THE EFFECTS OF EFFORT, INTEREST, AND RAPPORT ON WISCONSIN CARD SORTING TEST PERFORMANCE IN SCHIZOPHRENIA

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ABSTRACT

David L. Roberts: The Effects of Effort, Interest, and Rapport on Wisconsin Card Sorting Test Performance in Schizophrenia
(Under the Direction of David Penn)

Individuals with schizophrenia typically perform poorly on measures of executive function. This poor performance is widely attributed to disease-related neurocognitive deficits despite the fact that the role of motivational and interpersonal factors have not been adequately studied. In the present study, 30 individuals diagnosed with schizophrenia completed two trials each of the Wisconsin Card Sorting Test, a measure of executive function. Between trials, half of the participants received enhanced instructions. It was hypothesized that this experimental group would achieve better WCST scores, and would also report exerting greater effort on the task, being more interested in the task, and experiencing better rapport with the experimenter than participants in the control group. Results showed significantly improved WCST performance in the experimental group relative to the control group. However, findings did not support the hypothesized group differences in effort, interest, and rapport. Implications are discussed.

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Chapter I

Introduction

Individuals with schizophrenia have deficits in a variety of neurocognitive domains, including memory, attention, language processing, motor speed, and executive functioning (Kern & Green, 1998). These deficits correlate highly with individuals' current functioning and long-term outcome (Green, 1999; Velligan et al., 1997). Among neurocognitive domains, executive functioning (EF) is a particularly robust predictor of community outcomes in schizophrenia (Green, 1996; Green, Kern, Braff, & Mintz, 2000), and thus has received a great deal of attention, particularly from cognitive rehabilitation programs (Bellack, Gold, & Buchanan, 1999).

EF is a broad cognitive domain that encompasses various subsidiary capacities, including goal directed behavior, attention, working memory, and cognitive flexibility. EF reflects an individual's ability to actively integrate these capacities in the service of higher-order activities, such as flexibly using knowledge to abstract concepts, plan complex actions, and predict event outcomes.

EF deficits among individuals with schizophrenia are generally thought to reflect stable neurological effects of the disorder. Several lines of research support this view. First, the specific types of EF deficits observed in individuals with schizophrenia resemble those found among people who have sustained frontal lobe brain damage (Axelrod, Goldman, Tompkins, & Colleen, 1994). Second, whereas normal individuals' exhibit increased dorsolateral prefrontal metabolism and blood flow while performing EF tasks, individuals with schizophrenia typically do not (Liu, Tam, Xie, & Zhao, 2002; Weinberger, Berman, & Zec, 1986). And finally, poor cognitive performance in schizophrenia has been found to pre-date disease onset (Erlenmeyer-Kimling et al., 2000; Shenkel & Silverstein, 2004), remain relatively stable over time (Albus et al., 2002), and persist while the disorder is in remission (Heaton et al., 2001; Kurtz, Seltzer, Ferrand, & Wexler, 2005).

Despite evidence of stable neurological deficits, several findings suggest that non-neurological factors may also contribute to poor cognitive performance in schizophrenia. First, consistent findings show that poor performance on EF tasks is amenable to improvement via learning-based intervention strategies (see literature review below, and by Green, 1996; Kurtz, Moberg, Gur, & Gur, 2001). Although suggestive, this finding may reflect neurocognitive compensation, whereby an intact ability (e.g., long-term memory) is used to mitigate the impairment associated with a deficient ability (e.g., EF; Wilson, 2002). Several studies have also improved EF performance without using learning-based techniques or by artificially decreasing cognitive demand. For example, Perry, Potterat, and Braff (2001) instructed participants with schizophrenia to self-monitor during task performance by verbally articulating their thought processes while responding. These participants achieved results statistically indistinguishable from those obtained by non-ill subjects who were not instructed to self-monitor. Summerfelt et al. (1991) found that paying subjects for correct responses yielded improved performance (although see discussion below for contradictory findings).

Another line of research that suggests that neurocognitive deficits may be mutable derives from research on the negative symptoms of schizophrenia. Negative symptoms include apathy, avolition, thought blocking, and flattened affect. As a syndrome, negative symptoms are strongly correlated with cognitive deficits both cross-sectionally and longitudinally (Censits, Ragland, Gur, & Gur, 1997; Guillem et al., 2001; Nieuwenstein, Aleman, and de Haan, 2001). Although thought to be relatively stable, it appears that negative symptoms may be responsive to psychosocial interventions such as cognitive behavioral therapy (Gould, Mueser, Bolton, Mays, & Goff, 2001; Rector, Seeman, & Segal, 2003; Tarrier & Wykes, 2004). Thus, negative symptoms are likely multiply determined, and reflect a variety of causal factors, including neurobiological vulnerability, negative expectancies, and conditioned apathy (Rector, Beck, & Stolar, 2005). This reconceputalization of negative symptoms is consistent with conclusions from research on labeling theory (Link, Struening, Neese-Todd, Asmussen, & Phelan, 2001), self-stigma (Corrigan & Kleinlein, 2005), and stereotype threat (Corrigan & Calabrese, 2001), all of which posit a significant role for non-biological, psychosocial factors, in contributing to the cognitive and behavioral disabilities resulting from schizophrenia.

The current study extends research on such putative psychosocial factors by examining the role of participant effort, task interest, and participant/experimenter rapport in accounting for EF performance in schizophrenia. In the following section, I review studies that show that EF performance can be successfully improved in schizophrenia through use of enhanced instruction. It is pointed out that the mechanism underlying improved performance via enhanced instruction is not well articulated. To address this issue, I introduce Self-Determination Theory (SDT) as a potential framework for conceptualizing how enhanced instruction leads to improved EF performance, specifically by focusing on the following motivational and interpersonal factors: Effort, interest, and rapport. The literature review concludes with a description of study aims and hypotheses.

Remediation of EF Performance in Schizophrenia

Numerous studies have attempted to manipulate EF performance in schizophrenia. The bulk of these studies have used the same EF measure, the Wisconsin Card Sorting Test (WCST; Heaton, 1993). The WCST is a well-validated measure of EF that requires participants to sort 64 consecutive cards into four piles based on rules that are not disclosed by the experimenter, and that change over the course of the administration. Thus, the participant must discover the nature of the sorting rules, and modify his or her strategy each time the sorting rules change.

The only manipulation that consistently has led to improved WCST performance has been provision of enhanced instructions as to the underlying rules of the task. This manipulation has taken the form of divulging the rules to participants prior to testing, in a card-by-card fashion, or both prior to testing and periodically throughout testing. Card-by-card instruction involves explaining to the participant the nature of each error after each incorrectly sorted card. For example, after incorrectly attempting to sort a card by color, a participant might be told, "You tried to match this card based on its color, but that was wrong. So this means it would have been correct to match it by the shape of the symbols or the number of symbols instead."

Goldberg, Weinberger, Berman, Pliskin, and Podd (1987) divided 41 inpatients with schizophrenia into three pre-trial instruction conditions: standard instructions, standard instructions plus description of the three categories, and enhanced instruction including category description and an explanation of sorting rule shifts. Only the group receiving maximum enhanced instructions showed significant improvement in WCST performance; additionally, a cross-condition subgroup of participants was identified as "unable to learn."

Goldberg et al. concluded that poor performance among the latter group was likely due to a stable neuropsychological deficit as opposed to state-related psychological factors. However, a limitation of this study is that participants were selected on the basis of their being least likely to succeed on the task. This may help account for the lack of significant effects in the other enhanced instruction condition. In a less impaired sample, Bellack and colleagues (1990) found that a group receiving pre-trial instruction (which was more elaborate than in Goldberg et al.) plus monetary reinforcement ($.05 per correct response) performed significantly better than a control group that received monetary reinforcement alone. Metz, Johnson, Pliskin, and Luchins (1994) replicated the pre-test instructional procedure of Bellack et al. (1990) and found that instruction improved performance. Contrary to Goldberg et al., Metz et al. concluded that factors other than a stable neuropsychological deficit (i.e., frontal cortex dysfunction) likely contribute to poor performance on the WCST among individuals with schizophrenia. Nisbet, Siegert, Hunt, and Fairley (1996) also employed pre-test instructional procedures, and found significant improvements over baseline. Finally, Goldman, Axelrod, and Tompkins (1992) found that detailed instructions provided at pre-test and after 32 cards significantly improved WCST performance in schizophrenia.

