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Measuring learning potential in people with schizophrenia: A comparison of two tasks

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ABSTRACT

Learning potential measures utilize dynamic assessment methods to capture performance changes following training on a cognitive task. Learning potential has been explored in schizophrenia research as a predictor of functional outcome and there have been calls for psychometric development in this area. Because the majority of learning potential studies have utilized the Wisconsin Card Sorting Test (WCST), we extended this work using a novel measure, the Rey Osterrieth Complex Figure Test (ROCFT). This study had the following aims: 1) to examine relationships among different learning potential indices for two dynamic assessment tasks, 2) to examine the association between WCST and ROCFT learning potential measures, and 3) to address concurrent validity with a performance-based measure of functioning (Test of Grocery Shopping Skills; TOGSS). Eighty-one adults with schizophrenia or schizoaffective disorder completed WCST and ROCFT learning measures and the TOGSS. Results indicated the various learning potential computational indices are intercorrelated and, similar to other studies, we found support for regression residuals and post-test scores as optimal indices. Further, we found modest relationships between the two learning potential measures and the TOGSS. These findings suggest learning potential includes both general and task-specific constructs but future research is needed to further explore this question.

1. Introduction

There is an extensive literature on cognition in schizophrenia, including consistent evidence for a relationship with functional outcomes (Green et al., 2015, 2000; Kurtz et al., 2010). Although consistently observed, this relationship is only moderate, highlighting the need to understand factors that account for the remaining, unexplained variance in outcomes. In that regard, some researchers have suggested the field move beyond only examining static measures of cognition and explore dynamic *learning potential* as an important factor in predicting functional and rehabilitation outcomes.

Learning potential has been defined as the ability to attain cognitive skills and to employ those skills in appropriate situations to solve problems (Sternberg and Grigorenko, 2002). Learning potential is often measured with dynamic assessment methods, which combine supportive feedback and instruction with test administration. In this regard, learning potential examines to the extent to which an individual is able to use feedback and instruction to improve performance. Learning potential also has been examined in testing formats that provide repeated learning opportunities, without formal instruction or intervention, such as with word list learning tasks (e.g., Vaskinn et al., 2008b). While historically dynamic assessment and learning potential studies have been conducted in the context of education research, this approach has also been applied in populations with traumatic brain injury and neuropsychiatric conditions (see Boosman et al., 2016 for review). Wiedl and colleagues (e.g., Wiedl et al., 2001; Wiedl, 1999) first applied learning potential to schizophrenia research using the Wisconsin Card Sorting Test (WCST). Wiedl identified three learner subtypes ("learners," "non-retainers," and "high-scorers") in a sample of participants with schizophrenia, based on intra-individual changes in performance across pre-training/training/post-training conditions (Wiedl, 1999). *Learners* demonstrated significant improvements at post-training, while *non-retainers* did not maintain improvement at post-training. *High-scorers* included individuals who performed well across both pre- and post-training conditions.

Among persons with schizophrenia and other serious mental illnesses, learning potential has been associated with other cognitive processes and functional outcomes. For instance, learning potential has been associated with cerebral metabolism (Ohrmann et al., 2008; Pedersen et al., 2009) and the cognitive skills of attention and memory

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(e.g., Kurtz et al., 2010; Kurtz and Wexler, 2006; Rempfer et al., 2006; Wiedl et al., 2001). The evidence regarding learning potential and functional outcomes is mixed. Learning potential has been associated with work skills (Sergi et al., 2005), functional status (Kurtz and Wexler, 2006), rehabilitation readiness (Fiszdon et al., 2006) and response to rehabilitation or skills training (Davidson et al., 2016; Rempfer et al., 2011; Watzke et al., 2008; Wiedl, 1999). On the other hand, some studies have reported negative findings when examining learning potential as a predictor of social skills (Tenhula et al., 2007) or a mediator with regard to concurrent psychosocial functioning (Vaskinn et al., 2008a; Kurtz et al., 2010). Green et al. (2015) recently commented on the learning potential literature and posited that there has been a slowing of initial research on the construct due to mixed findings in predicting functional outcomes. Interestingly, learning potential has generally been supported in published studies that examine its predictive utility specifically within the context of an intervention or learning opportunity (i.e., Davidson et al., 2016; Rempfer et al., 2011; Watzke et al., 2008; Wiedl, 1999). Thus, learning potential may hold promise as a tool in predicting treatment response and/or tailoring interventions for individuals with schizophrenia.

