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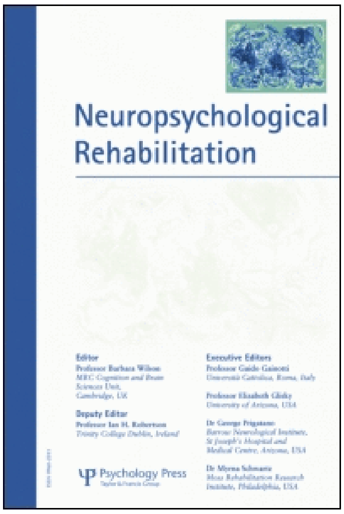

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Everyday action planning in schizophrenia

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Everyday action planning in schizophrenia

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Planning of everyday tasks was examined in 48 inpatients with schizophrenia and 26 healthy controls. Participants were administered the Naturalistic Action Test, which requires completion of three everyday tasks (e.g., make toast and coffee). Planning variables, including planning behaviours (e.g., gathering items before engaging in a subtask) and planning time (e.g., period between task instructions and first action) were coded to evaluate forward thinking in these tasks. Results showed that planning variables were reliably coded. Controls demonstrated more planning behaviours than participants with schizophrenia; however, this difference was accounted for by education. People with schizophrenia spent significantly less time planning when planning time was analysed as a proportion of the total time on tasks. Planning variables were related to the ability to accomplish everyday task steps and to perform everyday task steps accurately. Together these findings suggest that rehabilitation strategies that emphasise both planning time and planning behaviours may facilitate everyday functioning in people with schizophrenia.

Keywords: Everyday action; Planning; Schizophrenia; Activities of daily living; Instrumental activities of daily living; Naturalistic action.

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INTRODUCTION

Planning is an executive function associated with the prefrontal cortex and defined as the ability to think ahead (Owen, 1997; Shallice & Burgess, 1991; Sohlberg & Mateer, 2001; Unterrainer & Owen, 2006). It is regarded as a necessary component of many cognitive and motor tasks (Owen, 1997). Luria (1978) defined planning as the "ability to organise behaviour in relation to a specific goal that must be achieved through a series of intermediate steps" (Allain et al., 2005, p. 4). More recently, authors have similarly defined planning as the process of considering the future consequences of actions (Burgess & Robertson, 2002) and as the anticipation of future events and goal attainment (Carlin et al., 2000). Unterrainer and Owen (2006) use the term "forward thinking" to denote planning. Consistent with prior work, we considered planning as forward thinking or the deliberate consideration of an end state before the implementation of steps geared towards achieving that end state.

The present study focused on *planning abilities* in people with schizophrenia. People with schizophrenia are known to exhibit cognitive deficits, and these deficits are considered a central feature of the disorder (Carter et al., 2008; Elveåg & Goldberg, 2000; Heinrichs & Zakzanis, 1998; Marder & Fenton, 2004). Deficits in executive functioning are ubiquitous in this population (Barch et al., 2001; Barch & Smith, 2008; Elvevåg & Goldberg, 2000; Velligan & Bow-Thomas, 1999), with several studies reporting that people with schizophrenia show reliable differences from healthy controls on traditional neuropsychological tests of planning (Morice & Delahunty, 1996; Morris, Rushe, Woodruffe, & Murray, 1995; Staal, Hijman, Hulshoff, & Kahn, 2000). The extant literature also shows that cognitive deficits in schizophrenia are associated with reduced everyday functioning (Evans et al., 2003; Harvey, Green, Keefe, & Velligan, 2004; Kessler, Giovannetti, & MacMullen, 2007; Klapow et al., 1997; Patterson et al., 1998; Patterson, Goldman, McKibbin, Hughs, & Jeste, 2001; Semkovska, Bedard, Godbout, Limoge, & Stip, 2004; Semkovska, Stip, Godbout, Paquet, & Bedard, 2002; Sevy & Davidson, 1995; Velligan et al., 2007). However, the link between planning deficits and everyday functioning in schizophrenia has not been extensively studied. The goal of the present study was to investigate the cognitive process of planning in everyday tasks among people with schizophrenia.