In a notable variation of this research, Pardo et al. (2000) studied the effects of EF task training on twin sets discordant for schizophrenia. Pardo et al observed pre-training deficits among schizophrenia probands as well as non-ill monozygotic twins. These same deficits were not present in non-ill dizygotic twins, suggesting that neurobiological factors underlie cognitive deficits. However, after inter-test enhanced instructions, the non-ill monozygotic twins' performance improved substantially more than the ill twins'. Pardo et al. concluded that "nonheritable protective factors modulate the specific, plastic, and sometimes subtle neurocognitive deficits related to the schizophrenia genotype" (459). Thus, despite possessing similar neurocogntive deficits to their ill twins, non-ill monozygotic twins were better able to overcome these deficits via remediation techniques.

Kurtz et al. (2001) conducted a meta-analytic review of studies that have used enhanced instruction to remediate WCST performance in schizophrenia. Effect sizes were calculated for each of three dependent variables (number correct, categories achieved, and perseverative errors), and for composite dependent measures from each study. No consistent differences were found between scores on the three dependent measures, and composite measure effect sizes were all quite large ($d_+ \geq 0.80$). The large and consistent effect sizes show that most training interventions achieved a generalized positive effect on performance. Thus, enhanced instruction clearly can improve WCST performance in schizophrenia, although the mechanisms underlying this effect are relatively unknown.

In summary, the studies reviewed here consistently indicate that enhanced instruction (pre-test and/or card-by-card) can improve short-term WCST performance in schizophrenia. A particular strength of this research is the studies' consistent use of the WCST and of similar instructional manipulations. A limitation is that possible mechanisms underlying improved performance have not been directly measured. Specifically, findings do not unequivocally support the neurological theory of WCST deficit in schizophrenia because none of the studies measured concomitant neurological activity during task performance. Metz et al. (1994) and Pardo et al. (2000) concluded that non-neurological factors contribute to WCST deficits. Unfortunately, specific non-neurological factors were not discussed.

In the following section, Self-Determination Theory (SDT) is presented as a framework for understanding the role of non-neurological, psychosocial factors on task performance.

Self-Determination Theory

Self-Determination Theory (SDT; Ryan & Deci, 2000) is an empirically supported theory of motivation which posits that all people are fundamentally driven to achieve three ends: competence, relatedness, and autonomy. According to SDT, motivation toward these goals can be predictably enhanced or thwarted by various environmental and psychological factors. These factors can be organized on a continuum in terms of their corresponding motivational states, from "intrinsically motivated" to "extrinsically regulated." Intrinsically motivated actions are associated with perceived internal locus of control, high motivation, enjoyment, interest, and the action being perceived as consistent with one's identity and values. Conversely, externally regulated actions are associated with experiences of external locus of control, acting without intent ("going through the motions"), devaluing of the action, and either not feeling competent to do the action or not expecting positive outcome from the action.

According to SDT, activities are likely to become more intrinsically motivated if performing them increases an individuals' sense of competence, autonomy, or relatedness. For example, a person's intrinsic motivation to paint may grow when she realizes that her best friend is also interested in painting. Alternatively, a child might initially require external coercion to practice the piano, but as her musical competence grows so too would her intrinsic motivation. Conversely, committing to a demanding concert schedule may increase her sense of external regulation, decreasing her intrinsic motivation toward further mastery.

Empirical support for SDT primarily comes from educational psychology, where study findings are generally consistent with the following theory-implied relationships (Ryan & Deci, 2000): Task-related interest and student/teacher rapport are associated with intrinsic task motivation, and exert a causal influence on it; intrinsic motivation, in turn, influences the level of behavioral effort that a person exerts on a task, and effort influences task performance. The following section reviews the constructs of effort, interest, and rapport, and briefly summarizes the empirical literature supporting their contribution to task performance.

The Contribution of Effort, Interest, and Rapport to Performance

Effort

The construct of mental effort, defined as the mobilization of energy in the service of cognitive goals (Gaillard, 1993), has been studied in varying ways in psychology. First, *sufficient* effort has long been recognized as essential to optimal task performance, and therefore, effort is sometimes measured to assess the validity of participant responding (Green, Lees-Haley, & Allen, 2002). This is particularly common when malingering is suspected. Several standardized measures have been developed to distinguish valid from invalid protocols on the basis of sufficient versus insufficient effort (Lezak, Howieson, & Loring, 2004). Most, such as the Word Memory Test (WMT; Green, Iverson, & Allen, 1999), are performance-based measures that involve disguised simple recognition memory tests on which performance at or below chance level is highly unlikely (even for cognitively impaired populations), and is therefore considered an indicator of poor effort or of effortful poor performance. In this context, effort is often measured as a secondary, dichotomous variable that is peripheral to the aims of the study.

A second line of research on effort stems from educational psychology and has evaluated effort as a continuous, multifaceted variable that can enhance or diminish learning and performance. Research has established that task-related effort may differ based on students' intrinsic versus extrinsic motivation, task-related interest (Schiefele, 1999), rapport with their teacher (Ryan & Grolnick, 1986), and perceptions of their own competence and autonomy (Shernoff, Csikszentmihalyi, Shneider, & Shernoff, 2003). As such, effort is conceptualized not only as a key consideration in understanding students' performance, but also in improving performance and designing educational programming.

Despite their demonstrated utility in forensics and evaluation of malingering, performance-based measures of effort are less appropriate for use in educational research. Largely, this is because such measures are designed to produce a dichotomous estimate (sufficient versus insufficient effort), whereas educational research requires is continuous, more sensitive, measurements of effort. In addition to performance-based measures, effort has also been evaluated with metabolic and psychophysiological measures (such as heart-rate variability, and event-related brain potentials; Fairclough & Houston, 2004), however these approaches have not been found to be as reliable or sensitive as self-report measures (Paas, van Merrienboer, & Adam 1994). Instead, face-valid self-report rating scales have most often been used to measure effort in educational research (Kalyuga, Chandler, & Sweller, 2000; Paas, 1992; Paas & van Merrienboer, 1993, 1994). This approach is supported by the finding that subjects typically are able to introspect on their cognitive processes and to assign numerical values to their perceived level of mental exertion (Gopher & Braune, 1984). Among non-clinical samples, self-reports of effort show good reliability (Paas & van Merrienboer, 1993; Tabbers, Martens, & van Merrienboer, 2004) and evidence of validity (Paas & van Merrienboer, 1994).

<u>Task-related Interest</u>

Task-related interest is conceptualized as a precondition of intrinsic motivation that is a function of the interaction between the content of a task and the individual performing the task (Schiefele, 1991, 1999). As an internally generated impetus, task-related interest is contrasted with behavioral conditioning which leads to motivation via external reinforcement. The empirical literature suggests that interest and intrinsic motivation facilitate learning more effectively than extrinsic motivation (Terrell & Rendulic, 1996). Multiple studies in educational psychology have found that students with greater interest in a topic exert greater effort to understand the topic, leading not only to greater retention of surface facts, but to efforts to gain a broader understanding of the area (Benware & Deci, 1984; Hidi, 1990; Renninger, Hidi, & Krapp, 1992). Accordingly, topic interest shows a consistent, moderate association with learning (Tobias, 1994; reviewed in Schiefele, 1991). This association persists beyond the influence of cognitive ability and prior knowledge, the two most heavily studied contributors to learning (Alexander, Kulikowich, & Schulze, 1994).

Participant/Experimenter Rapport

Although there is a paucity of recent research in this area, older research from educational psychology consistently supports the role of interpersonal relatedness as contributing to intrinsic motivation, and task performance. For example, school children who are prompted to complete a task in the presence of an interpersonally aloof stranger have been found to demonstrate lower levels of intrinsic motivation than those who are in the presence of a warm, friendly stranger (Anderson, Manoogian, & Reznick, 1976). Similarly, students who perceive their teachers as uncaring and/or controlling have been shown to have lower levels of intrinsic motivation and effort in their school work, a tendency to blame teachers for negative outcomes (Ryan & Connell, 1989; Ryan & Grolnick, 1986), and poorer scholastic performance (Black & Deci, 2000). Conversely, perception of greater intrinsic motivation is associated with increased effort, interest, and enjoyment in school. In dyadic learning as well, in which students study in pairs, having a favorable opinion of fellow group members appears to facilitate learning (Battistich, Solomon, & Delucchi, 1993).

