10 was considered within acceptable limits (Cohen et al., 2003).

3. Results

Summary data for demographic and clinical characteristics are presented in Table 1. The ANOVA for role functioning scores (GFS:Role) was significant, $F(2, 139) = 8.66$, $p < .01$, $\eta^2 = .11$. Both groups of schizophrenia patients had lower role functioning scores than CHR participants (ts > 2.1, ps < .05, ds > 0.4), but significant differences were not observed between the two patient groups, $t(97) = 1.43$, $p = .16$, $d = 0.3$. The three groups were similar on social functioning scores and clinical symptom scores, as indicated by nonsignificant ANOVAs for the GFS:Social and the BPRS, $F(2, 139) = 2.62$, $p = .08$, $\eta^2 = .04$; $F(2, 137) = 0.37$, $p = .69$, $\eta^2 = .01$, respectively.

The full analysis of the 3-Group x 2-Time ANOVAs on WCST and FEIT scores is provided in the supplementary materials. All groups showed improved performance at the post-training administration of the WCST and FEIT (Fs > 86, ps < .01, η_p^2s > .37).

3.1. Relationships Involving Static Scores, Learning Potential Indices, and Role and Social Functioning Scores

Bivariate correlations involving static scores, learning potential indices, and role/social functioning scores are shown in Table 2. The relationships between pre- and post-training scores and GFS:Role scores were notable. With regard to correlations involving regression residuals, difference scores, gain scores, and the categorical classification measure and functional measures, only two were significant. To determine whether any relationships among static scores and learning potential indices were stronger for GFS:Role than for GFS:Social scores, coefficients were compared using tests for the equality of dependent correlations (Steiger, 1980a, b) and none were significant (ts < 1.3, ps > .21).

Another observation from Table 2 was that CHR participants showed no significant correlations, except for the relationship between categorical classification based on the FEIT and GFS:Role scores. Given this finding and the possibility of ceiling effects for static scores and learning potential indices in CHR participants, the remainder of the results focused on data from the chronic and first-episode patients.

3.2. Contribution of Learning Potential Indices versus Pre-training Score

We then examined whether the post-training and learning potential indices added incremental validity for predicting role and social functioning scores. Regression models were used to determine the unique contributions of pre-training scores and other measures (see Table 3). All regression models were significant when predicting GFS:Role and GFS:Social scores from pre-training scores only (block 1). However, none of the ΔR^2 values were significant after adding the predictors from block 2. Hence, post-training scores, gain scores, and categorical classification measures did not improve the prediction of role or social functioning over and

above what was predicted by pre-training scores alone. Lastly, multicollinearity among predictors, as measured by VIFs, was within acceptable limits.

3.3. Contribution of Pre-Training Scores from WCST versus Those from FEIT

Next, we conducted regression analyses to assess whether pre-training scores from the WCST and FEIT uniquely predicted role and social functioning. Specifically, we tested whether GFS:Role and GFS:Social scores were predicted from pre-training scores from the WCST, pre-training scores from the FEIT, and their interaction (see Table 4). Both overall models predicting GFS:Role and GFS:Social scores were significant, and multicollinearity of predictors, as measured by VIFs, was within acceptable limits. For GFS:Role, pre-training scores from both tasks were significant, suggesting that there is a benefit from administering both tasks, but the interaction term was not significant. For GFS:Social, pre-training scores from the WCST were the only significant predictor. Thus, including FEIT pre-training scores in the regression model provided no incremental benefit.

3.4. Relationships between Scores from WCST and FEIT

To determine whether different participants improved on the WCST and FEIT, static scores and learning potential indices from the WCST and FEIT were compared for patients that completed both tasks ($n = 94$). Between-task correlations were observed for pre- and post-training scores, $r(92) = .43$, $p < .01$; $r(92) = .56$, $p < .01$, respectively. Correlations between regression residuals, difference scores, and gain scores were not significant ($|rs| < .16$, $ps > .14$). The distribution of the categorical classification measure was significantly different between tasks, $X^2(2) = 32.31$, $p < .01$, suggesting that the percentage of individuals classified as "high scorers", "learners", and "nonlearners" was different for the WCST and FEIT. Although post-training scores were significantly correlated, the remaining learning potential indices were

unrelated to each other. These findings support the notion that learning potential is domain specific (see also Davidson et al., 2016; Rempfer et al., 2017).