There are numerous reasons why planning research is relevant to neuropsychological rehabilitation. First, planning deficits are common among many patients with cognitive impairment. Caregivers of mixed-aetiology neurological patients reported planning problems most frequently among 20 common dysexecutive symptoms (Burgess, Alderman, Evans, Emslie, & Wilson, 1998). Alarmingly, relatively few patients reported these planning problems,

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with the highest rate of caregiver-patient disagreement for planning problems relative to other difficulties (i.e., unconcern for social rules, etc.; Burgess & Robertson, 2002). Second, planning deficits are believed to have a negative impact on everyday functioning (Penfield & Evans, 1935; Shallice & Burgess, 1991). Luria (1980) described serious planning failures in patients with large lesions of the frontal lobes that resulted in fragmented action sequences precluding completion of most multiple-step everyday tasks. Finally, greater understanding of planning deficits may elucidate intervention strategies to promote everyday functioning and independent living. Planning deficits are often the focus of cognitive rehabilitation approaches (e.g., Goal Management Training; Burgess & Robertson, 2002; Lawson & Rice, 1989; Levine et al., 2000; Sohlberg & Mateer, 2001). While numerous studies show functional deficits in schizophrenia improve considerably with compensatory strategies (Velligan et al., 2000; 2002) and direct training (Medalia & Choi, 2009; for a review see Krabbendam & Aleman, 2003; Kurtz, Moberg, Gur, & Gur, 2001; McGurk, Twanley, Sitzer, McHugo, & Mueser, 2007; Medalia & Choi, 2009; Pilling et al., 2002; Suslow, Schonauer, & Arolt, 2001; Twamley, Jeste, & Bellack, 2003; Velligan, Kern, & Gold, 2006), few interventions for schizophrenia focus exclusively on planning. Thus, we reasoned that the careful characterisation of planning within ecologically valid, everyday tasks might offer clear directions for future rehabilitation strategies for improving everyday functioning in people with schizophrenia.

As stated above, planning abilities in schizophrenia have been studied using neuropsychological measures, such as the Tower of London task (TOL; Shallice, 1982), a well-established test of planning ability (Pantelis et al., 1997; Unterrainer et al., 2004; Unterrainer & Owen, 2006; Unterrainer, Rahm, Leonhart, Ruff, & Halsband, 2003) developed by Shallice and McCarthy (Shallice, 1982). The TOL, and related variants (e.g., Tower of Hanoi, Stockings of Cambridge, etc.), evaluate the ability to solve multiple-step problems in the fewest number of moves possible. The time taken between the final task instructions and the participants' first move is thought to reflect the time spent planning the solution before engaging in the task (e.g., planning time). Several investigators have shown that planning times in schizophrenia are not significantly shorter than those of healthy controls or other patient populations (Hanes, Andrewes, Pantelis, & Chiu, 1996; Morris et al., 1995; Pantelis et al., 1997). By contrast, analyses of other TOL variables show people with schizophrenia solve fewer TOL items and require significantly more moves to solve items compared to healthy controls or other patient populations (Hanes et al., 1996; Morris et al., 1995; Pantelis et al., 1997).

The Zoo Map Test (ZMT) also has been used to evaluate planning in schizophrenia (Wilson, Alderman, Burgess, Emslie, & Evans, 1996). The ZMT was designed to improve the ecological/face validity of planning measures (Davalos, Green, & Rial, 2002; Wilson et al., 1996). It requires participants to plan a trip to the zoo according to a series of rules. Participants receive a composite score that reflects the number of zoo sites successfully visited as well as the number of rules violated in their performance. Planning time, or the time elapsed between instructions and task initiation, also may be calculated. People with schizophrenia show significantly lower scores on the ZMT relative to healthy controls (Brüne, Abdel-Hamid, Lehmkämper, & Sonntag, 2007; Matsui, Sumiyoshi, Arai, Higuchi, & Kurachi, 2008). Furthermore, among people with schizophrenia, ZMT scores have been shown to be predictive of impaired everyday functioning as reported by caretakers (Wilson, Evans, Alderman, Burgess, & Emslie, 1997). To date, no study has reported ZMT planning time data in people with schizophrenia.