Similar findings have emerged in other performance domains. For example, in a review of studies on examiner familiarity in testing situations, Fuchs (1987) concluded that examiner unfamiliarity systematically depresses test performance among language handicapped children. In another study of examiner/participant effects, Isaac, Sansone, and Smith (1999) found that participants who were high in interpersonal orientation were more likely to find an examiner-administered task interesting and to be intrinsically motivated to engage in the task in the future. In work settings, employees who perceived their supervisors to support their autonomy experienced greater intrinsic motivation and received better performance ratings (Baard, Deci, & Ryan, 2004). And among new employees in three similar organizations, Sheridan (1992) found that an organizational culture emphasizing personal relationships retained employees longer and yielded better job performance.

In sum, research from multiple domains indicates that effort, interest, and rapport may all affect task performance. The following section reviews the contributions of effort, interest, and rapport to task performance in schizophrenia.

Effort, Interest, and Rapport in Schizophrenia Research

Effort

There is a paucity of empirical literature on task-related effort in schizophrenia. Of the few studies that have been conducted, all have used performance-based measures despite the more common practice in educational psychology of using self-report measures. It is possible that self-report measures of effort in this population have not been used because of concerns of how poor insight, cognitive disorganization, and delusions may impact their validity

(Atkinson, Zibin, & Chuang, 2003). However, individuals with schizophrenia have been shown to report anxiety and mood states with good levels of reliability and validity (Huppert, Smith, & Apfeldorf, 2002), and a good correspondence has been observed between self reported insight and interview-based insight (Francis & Penn, 2001), and self-perceived social skill and actual social skill (Ihnen, Penn, Corrigan, & Martin, 1998). Thus, the use of self-reported effort cannot be automatically discounted in individuals with schizophrenia.

Three recent studies have investigated whether individuals with schizophrenia exert sufficient effort on cognitive tasks. Egeland et al. (2003) administered the Recognition Memory Test (RMT; Warrington, 1984) in a study examining memory functioning in schizophrenia and depression. As with the Word Memory Test, a score below chance on the RMT has been demonstrated to effectively distinguish malingering-related insufficient effort from sufficient effort (Millis, 1994). Egeland et al. found that all participants with schizophrenia performed well above chance levels on this task despite exhibiting expected deficits on other cognitive measures, suggesting that reasonable levels of effort was expended on this task. Ilonen et al. (2000) compared EF performance among individuals experiencing their first episode of schizophrenia to non-ill controls using several putative indicators of motivation based on Rorschach structural summary scores, and found no significant motivational differences between the two groups.

Gorissen, Sanz, and Schmand (2005) administered the Word Memory Test (WMT) along with measures of EF, and attention to a cohort of schizophrenia patients, non-psychotic psychiatric patients, and controls. Gorissen et al. found that 72% of the schizophrenia group failed the WMT (i.e. performed below chance), and that WMT performance accounted for 14% to 23% of variance on the various measures of EF. However, a subsample of participants emerged who, similar to Egeland et al.'s sample, exerted sufficient effort according to the WMT while still performing poorly on EF and attention measures. In addition, WMT performance was negatively associated with negative symptoms. Gorissen et al. concluded that measurement of effort in schizophrenia is complex for several reasons. First, memory impairments are a feature of schizophrenia and yet memory tests are the most widely used method for assessing effort. Second, avolition is a core symptom of schizophrenia, and it is unclear what proportion of poor task-effort it explains. And last, schizophrenia is a heterogeneous illness, and it is likely that task effort is explained by different factors in different subgroups (e.g., individuals with paranoid schizophrenia versus those with the deficit syndrome). Despite these obstacles, Gorissen et al. argue that effort should be assessed more consistently in future neuropsychological research on schizophrenia.

The studies reviewed above attempted to measure task effort in schizophrenia. Taking a different tack, a series of studies have sought to manipulate effort using monetary reinforcement. These studies either have compared baseline EF performance (as measured by WCST scores) to performance in a subsequent monetary reinforcement trial, or have compared experimental and control group EF performance. Summerfelt et al. (1991) provided participants with an initial stake of $7.50, to which $.10 was added for each correct sort and from which $.05 was deducted for each incorrect sort. The reinforcement condition yielded significantly fewer errors than the control condition ($p < .01$). Although sample size ($n = 14$) limits the generalizability of these findings, these results nonetheless suggest that motivation may play a role in EF performance in schizophrenia.

A number of studies suggest that monetary reinforcement does not improve WCST performance in schizophrenia, however. Bellack, Mueser, Morrison, Tiernery, and Podell

(1990) administered the WCST under contingent and noncontingent monetary reinforcement conditions—reinforcement for the latter group was yoked to the former. Using reinforcement increments of $.05, results from experimental trials were not significantly better than baseline results. Green, Satz, Ganzell, and Vaclav (1992) used a 2 x 2 design in which level of monetary reinforcement and level of enhanced instruction were manipulated (n = 46). Monetary reinforcement, consisting of $.02 for each correct answer, did not yield significant improvements over baseline. Similarly, Hellman, Kern, Nielson, and Green (1998) divided 32 participants into four experimental conditions in which the level of monetary reinforcement (2 cents vs. 10 cents), and enhanced pre-trial instruction (present vs. absent) were manipulated. No significant monetary reinforcement effects were observed. In fact, the high reinforcement group showed a trend toward poorer WCST performance, which may be consistent with the "overjustification effect" (Greene, Sternberg, & Lepper, 1976; Tang & Hall, 1995).

Two studies have directly compared monetary reinforcement to enhanced instruction, and found the latter to be superior. Using card-by-card instruction modeled after that used by Goldberg et al. (1987), Green et al. (1992) found that the instruction group performed significantly better than the monetary reinforcement group. Relatedly, Hellman et al. (1998) found that enhanced pre-trial instruction led to significant improvements on all dependent measures, while monetary reinforcement did not.

The monetary reinforcement studies reviewed here share an important limitation that points to the need for further research into the effects of effort on WCST performance in schizophrenia. Specifically, all of these studies *inferred* the motivational value of monetary reinforcement without actually *measuring* participant motivation. This is problematic for several reasons. First, it is plausible that the studies did not provide adequate incentive, as they offered only 2 to 10 cents per correct answer (Bellack et al., 1990; Green et al., 1992; Hellman et al., 1998). Indeed, the study that offered the largest financial stake to the participants ($7.50 up front, and a maximum potential earning of $20.30; Summerfelt et al., 1991) found a significant effect. Thus, the financial incentive may have been insufficient to increase effort. Second, and somewhat contradictory to the first point, money itself may not be an appropriate motivator for many participants. When participants in the Hellman et al. (1998) study were offered food items instead of money as reinforcement, over 85% chose food. This preference for non-monetary reinforcement may be especially strong among inpatients, the population that makes up the bulk of study samples in this area, as they may have limited spending opportunities within a hospital setting. Finally, numerous studies have found that tangible reinforcers of any sort may actually undermine intrinsic motivation and thus performance (Cameron & Pierce, 1994; Wiersma, 1992; and see the meta-analysis by Deci, Koestner, & Ryan, 1999) via the overjustification effect (Greene, Sternberg, & Lepper, 1976), which has also been observed in schizophrenia (Atkinson & Robinson, 1961). Therefore, providing financial incentives on the WCST may not be an appropriate strategy for inducing, and inferring, effort in schizophrenia.

Interest

There is only one study that examined the relationship of task interest to performance in schizophrenia. Medalia, Revheim, and Casey (2001) modified an award winning educational computer program to remediate problem solving deficits in schizophrenia. The intervention aimed at maximizing task engagement and intrinsic motivation by making the content personally relevant to participants and providing participants with control over their learning.