4. Discussion

Scores from the initial administrations of both non-social and social cognitive tasks predicted concurrent role and social functioning in first-episode and chronic patients. However, assessments of learning potential did not explain variance in concurrent role or social functioning over and above pre-training scores during any phase of illness. Hence, the dynamic assessments provided no incremental validity above static assessments in predicting community functioning.

In both groups of schizophrenia patients, poorer cognitive and social cognitive pre- and post-training scores were related to poorer role and social functioning, consistent with studies of first-episode (Addington et al., 2005; Allott et al., 2011; Ayesa-Arriola et al., 2013; Nuechterlein et al., 2011; Stouten et al., 2014) and chronic patients (Green et al., 2000; Green et al., 2004). Current results also indicated that social and non-social cognition were uniquely related to role functioning, but only non-social cognition was uniquely related to social functioning. This latter result is inconsistent with research that demonstrated social cognitive impairment has a greater impact on community functioning than non-social cognition (Fett et al., 2011; Green et al., 2012b). The discrepancy with prior findings may be because we used one aspect of social cognition, whereas prior studies assessed multiple domains (e.g., theory of mind, emotion processing, social perception). For example, another study from this Center used multidimensional assessments of social cognition and observed significant correlations between social cognition and concurrent role/social functioning and role/social functioning a year later (Horan et al., 2012).

For the CHR participants neither cognitive nor social cognitive measures were related to role or social functioning. However, previous studies reported that cognition predicted concurrent role and social functioning (Carrión et al., 2011) and functioning a year later in CHR participants (Meyer et al., 2014). The negative findings from the current study and others (Schlosser et al., 2015; Strassnig et al., 2015) may be due to the heterogeneity of the CHR group. Approximately 30% to 35% of CHR participants are expected to develop a psychotic disorder within 2.5 years (Cannon et al., 2008; Fusar-Poli et al., 2012). Cognitive impairment in those CHR participants who do not develop overt psychosis is relatively mild (Seidman et al., 2010), which may result in a reduced impact on functioning (Meyer et al., 2014).

Learning potential research in schizophrenia began with a few early papers (Bellack et al., 1990; Green et al., 1992; Wiedl, 1999; Wiedl and Schöttke, 1995; Wiedl and Wienöbst, 1999) followed by a meta-analysis and review paper (Green et al., 2000). These papers highlighted learning potential as a valuable predictor of rehabilitation success and the possibility of using learning potential to match patients to type or intensity of rehabilitation. Despite the initial enthusiasm for learning potential research in schizophrenia, this research has slowed in recent years, possibly due to mixed findings regarding its relationship to functional outcome (Green et al., 2015). Although learning potential indices have been related to community (Rempfer et al., 2017) and global functioning (Fiszdon and Johannesen, 2010), only the latter study demonstrated incremental validity of learning potential over pre-training performance. Other studies have failed to observe relationships between learning potential and clinical symptoms (Kurtz et al., 2010; Pedersen et al., 2012; Wiedl et al., 2001a; Wiedl et al., 2004), duration of illness (Pedersen et al., 2012), psychosocial functioning (Kurtz et al., 2010; Vaskinn et al., 2008; Vaskinn et al., 2009; Woonings et al., 2002), and functional capacity (Kurtz and

Wexler, 2006). In the present study, learning potential did not predict concurrent role/social functioning over and above pre-training performance, which is consistent with one other study (Rempfer et al., 2017). These negative studies employed a wide range of learning potential indices; thus, it is unlikely the findings are due to the selection of any one specific index. Taken together, learning potential does not appear to be a useful predictor of community functioning.

Unlike the negative findings for community functioning, learning potential has consistently outperformed pre-training scores when predicting response to rehabilitation and skills training in schizophrenia (Davidson et al., 2016; Fiszdon et al., 2006; Rempfer et al., 2011; Sergi et al., 2005; Watzke et al., 2008; Wiedl, 1999; Wiedl et al., 2001b; cf. Tenhula et al., 2007), which was the impetus for learning potential research in schizophrenia (e.g., Green et al., 2000; Wiedl and Wienöbst, 1999). A recent study demonstrated that learning potential predicts skills acquisition, but only in the context of an intervention (Davidson et al., 2016). That is, learning potential predicted increased skills acquisition in the context of cognitive remediation, but not in treatment as usual (TAU). Pre-training scores were the strongest predictor of skills acquisition for patients in TAU. Thus, learning potential was a useful predictor only when participants had the opportunity to learn from an intervention. Taken together, dynamic assessment has advantages for predicting response to rehabilitation or training, but it is less useful for predicting current functioning in schizophrenia.