People with schizophrenia also have demonstrated inefficient planning on more complex planning tasks, such as the Six Elements Test (SET; Shallice & Burgess, 1991) and related variants (Modified SET, MSET; Wilson et al., 1996; Cognitive Effort Test, CET; van Beilen, van Zomeren, van den Bosch, Withaar, & Bouma, 2005). On the SET/MSET, participants are instructed to work on three different types of tasks for a specified amount of time (e.g., 10 minutes), while adhering to several rules. The most efficient approach to the SET/MSET is to divide the allotted time between the six required tasks and work on each for some time (e.g., approximately 1.5 minutes) before shifting to another task (Chan, Chen, Cheung, & Cheung, 2004; Evans, Chua, McKenna, & Wilson, 1997). van Beilen, Withaar, van Zomeren, van den Bosch, and Bouma (2006) reported that relative to participants with closed head injury, peripheral injury, and healthy controls, people with schizophrenia most frequently demonstrated a less effortful approach (i.e., continuous switching) on the SET/MSET tasks (see also Gouveia, Brucki, Malheiros, & Bueno, 2007).

The CET was developed specifically to investigate differences in approach to complex multitasking by requiring participants to perform three tasks as quickly as possible and in any order (e.g., participants were told that they were free to multitask). Participants also were asked to describe their plan before executing the task. Participants were scored on the quality of their plan, their initiative in asking questions during the task, and their approach to the tasks (i.e., amount of time that they spent multitasking during the test). Although people with schizophrenia generated a task plan as often as controls, their plans tended to be inefficient (e.g., demonstrated less multitasking; van Beilen et al., 2005). People with schizophrenia also demonstrated less multitasking than controls during actual task execution.

There are several drawbacks to the neuropsychological tests described above. For example, some of the tests have limited ecological/face validity, as they do not utilise everyday tasks, such as meal preparation (e.g., TOL, ZMT). Others utilise everyday tasks that require specialised knowledge,

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such as computers (e.g., CET). Schwartz et al. (1998) addressed these limitations in a novel SET/MSET-type task called the 2 x 3 Multi-Level Action Test. The 2 x 3 requires participants to execute three everyday tasks (e.g., pack lunchbox, wrap present, make toast) twice while following specific rules such that two tasks cannot be performed in succession (see also Cook, Chapman, & Levin, 2008). However the 2 x 3 task, like several of the aforementioned planning tasks, is quite complex and may be too difficult to offer useful information regarding rehabilitation strategies for people with moderate-level cognitive impairments. For instance, several investigators have reported considerable variability in ZMT and SET/MSET performance even among healthy controls, with some healthy participants scoring as impaired as patients with frontal lobe lesions (Chevignard et al., 2000; Levine et al., 1998). These drawbacks underscore the need for planning studies that rely on relatively simple, ecologically valid, everyday tasks.

In summary, individuals with schizophrenia demonstrate clear deficits on neuropsychological measures of planning, and these deficits have been linked to difficulties in everyday functioning (Wilson et al., 1997). However, the direct evaluation of planning abilities in relatively simple everyday tasks has not been conducted in this population. This study evaluated whether people with schizophrenia demonstrated poor planning of relatively basic everyday tasks, such as coffee making and meal preparation.

The extent to which plans are assembled prior to execution of more basic everyday action tasks is a matter of debate. Some investigators de-emphasise planning of these tasks and posit that everyday task "plans" are formulated online to allow for flexibility in achieving practical goals (Joe, Ferraro, & Schwartz, 2002). If behaviour is overly planned or rigid, it may not be adaptable to variability in contexts and available materials/objects. Flexibility, rather than a rigid, plan-driven approach to everyday tasks may be more advantageous. Other researchers offer contradictory support for plan-driven everyday task behaviour (Bickerton, Humphreys, & Riddoch, 2007), and anecdotal accounts suggest that deliberate planning of everyday tasks may be quite helpful for individuals with cognitive deficits. For example, Sohlberg and Mateer (2001) highlight the case of Jeff, a 30-year-old man who suffered a brain injury in an industrial accident. Jeff experienced moderate executive function impairments on neuropsychological tests, such as impulsive responding, and a disorganised approach to problem solving. Following rehabilitation training that promoted deliberate planning of everyday tasks, everyday functioning improved.

> "If [Jeff] simply took a bit of time before task initiation to think about what he was going to do, he was able to prevent errors. For example, he noted how doing this prompted him to get out all of the ingredients for cooking, instead of getting halfway through and needing to do a

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preparation activity (e.g., slicing the ham when an omelet was already cooking)" (Sohlberg & Mateer, 2001, p. 258).