The program interactively simulated a detective chase, enabled users to personalize non-essential aspects of the tasks, and provided opportunities for simulated advancement within a fictional detective agency structure. An experimental trial comparing this intervention to a memory training group and a control group indicated that the interest-based intervention led to significantly greater improvement in problem solving skills relative to the comparison groups.

This finding provides indirect support for the role of task interest in performance. Although interest was not directly measured, a proxy measure of "intrinsic motivation" was completed by those participants who received the experimental training. The authors used a three-item, ten-point, Likert-type scale to gauge whether respondents: 1) enjoyed the activity; 2) were satisfied with their participation, and; 3) desired to continue, if possible. Mean responses on these items were 9.6, 8.6, and 9.6, respectively, suggesting a high level of engagement with the task. However these findings should be interpreted with caution because no psychometric properties of the items were reported and the items were not administered to a comparison group.

<u>Participant/Experimenter Rapport</u>

Although no recent studies have examined links between the quality of the experimenter/participant relationship and task performance, several suggestive social reinforcement experiments were conducted during the 1960s and 1970s. D'Alessio and Spence (1963) manipulated interpersonal variables in order to improve performance on a timed motor task. Over three one-minute trials, participants in the control and experimental conditions were asked to insert as many tacks as possible into holes in a board. Between trials, the experimental group was given verbal encouragement by the experimenter. The gain scores and overall speed of the experimental group was found to be significantly greater than that of the control group ($p < .01$). D'Allesio and Spence concluded that social reinforcement improved performance in the experimental group, but noted the qualification that participants in the experimental group were "treated in a warmer and friendlier manner prior to actual testing" (p. 391), and were told that it was personally important to the experimenter that they perform well on the task. Therefore, it is unclear what portion of their improved scores is directly attributable to social reinforcement, what portion to pleasing the experimenter, and what portion to the non-specific social factors that comes with being treated in a friendly manner.

Meichenbaum (1966) assigned 64 participants with schizophrenia to one of four conditions: contingent positive reinforcement, non-contingent positive reinforcement, contingent negative reinforcement, and a control condition. Verbal reinforcement was provided in the context of a proverb comprehension test, which was considered a measure of abstraction. The group that received contingent positive reinforcement showed significant improvement in their performance over the course of the test, whereas none of the other three groups improved. This study suggests that well established performance deficits in schizophrenia can be improved through a social reinforcement manipulation.

Gelburd and Anker (1970) randomized 91 inpatients with schizophrenia to three experimenter-proximity conditions: 1) experimenter out of the room (control group); 2) experimenter 10 feet away, reading, and; 3) experimenter sitting next to the participant, facing the participant. Participants completed a measure of vigilance and psychomotor speed in which they cancelled by pencil 90 "a's" interspersed every three to six characters with other letters. Participants were asked to complete the task as quickly as possible. Participants completed five trials (using five different measure forms), between which they were allowed to rest for several minutes. Results showed a significant positive association between proximity to the experimenter and speed of task completion. There were no significant differences in error rates between the groups. Gelburd and Anker concluded that individuals with schizophrenia are motivated to minimize interpersonal contact. Although other interpretations may also be consistent with these findings, this study provides evidence of an association between task performance and the level of experimenter/participant contact.

In sum, the findings reviewed above, albeit limited in number, suggest a relationship between task performance and task-related effort, interest, and participant/experimenter rapport, respectively. However, these constructs are rarely directly measured, as the norm in this research is to infer their presence based on performance on effort validity tasks (e.g., the Word Memory Task), responsiveness to monetary or experimenter reinforcement, or whether the task is considered to be engaging (Medalia et al., 2001). Thus, there is a need to directly assess the role of effort, interest, and rapport on EF performance in schizophrenia, which is the primary goal of this thesis.

The Current Study

The primary aim of this study is to directly examine the role effort, interest, and experimenter/participant rapport on WCST performance in schizophrenia. To achieve this aim, participants will be randomly assigned to one of two conditions: An experimental group that, following an initial baseline assessment, receives enhanced test instructions on a second trial, and a control group that receives standard instructions across two trials. This design is consistent with previous research in the area. Therefore, it is hypothesized that the enhanced instruction group will show superior performance on the WCST (as measured by Total

Number of Correctly Sorted Cards and Number of Categories Achieved) compared to the control group.

In addition, it is hypothesized that participants in the enhanced instruction group will report significantly higher effort, interest, and rapport than those in the control group, and that these factors will partially mediate the effects of enhanced instruction on WCST performance.

Chapter II

Method

Participants

Participants were 30 adults diagnosed with DSM-IV schizophrenia or schizoaffective disorder. All participants were receiving antipsychotic medications and none was experiencing an acute exacerbation of the illness at the time of testing. Nineteen participants were patients from the long-term inpatient units at either John Umstead Hospital (JUH) or Dorothea Dix Hospital (DDH). Eleven participants were outpatients receiving psychiatric care through the University of North Carolina Hospitals' Department of Psychiatry, Schizophrenia Treatment and Evaluation Program (STEP). Participants were recruited from both outpatient and inpatient settings to maximize sample size.

Inclusion criteria were: 1) diagnosis of schizophrenia or schizoaffective disorder as determined by chart review, clinician report, and corroboration through PANSS administration (i.e., for current symptoms); 2) never having met DSM-IV criteria for a substance dependence disorder, as indicated by chart diagnosis and review of clinical history; 3) no self- or clinician report of cognitive impairment due to substance use; 4) no indication in interview or chart of substance abuse within the past month; 5) no traumatic head injury with loss of consciousness totaling fifteen minutes; 6) ability to provide informed consent (i.e. not too acutely ill according to self or clinician); 7) reading level above third grade, as determined by the WRAT-R-Reading test. Participant clinical history was assessed through chart review, preliminary interview, and consultation with clinical staff.

Measures

Executive Function

The Wisconsin Card Sorting Test (WCST; Heaton, 1993) was used in the present study for two primary reasons. First, it has strong psychometric properties when used with individuals with schizophrenia (Heaton, 1993); and second, it is the most common executive functioning measure used in cognitive remediation research for individuals with schizophrenia.

Computer administration of the 64-card WCST (Heaton, Latshaw, & Leitten, 1990) proceeded as follows. The participant was shown a computer screen displaying four key cards, each of which depicts shapes that vary across three categories (number, color, and shape). Each category contains four variations. Numbers include one, two, three, and four; colors include red, blue, green, and yellow; and shapes include triangles, stars, crosses, and circles. For example, one card may display two blue triangles, while another may display four red circles. A simulated deck of cards, similar to the four key cards, appears at the bottom of the computer screen, and the participant is told to match the top card on the deck to the key card it best matches. This is repeated for 64 trials. The participant is not told what strategy to use in matching the cards. After the participant matches each card, the computer screen displays a message of either "right" or "wrong" accompanied by a synthesized voice saying the same word. Unbeknownst to the participant, a "correct" matching rule is determined by the computer at the beginning of the test (i.e. one of the three categories is selected as correct). After the participant correctly matches ten consecutive cards, the matching rule switches (e.g. from color to number) without the participant being informed.

The matching rule rotates among the three categories after ten consecutive correct answers for the remainder of the 64-card deck.

The WCST offers numerous scores that can be used as dependent measures, based on the goal of the research. The primary dependent variables in the current study were: 1) Number of categories achieved; and 2) number of total cards correctly sorted. The *Number of Categories achieved* is the total number of times a participant matches ten consecutive cards based on the same matching rule. This score is an indication of one's ability to form abstract concepts based on partial information. This score also provides information about participants' sustained attention and working memory because achieving a category requires holding a matching rule in one's mind and applying it correctly on ten consecutive cards. The demand on working memory of achieving categories in the WCST is increased by the fact that participants are not permitted to refer to previously matched cards, but must hold information from previous cards in their memory when making a new decision. Additionally, achieving categories requires cognitive flexibility because participants must use a new matching rule for each new category. The *Number of correctly sorted cards* is a broad summary score that reflects an individual's overall level of executive functioning. It is not reflective of specific sub-domains within EF[1].