Social cognitive learning potential indices were mostly unrelated to non-social learning potential indices, suggesting that learning potential might be domain specific. One other study has examined learning potential for two different domains and found that learning potential from an executive functioning task showed small-to-medium correlations with learning potential from a memory task (Rempfer et al., 2017), suggesting that some task specific abilities were uniquely

assessed by the two measures. Additional support for the domain specificity of learning potential comes from a study of cognitive remediation (Davidson et al., 2016) in which learning potential on a memory task was more strongly related to skills acquisition for verbal memory than for skills acquisition for spatial memory or memory of number sequences.

We note the following limitations to the study. First, we only examined learning potential's relationship with current community functioning. Given the difference in findings for learning potential in predicting clinical rehabilitation outcome vs. community functioning, future studies may consider examining this putative differential relationship. Second, learning potential was examined cross-sectionally, and there may be longitudinal associations between learning potential and community functioning. Third, GFS:Role and GFS:Social assess broad domains of functioning that could be parsed into multiple components. Learning potential might relate to specific components of community functioning that were obscured in the broad functional scores. Furthermore, the GFS:Role and GFS:Social relied on patient self-report rather than on informants, observed behaviors, or ecological momentary assessment. Thus, these scales are limited by patient introspection and ability to recall daily events. Fourth, WCST and FEIT training methods were not identical, which might have impacted learning potential measures. Fifth, the present study only assessed one domain of social cognition, and future work may consider other domains. Emotion processing and social relationship perception are viable candidates for future study, as they are stable across phase of illness in cross-sectional studies (Green et al., 2012a), demonstrate long-stability over a 5-year period within patients (McCleery et al., 2016), and predict community functioning (Horan et al., 2012; McCleery et al., 2016).

Table 1

Summary of Demographic and Clinical Characteristics, Static Scores, and Learning Potential Indices as a Function of Phase of Illness and Task

Characteristic	CHR Participants		First-Episode Patients		Chronic Patients	
	n = 43		*n* = 63		*n* = 36	
	n	%	*n*	%	*n*	%
Female	12	27	17	26	14	38
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Age (yrs)	18.8[1]	3.9	22.7	3.5	31.2	6.3
GFS:Role	6.1	2.6	4.0	2.3	4.8	2.8
GFS:Social	6.1	1.7	5.5	1.9	6.3	2.0
BPRS	40.5[2]	9.9	41.4	11.5	42.6	9.5
WCST	*n* = 42		*n* = 63		*n* = 36	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Pre-Training	51.9	5.4	43.7	12.0	44.6	10.7
Post-Training	56.4	4.1	54.3	5.3	52.1	9.4
Difference Scores	4.6	5.9	10.6	11.3	7.5	9.0
Gain Scores	0.3	0.4	0.4	0.4	0.3	0.4
	n		*n*		*n*	
High Scorer	30		33		21	
Learner	8		21		8	
Non-Learner	4		9		7	
FEIT	*n* = 43		*n* = 62		*n* = 32	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Pre-Training	48.2	7.3	46.0	6.4	43.0	*7.6*
Post-Training	51.2	5.6	49.3	5.9	47.0	6.8
Difference Scores	2.7	4.7	3.4	3.7	4.0	4.2
Gain Scores	0.2	0.8	0.3	0.5	0.3	0.4
	n		*n*		*n*	
High Scorer	23		18		5	
Learner	11		13		7	
Non-Learner	10		31		20	

Note: Pre- and post-training scores are based on the number of correct responses. Difference scores and gain scores represent raw, not standardized, scores. Summary information for regression residuals was not included in the table due to the computational definition of residualized scores requiring a mean of 0. [1]Sex information is missing for one CHR participant. [2]BPRS scores are missing for two CHR participants. CHR = clinical high risk, GFS:Role = Global Functioning Scale: Role; GFS:Social = Global Functioning Scale: Social; BPRS = Brief Psychiatric Rating Scale; WCST = Wisconsin Card Sorting Test; FEIT = Facial Emotion Identification Test

Table 2

Bivariate Correlations Involving Static Scores, Learning Potential Indices, and Role/Social Functioning Scores as a Function of Phase of Illness and Task