There also have been recent calls for additional psychometric research on learning potential (Boosman et al., 2016; Davidson et al., 2016), including the need for the development of additional learning potential tools. The majority of schizophrenia-learning potential studies have utilized the WCST. Other learning potential tests have included dynamic assessment versions of the California Verbal Learning Test –II (CVLT-II; e.g., Davidson et al., 2016; Fiszdon et al., 2006; Kurtz et al., 2010; Vaskinn et al., 2008b) and the Auditory Verbal Learning Test (e.g., Wiedl et al., 2001). However, the extent to which these different tasks produce consistent findings has not been examined. Davidson et al. (2016) have suggested that rather than reflecting a general or unitary construct, different learning potential tasks may reflect domain specific abilities. There has been very little direct comparison among different learning potential tasks to address this possibility. In one study, Weingartz et al. (2008) compared several learning potential indices from the WCST to a dynamic assessment version of the Auditory Verbal Learning Test (AVLT) that provided enhanced instruction. They reported significant correlations between WCST learning potential indices and overall AVLT performance. However, this study did not examine specific learning potential indices of the AVLT so no direct comparisons of learning potential across tasks were possible. Thus, it remains unclear the extent to which different learning potential tasks will produce the same pattern of results.

In addition to the need for more research directly comparing learning potential tasks, Davidson et al. (2016) noted that there also is a need for consensus on optimal computational methods to assess learning potential within tasks. Various learning potential studies have used different indices of learning, such as assignment to categorical learning groups, post-training performance scores, and various types of pre- to post-training gain scores. Two prior psychometric investigations have examined the properties of these different indices with regard to the WCST (Weingartz et al., 2008) and the CVLT-II (Fiszdon and Johannesen, 2010). These investigations concluded that while there is some overlap among the different computational methods, there are some distinct psychometric and theoretical advantages to using regression residuals and post-training scores in learning potential research. Namely, these two indices have demonstrated superior construct and criterion validity in terms of their relationships with other dynamic cognitive measures and concurrently assessed psychosocial functioning. Further, post-training scores and regression residuals have been viewed as preferable because they do not suffer from the undesired psychometric properties of simple gain or difference scores, which can be vulnerable to lowered reliability (Weingartz et al., 2008; Fiszdon and Johannesen, 2010).

The overarching purpose of the present study was to examine the association between learning potential measures both within and between two learning potential assessments, the Rey Osterrieth Complex Figure Test (ROCFT) and the more common learning potential task, the WCST. The ROCFT requires visuo-perceptual organization ability and visual memory (Rey, 1941/1993; Osterrieth, 1944/1993; Meyers and Meyers, 1995). Difficulties on the ROCFT have been identified in people with schizophrenia, and are associated with poor organizational strategy (e.g., Silverstein et al., 1998; Seidman et al., 2003; Kim et al., 2008). In this regard, the ROCFT is well-suited for adaptation as a learning potential measure, in which test-takers are provided with enhanced instruction based on an effective organizational strategy. We have previously demonstrated the feasibility of adapting the ROCFT as a measure of learning potential (Rempfer et al., 2012).

To our knowledge, this is the first study to directly compare learning potential indices across dynamic assessment versions of two different tasks in people with schizophrenia. Specifically, we examined the following issues. First, with regard to the issue of computational methods, we sought to examine the relationships among different indices of learning potential within each of the learning potential tasks to evaluate the extent to which the different measures assess the same construct. Second, in order to address the question of whether learning potential reflects a unitary construct or is task-specific, we examined the association between performance measures on the two learning potential tasks. Finally, in order to examine criterion validity, we examined the relationships between learning potential measures from both tasks and a performance-based measure of community functioning (Test of Grocery Shopping Skills).

2. Method

2.1. Participants

Individuals with diagnoses of schizophrenia or schizoaffective disorder were recruited from three community mental health centers (N = 81). Study procedures were approved by the relevant institutional review boards and all participants provided written informed consent. The Structured Clinical Interview for DSM-IV (First et al., 2002) was utilized to confirm diagnoses of schizophrenia (n = 45) or schizoaffective disorder (n = 36). Additional inclusion criteria included: age between 18 and 65, no substance abuse/dependence in past 30 days, and no known developmental or neurological disability. Medication data were available for 73 of 81 participants. Of these, 4 were not taking antipsychotic medication and 69 were prescribed antipsychotics (62 were prescribed second generation antipsychotics and 7 were prescribed only conventional antipsychotics). Average age of participants was 41.7 (SD = 8.6) years; 40 were female and 41 were male. Participants from the current study have been described elsewhere (Rempfer et al., 2012) in a report limited to describing the development and feasibility of the ROCFT learning potential measure. Table 1 includes additional participant information.

2.2. Measures

2.2.1. Learning potential assessments

The learning potential tasks (WCST and ROCFT) were administered within one testing session lasting approximately two hours. Each learning potential task included three consecutive trials consistent with the test-train-test format of dynamic assessment. The first (“pre-training”) and third trials (“post-training”) utilized standard administration procedures, while the second trial constituted the training phase for all participants. The order in which the WCST and ROCFT were administered was counterbalanced across participants.

The WCST 64 card version (Kongs et al., 2000) was administered using the training and scoring approach developed by Wiedl et al. (2001, 1999). The standard administration of the WCST requires participants to match cards to one of four key cards and evaluates problem solving and abstraction. In the training phase (trial 2) the card sorting