The WCST was administered by trained undergraduate research assistants following a script modeled on the technique used by Bellack et al. (1990) for both the experimental and control conditions (See Appendix B for the administration script). Each research assistant

[1] *Perseverative errors* are a commonly used dependent variable in WCST research on schizophrenia. This score is typically considered a reflection of task switching and inhibitory function ability. Although it has been suggested that individuals with schizophrenia exhibit particular deficit in these areas of EF, this view was not supported in a recent meta-analysis on the subject (Li, 2004). Thus, perseverative errors were not measured in the current study.

studied the script and conducted at least two supervised practice administrations prior to the beginning of the study. Several WCST administrations conducted by the two primary assistants were either observed or listened to by the author during the course of the study in order to ensure inter-administrator reliability and adherence to the script. Additional supervision was provided as needed to WCST administrators.

Self-Reported Effort, Task Interest, & Experimenter/Participant Rapport

No standard measure for any of these three constructs has been validated among individuals with schizophrenia. Therefore, items from existing measures were adapted for the current study to create three subscales, which were then combined into a single measure, called the Effort, Interest and Rapport Questionnaire (EIR; See Appendix A). All EIR items were rated on an 8-point Likert-type scale. The following sections describe how each of the three subscales was derived.

Effort

The Bratfisch Mental Effort Scale is a one-item, Likert-type, paper-and-pencil scale on which participants are asked to report the amount of mental effort they exert on a task (Bratfisch, Borg, & Dornic, 1972). Scores range from 1 ("very, very low mental effort") to 9 ("very, very high mental effort"). Paas and Van Merrienboer (1994) assessed the scale's reliability by calculating internal consistency across multiple test problems in two student samples. Cronbach's α for the two data sets were .90 and .82, respectively (based on participants' reports from 28 and 6 attempted problems, respectively). Sensitivity of the scale was assessed by comparing participants' reports of mental effort across three levels of problems designed to vary in subjective difficulty. Analyses of variance showed significant differences in the amount of mental effort reported by participants for problems in the three difficulty levels ($p < .0001$). Thus, although face valid self-report of effort has not been used among individuals with schizophrenia, there is evidence supporting the internal consistency and sensitivity of this approach among healthy individuals.

In the current study, The Bratfisch scale was modified to include two items instead of one. The additional item was added so that the internal consistency of participant reporting could be evaluated (as only one task was used in the current study). As in the Bratfisch scale, both items were face valid, Likert-type, self-report questions of mental effort, with higher ratings reflecting greater effort (See Appendix A). The Effort subscale ranged from a minimum possible score of 2 to a maximum of 16.

Interest

Despite the research on interest in educational psychology, no psychometrically sound instruments have been developed that measure general task interest. Rather, most existing measures of task interest are content-specific, and therefore they are only practical for use in relation to the specific topic area for which they were designed. These are typically Likert-type, self-report questionnaires with high face validity.

Based on previous scales and theoretical views on task interest (Schiefele, 1991), an initial pool of eight items were generated. These items were developed as statements, following Mitchell (1993), and to be consistent with the structure of the Effort and Rapport sub-scales. These items were then shared among four colleagues and assessed for clarity and construct accuracy. Based on this review, four items were removed, leaving a final subscale of four items (See Appendix A). The range of the Interest subscale was 4 to 32.

Rapport

The *Working Alliance Inventory – Client Version* (WAI-C) is a self-report measure of psychotherapy clients' impression of the quality of the working relationship with their therapist. The WAI has been found to be valid and reliable in various clinical populations (Horvath, 1999). Although its validity among individuals with schizophrenia has not been established, preliminary evidence suggests that it is a reliable instrument in this population (Couture et al., in press). The WAI includes 36 Likert-type items in which statements are provided about the therapist/client relationship and response options range from 1 ("Never") to 7 ("Always"). The WAI has been found to consist of three factors: 1) shared goals; 2) a shared view of the tasks necessary to reach these goals, and; 3) interpersonal bond. Eight of the twelve WAI-C items from the *Interpersonal Bond* factor were thus adapted for the present measure because they are most applicable to experimenter/participant rapport (See Appendix A). The range of the Rapport subscale was 8 to 64.

Symptoms

The *Positive and Negative Syndromes Scale (PANSS)* is a valid and reliable instrument for measuring the positive and negative syndromes of schizophrenia and general psychopathology in this population (Kay, Opler, & Lindenmayer, 1988). This instrument is commonly used in both clinical and research settings. It is administered as a semi-structured interview, taking between one half-hour and one hour. The PANSS was used to provide information on the participants' positive, negative, and general symptoms. It was administered by a graduate student who was trained to reliability to a gold standard criterion (ICC $\geq$.70).

Reading Ability & Estimate of Premorbid Cognitive Ability

The *Wide Range Achievement Test-Revised: Reading (WRAT-R)* is a brief test designed to assess reading ability. The WRAT-R has been normed and validated using a large, diverse sample (Jastak & Wilkinson, 1984). Reading ability has been found to function as an estimate of premorbid cognitive ability in schizophrenia (Dalby & Williams, 1986; Goldberg et al., 1995), and the WRAT-R has been used for this purpose (Weickert et al., 2000). The WRAT-R was administered in the present study as a screening measure to exclude individuals with generalized cognitive disabilities (such as mental retardation) and as a gross measure to evaluate inter-group differences in general cognitive functioning.

Procedures

After informed consent was obtained, the WRAT-R was administered to ensure reading ability at or above third grade level. Next, each participant was administered a baseline computer-based trial of the WCST (64-card version) by one of four trained research assistants. These experimenters entered participants' verbal responses into the computer and were blind to each participant's group assignment until after the baseline WCST. After baseline administration, the experimenter opened an envelope to discover each participant's group assignment. Participants in the control group were asked to wait for ten minutes while the experimenter completed some paperwork. Participants in the experimental condition received 10 minutes of enhanced instruction from the experimenter, following the technique used by Bellack et al. (1990). Both groups were offered the opportunity to use the bathroom or get a drink of water during this period. After approximately ten minutes, all participants were administered a second trial of the WCST. During the second trial, experimental participants received enhanced card-by-card instructions. Specifically, after each incorrect answer, the participant was told the possible reasons for her error, and directed toward the appropriate strategy to use with the next, as yet unseen, card. For example, an experimenter might say, "On this card, there was one yellow square. You put it on the pile with one blue circle. You tried to match by number. This was wrong, so you know that the next card should be matched by either shape or color. You should not match this next card by number." Administrators were instructed to suggest strategy but not specific actions. Therefore, they never indicated specifically which sorting rule to use or to which pile the key card should be matched.

Upon completion of the second WCST trial, participants were informed that the individual who conducted the consent and the WRAT-R (DR) would return to complete the testing session. DR then replaced the WCST administrator in the room, and administered the EIR scale and the PANSS, in that order. Before participants completed the EIR scale, the experimenter told them, "Some of these questions are about how you got along with [name of WCST administrator], the person who just did the computer puzzles with you. S/he will never see your responses to these questions, and your answers won't affect him/her in any way. So I would like it if you could answer all these questions as freely and honestly as possible." The experimenter also told participants to respond to the EIR based on their overall experience, not just the first trial or the second trial of the WCST.

Data Analytic Plan

The following preliminary analyses were conducted before testing the primary study hypotheses. First, the control and experimental groups were compared on demographic and clinical variables. Second, inpatient participants were compared to outpatient participants on the following variables to determine whether patient status should be included as a covariate in the primary analyses: proportion of participants assigned to the experimental group, demographic and clinical variables, self-reported effort, interest, and rapport, and WCST performance. Finally, Cronbach's α was calculated for the subscales of the Effort, Interest, and Rapport measures to evaluate the internal consistency of these scales.

The following steps were taken in analysis of the primary study hypotheses. To test the first hypothesis that the participants in the experimental condition would show a greater improvement in their WCST performance than participants in the control condition, a multivariate analysis of variance (MANOVA) was conducted on the change scores on the two WCST measures (number correct and categories achieved). Following this, a separate analysis of variance (ANOVA) was conducted on each dependent variable. The same analytic process was used to test the hypothesis that participants in the experimental condition would report significantly greater effort, interest, and rapport than participants in the control condition. If significant group differences emerged on the EIR variables, then the third hypothesis, concerning whether EIR partially mediates the enhanced instruction effect, would be tested.