			Pre-Training	Post-Training	Regression Residual	Difference Scores	Gain Scores	Categorical Classification[1]
WCST	Chronic	GFS:Role	.42*	.35*	-.02	-.13	.13	-.18
		GFS:Social	.36*	.28	-.05	-.15	-.12	-.15
	First Episode	GFS:Role	.27*	.09	-.23	-.24	-.10	-.24*
		GFS:Social	.27*	.11	-.21	-.23	-.04	-.16
	CHR	GFS:Role	-.18	-.04	.11	.13	.09	.22
		GFS:Social	-.04	-.07	-.03	-.01	-.02	.03
FEIT	Chronic	GFS:Role	.53*	.45*	-.12	-.24	.19	-.18
		GFS:Social	.34	.29	-.07	-.15	.02	.00
	First Episode	GFS:Role	.26*	.27*	.04	-.02	-.02	-.19
		GFS:Social	.23	.17	-.09	-.13	-.09	-.18
	CHR	GFS:Role	-.12	-.07	.10	.11	.15	.26*
		GFS:Social	.00	-.05	-.07	-.06	-.09	.22

Note: $*p < .05$; [1]Kendall's Tau b was used for correlations involved the categorical classification of participants. CHR = clinical high risk; WCST = Wisconsin Card Sorting Test; FEIT = Facial Emotion Identification Test; GFS:Role = Global Functioning Scale: Role; GFS:Social = Global Functioning Scale: Social

Table 3

Hierarchical Regression Models Examining the Relationships Involving Static Scores, Learning Potential Indices, and Role/Social Functioning Scores in First-Episode and Chronic Patients

				R^2	*p* value	ΔR^2	*p* value	*B* (*SE*)	*p* value	VIF
WCST	GFS:Role	Block 1		.10	<.01					
			Pre-Training					.07 (0.02)	<.01	--
		Block 2		.12	.01	.02	.57			
			Pre-Training					0.09 (0.04)	.02	3.51
			Post-Training					-.04 (0.07)	.57	3.84
			Gain Score					1.32 (1.08)	.22	3.51
			Categorical Classification					-.16 (0.50)	.74	2.36
	GFS:Social	Block 1		.09	<.01					
			Pre-Training					0.05 (0.01)	<.01	--
		Block 2		.10	.04	.01	.82			
			Pre-Training					0.07 (0.03)	.02	3.51
			Post-Training					-.01 (0.05)	.88	3.84
			Gain Score					0.42 (0.84)	.62	3.51
			Categorical Classification					0.24 (0.39)	.54	2.36
FEIT	GFS:Role	Block 1		.11	<.01					
			Pre-Training					0.12 (0.04)	<.01	--
		Block 2		.12	.02	.01	.90			
			Pre-Training					0.09 (0.09)	.31	6.72
			Post-Training					0.02 (0.12)	.85	9.04
			Gain Score					0.10 (0.89)	.91	2.57
			Categorical Classification					-.17 (0.35)	.64	1.42
	GFS:Social	Block 1		.05	.02					
			Pre-Training					0.06 (0.03)	.02	--
		Block 2		.06	.25	.004	.94			
			Pre-Training					0.04 (0.07)	.38	6.72
			Post-Training					0.03 (0.10)	.74	9.04
			Gain Score					-.42 (0.71)	.44	2.57
			Categorical Classification					0.01 (0.28)	.37	1.42

Note: VIF = variance inflation factor; WCST = Wisconsin Card Sorting Test; FEIT = Facial Emotion Identification Test; GFS:Role = Global Functioning: Role Scale; GFS:Social = Global Functioning: Social Scale

Table 4

Multiple Linear Regressions Examining the Contribution of Pre-Training Scores from the WSCT and FEIT in Predicting Role/Social Functioning Scores in First-Episode and Chronic Patients

		R^2	*p* value	*B* (*SE*)	*p* value	VIF
GFS:Role		.17	<.01			
	WCST Pre-Training			0.64 (0.26)	.02	1.27
	FEIT Pre-Training			0.75 (0.28)	<.01	1.38
	Interaction			0.42 (0.25)	.09	1.29
GFS:Social		.10	.02			
	WCST Pre-Training			0.44 (0.21)	.04	1.27
	FEIT Pre-Training			0.26 (0.22)	.25	1.38
	Interaction			0.003 (0.20)	.99	1.29

Note: VIF = variance inflation factor; WCST = Wisconsin Card Sorting Test; FEIT = Facial Emotion Identification Test; GFS:Role = Global Functioning: Role Scale; GFS:Social = Global Functioning: Social Scale

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