Post-hoc, supplemental analyses were conducted using logistic regression to evaluate the characteristics that distinguished participants who improved WCST performance from those who did.

Chapter III

Results[2]

Preliminary Analyses

Demographic and Clinical Analyses

Demographic and clinical characteristics of the two study groups are summarized in Table 1. ANOVA and chi-square analyses revealed that the groups did not significantly differ on any of the demographic or clinical variables.

Inpatient versus Outpatient Participants

Because of recruiting difficulties on inpatient units, recruitment for this study was expanded to include outpatients. Several analyses were conducted to determine whether inpatient/outpatient status needed to be incorporated into the primary analyses. Table 2 summarizes the demographic and clinical characteristics of inpatients and outpatients, as well as the WCST data from these groups. ANOVA and chi-square analyses revealed that inpatients did not differ significantly from outpatients on any of the demographic or clinical characteristics. Nor did these groups differ in the proportion of participants randomly assigned to each study condition or in their responses on the Effort, Interest, and Rapport scales[3].

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[2] The initial projected N for this study was 34, but data collection was stopped at 30 when preliminary analyses revealed the lack of a trend toward statistical significance in the hypotheses of interest.

[3] Due to low power to detect significant differences, the null finding of the chi-square test should be interpreted cautiously.

Significant group differences were recorded in baseline WCST performance, with outpatients generating a greater number of correct WCST responses ($F(1,28) = 4.59$, $p < .05$; partial eta squared = .145) and completing significantly more categories than inpatients ($F(1,28) = 5.17$, $p < .05$; partial eta squared= .161). Despite this baseline disparity, no differences were apparent at post-test or in terms of pre-test to post-test change scores[4]. Additionally, a 2 (inpatient/outpatient) X 2 (control/experimental) ANOVA using WCST change score as the dependent variable was conducted to examine whether patient status had either a main or interactive effect on change scores. A significant main effect emerged for study condition ($F(1,24) = 18.00$; $p < .001$; see Primary Analyses below), however neither inpatient/outpatient status ($p = .428$) nor the interaction term ($p =.277$) was significant.

In summary, despite outpatients' superior baseline WCST performance, outpatients and inpatients showed similar patterns of response to the study manipulation and did not differ on effort, interest, or rapport, or on any of the demographic or clinical variables. In addition, the proportion of inpatients and outpatients in the experimental groups did not significantly differ. Therefore, inpatients and outpatients were combined for the primary analyses.

<u>Psychometric Properties of the EIR Scales</u>

The Effort, Interest and Rapport (EIR) scales were evaluated separately for internal consistency. Cronbach's alpha for the four items of the interest subscale was .859, and for the eight items of the rapport scale was .850. The internal consistency of these two subscales was strong, and was not substantially improved when individual items were removed. The two items of the effort subscale had a significant inter-item correlation ($r = .498$; $p <.005$), which was deemed to be acceptable.

[4] Due to low power, the null finding of the ANOVA comparing change scores in Number Correct may not generalize to the broader population of individuals with schizophrenia.

The EIR questionnaire does not appear to be assessing a unitary construct ($\alpha = .536$). Zero-order correlations between the subscales indicated that effort was not significantly correlated with either of the other subscales, whereas the interest and rapport scales were significantly correlated with one another ($r = .634$, $p < .001$). Therefore, the interest and rapport scales were converted to standardized scores, and then summed to create a single variable labeled "Interest/Rapport."

Primary Analyses[5]

Hypothesis #1

Consistent with previous research, enhanced instruction was expected to lead to improved WCST performance. To test this hypothesis, a one factor (study group) MANOVA was conducted on the change scores for the number of correct responses and number of categories achieved (post-test scores – pre-test scores). The omnibus test was statistically significant (Wilk's $\lambda = .549$; $F = 10.284$; $p < .01$; partial eta squared = .451), indicating an overall difference between groups on the two dependent WCST variables. To probe this significant MANOVA, separate one-way (group: control versus experimental) ANOVAs were conducted for each of the two dependent variables (See Table 3). Results revealed that participants in the experimental group showed significantly greater improvement from pre-test to post-test in the number of correct WCST responses than did participants in the control group ($F(1,26) = 18.91$; $p < .001$; partial eta squared = .42). Similarly, experimental group participants showed significantly greater improvement in the number of categories achieved than did control group participants ($F(1,26) = 7.95$; $p < .01$; partial eta squared = .23). Therefore, the findings support hypothesis #1.

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[5] Because of the small sample size in this study, effect sizes are reported in addition to F statistics and significance levels where possible.

Hypothesis #2

The second hypothesis was that participants in the enhanced instruction group would report significantly higher effort, interest and rapport than those in the control group. To test this hypothesis, a one factor (group) MANOVA was conducted on the Effort and Interest/Rapport variables. This MANOVA yielded a non-significant result (Wilk's λ=.926; F = .997; p = .383; partial eta squared = .074; See Table 4), indicating that the control and experimental groups did not significantly differ on self-reported Effort and Interest/Rapport. Due to the small sample size, two exploratory one-way ANOVAs were conducted to evaluate group differences on the Effort and Interest/Rapport variables separately. Group differences on the Effort scale were in the expected direction and approached a trend level of statistical significance ($F(1,28) = 2.06$; p =.162; partial eta squared = .069). However, group differences on the Rapport/Interest scale were neither in the expected direction nor statistically significant ($F(1,28) = 1.058$; p = .313; partial eta squared = .039). Therefore, hypothesis #2 was not supported with respect to any of the putative mediator variables.

Hypothesis #3

The third hypothesis was that effort, interest, and rapport would partially mediate the effect of enhanced instruction on WCST performance. Testing of hypothesis #2 determined that variation in these self-report variables was not associated with group assignment. Therefore, these variables do not appear to be potential mediators of enhanced instruction on WCST performance.

Post-hoc Analysis

Characteristics of Learners and Non-learners

Recently, efforts have been made to identify characteristics that distinguish individuals who do and do not improve WCST performance across repeated trials (e.g. Bersani, Clemente, Gherardelli, & Pancheri, 2004). This research may be useful in informing cognitive rehabilitation planning for clients (Wiedl, 1999). Therefore, this analysis was conducted in the current study, following the method of Wiedl (1999) as follows. Improvement of 15 points or more from pre-test to post-test was considered to be clinically significant, and participants who achieved this were categorized as "learners." Individuals who scored below 43 on pre-test and did not meet criteria as learners were dubbed "non-learners" (Wiedl, 1999).

Multiple logistic regression was used to predict membership in the learner versus non-learner categories. The following predictor variables were entered, in order, in separate blocks of a hierarchical model: (1) group membership (categorical: experimental versus control), (2) WRAT-R reading score; (3) PANSS negative symptoms, and; (4) PANSS illness insight item score. Because the goal of this analysis was to identify person-level factors that are predictive beyond the experimental manipulation, experimental condition was entered into the model first. Reading ability was entered second in order to assess the contribution of premorbid cognitive functioning to WCST learning. Following cognitive functioning, symptom-level items were entered. Negative symptoms were entered in the third block because of their demonstrated association with cognitive functioning (Nieuwenstein et al., 2001; Guillem et al., 2001). Finally, insight was entered because it has also been associated with cognitive functioning in schizophrenia (Amador, Strauss, Yale, & Gorman, 1991). Insight was entered last because it was based on a single scale item, and therefore was expected to possess lower reliability and validity than the other predictors.

The resultant regression model approached statistical significance ($\chi^2 = 9.263$; $p = .055$) with the four predictors accounting for roughly 28% of the null deviance (See Table 5 for a complete model summary). Study condition was the only significant unique predictor in the model (*Exp(B)* = .041; $p = .017$). The odds ratio of .041 indicates that participants in the control condition were approximately half as likely to be categorized as “learners” as those in the experimental condition. No other variables approached statistical significance.

Chapter IV

Discussion

The present study sought to replicate previous research indicating that enhanced instruction yields improved WCST performance in schizophrenia, and to examine possible mechanisms underlying this improvement. Specifically, it was hypothesized that self-reported effort, interest, and experimenter/participant rapport would be greater among participants who received enhanced instruction, and that these effects would partially mediate the effect of enhanced instruction on WCST performance. Results supported the first objective of the study. Enhanced instructions produced a significant improvement in performance on the WCST compared to standard instructions. However, the two groups did not differ in self-reported effort, interest, or rapport. Because no significant group differences were observed on these variables, mediational analyses were not conducted. These findings are discussed in order below.

The current findings replicate previous studies (Bellack et al., 1990; Goldberg et al., 1987; Goldman et al., 1992; Metz et al., 1994; Nisbet et al., 1996) in showing that enhanced instruction leads to improved WCST performance among individuals with schizophrenia. This finding was expected given the consistency of the results across previous studies (Kurtz et al., 2001). Thus, enhanced instructions are a robust strategy for improving short-term WCST performance. As cognitive rehabilitation programs mature, efforts should be made to develop instructional techniques that allow these effects to endure over time and to generalize to non-task specific problem solving abilities (Bellack, Blanchard, Murphy, & Podell, 1996).

The findings did not support the hypothesis that the enhanced instruction group would show higher ratings for self reported effort, interest, or rapport with the examiner compared to the standard instructions group. Although the Effort subscale was in the expected direction, the mean differences were not statistically significant. These results suggest that the positive effects observed for these variables on performance from the education and motivation areas, may not generalize to individuals with psychotic disorders and/or on this particular task. These null findings suggest that enhanced instruction does not work via increasing participant effort or interest in the task, or via the participant's relationship with the examiner. Rather, participant improvement is more likely due to the combination of cognitive compensation (i.e. displacing the cognitive load from EF to other functions) and environmental support afforded by enhanced instructions (Wilson, 2002).

Post-hoc logistic regression revealed that the only significant predictor of WCST improvement in this sample was study condition. Because of the small sample size in the present study, cross-validation of this model was not conducted, and therefore the stability of these findings is questionable. This finding provides little predictive utility for treatment planning because of the lack of significant person-level predictors of WCST success. However, this finding can be viewed as promising in that no person-level factors predicted failure to learn in this sample. This comes in contrast to previous research linking negative symptoms and poor illness insight to neurocognitive ability in schizophrenia (Amador et al., 1991; Censits et al., 1997; Guillem et al., 2001; Nieuwenstein et al., 2001).

It is worth noting that mean self-reported effort, interest, and rapport were all quite high in this sample, suggesting that participants generally enjoyed working on the WCST. These findings are consistent with Medalia et al.'s (2001) findings on their three-item proxy measure of intrinsic motivation. This similarity is surprising given that Medalia et al.'s participants were rating their experience with a computer program that was specifically designed to heighten interest and engagement. Future studies of interventions that are designed to be enjoyable and engaging should interpret positive client feedback cautiously, as they may reflect a social desirability bias, and should consider using multiple methods to assess their clients' experience.

This study has several limitations that should be mentioned. First, the small sample size limited the statistical power of the study, particularly for the analyses that examined the role of effort on WCST performance, and on whether inpatients and outpatients differed in their change on WCST performance over time. Second, this study used face-valid self-report questionnaires to measure participant effort, interest, and rapport. It was argued in the introduction that measuring effort in this way has certain advantages over inferring effort on the basis of performance or receipt of money. Moreover, this form of measurement is consistent with previous research in educational psychology. Nonetheless, self-report should always be supplemented with more performance based assessments, especially in schizophrenia, before confident conclusions can be drawn about the role of effort, interest, and rapport on task performance[6].

[6] WCST administrators completed a behavioral measure of effort, cooperation, and rapport for each participant. Findings were consistent with the self-reported EIR data. For this reason, and because measurement of these items was not standardized, these data are not reported.

In conclusion, the present study provided further support for the robust finding that enhanced instruction can be used to improve WCST performance in schizophrenia. However, this study did not elucidate the mechanisms that may underlie this improvement. Future research should use multiple measures of effort, interest, and rapport, assessed from multiple perspectives (i.e., participant, examiner, psychophysiological reesponses), and with a larger sample size before ruling out the influence of these factors on EF performance (or on different tasks).

Table 1
Demographic and Clinical Information

	Control (n =13)		Experimental (n =17)	
	Mean	*SD*	Mean	*SD*
Age	32.2	10.85	34.47	11.29
Female (number)	6	n/a	11	n/a
Ethnicity (number)				
African American	8	n/a	8	n/a
Caucasian	5	n/a	7	n/a
Other	0	n/a	2	n/a
Inpatient (number)	7	n/a	12	n/a
Diagnosis (number)				
Schizophrenia	4	n/a	12	n/a
Schizoaffective	8	n/a	4	n/a
Psychosis NOS	1	n/a	1	n/a
Positive symptoms	13.7	5.26	15.2	3.82
Negative symptoms	15.7	7.75	16.1	4.31
General symptoms	28.8	6.94	32.1	5.11
WRAT-Reading	44.5	5.93	41.7	6.76

Note. No significant group differences were observed.

Table 2 Comparison of Inpatient and Outpatient Participants

	Inpatient (n =19)		Outpatient (n =11)	
	Mean	*SD*	Mean	*SD*
Age	33.2	10.04	33.9	12.93
Female (number)	9	n/a	4	n/a
Ethnicity (number)				
African American	11	n/a	5	n/a
Caucasian	8	n/a	4	n/a
Other	0	n/a	2	n/a
Control group (number)	7	n/a	6	n/a
Diagnosis (number)				
Schizophrenia	10	n/a	6	n/a
Schizoaffective	7	n/a	5	n/a
Psychosis NOS	2	n/a	0	n/a
Positive symptoms	14.6	5.25	14.6	2.95
Negative symptoms	17.2	6.78	13.7	3.29
General symptoms	31.2	6.24	30.0	5.93
WRAT-Reading	42.0	7.14	44.6	4.99
Effort	11.8	3.56	13.0	2.65
Interest	21.4	8.00	24.4	5.45
Rapport	39.7	9.69	43.6	4.88
Baseline WCST				
Number correct*	26.8	12.41	37.2	13.14
Categories achieved*	0.83	1.20	2.00	1.55
Post-test WCST				
Number correct	42.6	13.14	44.27	13.49
Categories achieved	2.33	2.00	2.73	1.68
WCST Change score				
Number correct	14.2	13.92	7.09	16.87
Categories achieved	1.41	1.66	0.73	1.95

* $p<.05$

Table 3
WCST Improvement from Pre-test to Post-test (Change Scores)

	Control (*n* =13)		Experimental (*n* =17)	
	Mean	*SD*	Mean	*SD*
Increase in raw number correct**	0.17	9.18	19.81	13.44
Increase in number of categories achieved*	0.17	1.34	1.88	1.75

** $p<.001$; * $p<.01$

Table 4
Descriptive Statistics for the Effort & Interest/Rapport Scales

	Control (*n* =13)		Experimental (*n* =17)	
	Mean	*SD*	Mean	*SD*
Effort	11.3	3.66	13.0	2.81
Interest/Rapport	.440	1.30	-.252	2.03

Note. Interest/Rapport statistics reflect standardized scores.

Table 5
Hierarchical Logistic Regression for Variables Predicting WCST "Learner" Status

Variable	*B*	*SE*	Wald χ^2	Statistical Significance	*Exp(B)*
Step 1					
Experimental condition	-3.184	1.333	5.704	.017*	.041
Step 2					
WRAT-R reading ability	.055	.075	.528	.467	1.056
Step 3					
PANSS negative symptoms	-.124	.132	.873	.350	.884
Step 4					
PANSS insight item	.025	.325	.006	.939	1.025

Note. Cox & Snell Index = 27.235; Total model $\chi^2 = 9.263$; $p = .055$†
* $p < .05$; † approaching significance

APPENDIX A

Effort, Interest, and Rapport Scale items

NB : Items below are listed out of order to show subscale groupings. Reverse-scored items are marked with an asterisk.

Effort items

1)
I worked hard on this puzzle.

1	2	3	4	5	6	7	8
No, not at all			kind of hard				Yes, very hard

11)
I gave my best possible effort on this puzzle.

1	2	3	4	5	6	7	8
No, I could have tried harder			medium effort				Yes, I tried as hard as I could

Interest items

3)
This puzzle was interesting to me.

1	2	3	4	5	6	7	8
No, it was boring			It was OK				Yes, very interesting

*** 5)**
I was bored by this puzzle.

1	2	3	4	5	6	7	8
No, not at all			once or twice				Yes, very much

8)
I liked this puzzle more than most puzzles or board games I have played.

1	2	3	4	5	6	7	8
No, much less			about the same				Yes, much more

10)
I had fun doing this puzzle.

1	2	3	4	5	6	7	8
No fun at all			some fun				a lot of fun

Rapport items

2)
I believe the first examiner appreciated me.

1	2	3	4	5	6	7	8
Not at all			kind of				Extremely

*** 4)**
I got the feeling that when I got the wrong answers, the examiner was unhappy with me.

1	2	3	4	5	6	7	8
Not at all			sometimes				Very much

6)
I believe the first examiner liked me.

1	2	3	4	5	6	7	8
Not at all			kind of				Extremely

*** 7)**
I felt uncomfortable with the first examiner.

1	2	3	4	5	6	7	8
Not at all			a little uncomfortable				Extremely

*** 9)**
I did not trust the first examiner.

1	2	3	4	5	6	7	8
No, I trusted him			kind of				Yes, he seemed untrustworthy

*** 12)**
The first examiner made me nervous.

1	2	3	4	5	6	7	8
Never			sometimes				Very often

13)
I believe the first examiner was genuinely concerned for my welfare.

1	2	3	4	5	6	7	8
Not at all			kind of				Extremely

14)
I respect the first examiner.

1	2	3	4	5	6	7	8
Not at all			kind of				Extremely

APPENDIX B

Script for WCST Administration

Pre-test script for all participants

This test is a little unusual because I am not allowed to tell you very much about how to do it. You should match each of the cards that appear here [POINT TO THE FIRST RESPONSE CARD AT THE BOTTOM CENTER OF THE SCREEN] *to one of these four cards* [POINT TO EACH OF THE STIMULUS CARDS AT THE TOP OF THE SCREEN]. *Point to the card at the top that you think matches the card at the bottom. Or you can say "card 1", "card 2", "card 3", or card 4"* [POINT AT EACH KEY CARD]. *I will click on the card you choose. The computer will put your card under the card at the top that you choose, and a new card will appear at the bottom of the screen.*

I can't tell you how to match the cards, but the computer screen will show you each time whether you are right or wrong. The computer will also say the same word it shows on the screen.

If you are wrong, just try to match the next card correctly, and then continue matching the cards correctly. There is no time limit on this test. Are you ready? Lets begin.

IF THE PARTICIPANT DOES NOT MATCH THE FIRST CARD, GESTURE TO THE SCREEN AND SAY:

Now you match the first card.

Post-test script for experimental participants

Now I am going to ask you to do this puzzle again. But this time, I want to give you some hints to help you match the cards even better, OK? I will show you using these cards here as an example.

LAY THE FOUR WCST KEY CARDS [I.E. 1 RED TRIANGLE, 2 GREEN STARS, 3 YELLOW CROSSES, & 4 BLUE CIRCLES] ON THE TABLE BESIDE THE COMPUTER, AND GESTURES TO THEM THROUGHOUT THE INSTRUCTIONAL PERIOD TO FACILITATE LEARNING.

In this puzzle, there are three different ways you can match cards. You can match cards by the shape on the card, the color on the card, or the number of shapes on the card. There are four different shapes (triangles, stars, crosses, and circles), four different colors (red, green, yellow, and blue), and four numbers (there can be one, two, three, or four shapes). Remember this from the last puzzle?

Just like in the last puzzle, the computer will choose the right way to match cards, but you won't know. It could match by shape, color, or number. Because you don't know which one the computer is using, at first you will have to guess. But you know that there are only three ways to match (shape, color, or number), so if you guess wrong, you can guess a *different way on the next card, and you may get it right. If you get it wrong the second time, you should get it right on the third try. Lets try an example.*

DEMONSTRATE, USING THE CARDS ON THE TABLE.

If you get a card with four green crosses, maybe you will put it on the green pile. If the computer tells you that you were wrong, then you should not try to match the next card by color. If you match the next card by shape, and the computer tells you that you are wrong, then you know that it is not right to use color, and it is not right to use shape. So you know that you should match the next card by number. Is that clear?

Why don't we try a few? Here is a card with four green crosses. What pile will you match it to? [WAIT FOR PARTICIPANT TO MATCH THE CARD.] *Now, if the computer says that your guess is wrong, what does that tell you?*

WAIT FOR THE CORRECT RESPONSE [I.E. COLOR, NUMBER, OR SHAPE IS THE INCORRECT MATCHING RULE]. IF THE RESPONSE IS INCORRECT, EXPLAIN THE CORRECT RESPONSE BEFORE MOVING ON TO THE NEXT CARD.

Now here is a card with one blue triangle. You know that [color/shape/number] is the wrong way to match. So what pile will you match it to? [WAIT FOR PARTICIPANT TO MATCH THE CARD.] *Now, if the computer says that this guess is wrong, what does that tell you now?*

AGAIN, WAIT FOR THE PARTICIPANT'S RESPONSE, AND ENSURES THAT THE SIGNIFICANCE OF THE COMPUTER'S RESPONSE IS UNDERSTOOD BEFORE CONTINUING.

OK, now you know that [e.g. color] and [e.g. number] are wrong. Now here is a card with three red stars. What pile will you match it to?

WAIT FOR PARTICIPANT TO MATCH THE CARD. IF THE SORT IS INCORRECT, EXPLAIN WHAT THE CORRECT SORT WOULD BE.

Great job. Now here's another hint about the way this puzzle works. After you get <u>*ten*</u> *cards right, the computer will change the way it is matching. For example, maybe it will switch from shape to color. So if you figure out that you should match by shape, then you will match by shape for ten cards in a row and get them all correct. But when you get ten cards in a row correct, then on the eleventh card, the computer will switch, and it will match by color or number instead. Do you understand?*

IF PARTICIPANT DOES NOT UNDERSTAND, EXPLAIN AGAIN, GESTURING TO THE CARDS AS AIDS.

So you see how the computer will change the rule after ten cards. Well, the computer will keep changing the rule on you for the rest of the test after every ten correct answers. So, once you match by color or number for ten in a row, the computer will switch again. Any *time you get ten cards in a row correct, the computer will switch the rule on you, and you will have to figure it out again.*

Are you ready to do the puzzle, or do you have questions about these two hints?
IF NO QUESTIONS: *OK, so remember I gave you two hints. First, when the game starts, the computer will choose either shape, number, or color, and you will have to figure out which one to match by so that you can start getting cards right. And second, if you figure it out and get ten cards right, then the computer will switch, and you will have to figure out which other rule to use to match the cards.*

<u>BEGIN ADMINISTRATION 2</u>. EACH TIME THE PARTICIPANT GIVES AN INCORRECT RESPONSE, EXPLAIN THE SORTING STRATEGY THAT THE PARTICIPANT USED, AND THE IMPLICATIONS FOR SORTING THE NEXT CARD. FOR EXAMPLE:

On this card, there was one yellow square. You put it on the pile with one blue circle. You tried to match by number. This was wrong, so you know that the next card should be matched by either shape or color. You should not match this next card by number.

IF THE PARTICIPANT MAKES A PERSEVERATIVE ERROR [I.E. INCORRECTLY USES THE SAME STRATEGY TWO CARDS IN A ROW] NOTE THIS AS WELL. FOR EXAMPLE:

On this card, you tried to match by number again, but this is still the wrong way to match. Remember, you matched by number on the card before this one, and that was wrong too. Now you know for sure that the next card should not be matched by number.

<u>Post-test script for control participants</u>

WHEN READY TO BEGIN THE NEXT ADMINISTRATION, SAY:

Now I am going to ask you to do the same puzzle again. It has the same rules as the first puzzle. Let's begin.

REMIND THE CLIENT OF THE PROCEDURES IF NECESSARY, THEN BEGIN TRIAL TWO.

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