In conclusion, everyday action planning has not been carefully characterised among people with schizophrenia. This study presents a scheme for quantifying markers of planning in the relatively basic everyday tasks that compose the Naturalistic Action Test (NAT), a standardised, validated, and reliable measure of everyday actions (Schwartz, Segal, Veramonti, Ferrara, & Buxbaum, 2002). Our goals were to examine the extent to which *planning* is observed among healthy control participants and to assess whether or not these planning behaviours are also observed among people with schizophrenia who are known to exhibit deficits in executive functions. It was also of interest to evaluate whether planning was related to the ability to *perform* everyday tasks accurately and efficiently. Our *first* hypothesis was that indicators of planning, such as planning behaviour and planning time, could be reliably coded for everyday action tasks. Although reliability of the NAT performance variables has been established (Schwartz et al., 2002; Schwartz, Buxbaum, Ferraro, Veramonti, & Segal, 2003), reliability of this novel planning scoring has not. Therefore, it was essential to establish basic reliability of this novel-planning scheme. *Second*, we hypothesised that control participants would differ from participants with schizophrenia on planning variables (i.e., planning behaviours and planning time), with controls showing more evidence for planning. Our *third* hypothesis was that planning variables would be related to successful performance on everyday tasks (i.e. higher accomplishment, fewer task errors).

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METHOD

Participants

This study included 48 individuals with schizophrenia or schizoaffective disorder (SZ) and 26 healthy controls. Participants with SZ were recruited from extended-stay, inpatient units of two Philadelphia hospitals; participants on these units typically exhibit moderate-level cognitive deficits. Individuals were recruited if they were between the ages of 18 and 65 years and had a primary diagnosis of schizophrenia ($N = 36$) or schizoaffective disorder ($N = 12$) according to DSM-IV criteria (American Psychiatric Association, 1994) for a prior study on everyday action impairment (see Kessler et al., 2007). All participants were clinically diagnosed with schizophrenia or schizoaffective disorder by their treating psychiatrist on the inpatient unit. Diagnoses for a subset of patients ($n = 28$) were confirmed through structured diagnostic interviews (modules B and C of the SCID-CV; First, Spitzer, Gibbon, & Williams, 1997) by a doctoral-level investigator as part of this study; no discrepancies between the SCID-CV results and the participant's clinical diagnosis were observed. A healthy control group with no history of schizophrenia/schizoaffective disorder also was recruited from the same Philadelphia communities. All participants met the following inclusion criteria: (1) no alcohol or illicit substance abuse (in the past month); (2) no history of traumatic brain injury or neurological disorder, such as cerebral vascular accident or epilepsy; (3) no mental retardation; and (4) fluent in English. For SZ participants, inclusion/exclusion criteria were evaluated using data from medical charts and neuropsychological assessment. Healthy controls also met these additional inclusion criteria: no current psychiatric disorders and no history of psychiatric disorders that required hospitalisation. Controls were screened through phone and in-person interviews.

All of the SZ participants were taking either an atypical antipsychotic or conventional antipsychotic medication (see Kessler et al., 2007). Participants with schizophrenia did not differ from those with schizoaffective disorder in age, education, IQ, duration of illness between symptom level, and performance on the Mini Mental State Exam (MMSE), a measure of general cognitive disturbance. As there were no significant differences between participants with different diagnoses, all analyses were conducted using the entire SZ group.

Procedure

This study was approved by Temple University's Institutional Review Board. All participants signed approved consent forms for participation and to be videotaped, and all were compensated for their time.

Measures

Everyday action. The Naturalistic Action Test (NAT; Schwartz et al., 2002; 2003) was used to assess SZ and control participants' everyday action abilities. The NAT is a standardised and published measure of everyday action with standardised instructions, object placement, cuing procedures, and scoring (Schwartz et al., 2003). The NAT has been used to study diverse groups of cognitively impaired individuals, including people with closed head injury (Schwartz et al., 1998, 2002), cerebral vascular accident (Buxbaum, Schwartz, & Montgomery, 1998; Schwartz et al., 1999), dementia (Giovannetti, Libon, Buxbaum, & Schwartz, 2002; Giovannetti, Schmidt, Gallo, Sestito, & Libon, 2006), and schizophrenia (Kessler et al., 2007). Normative data are reported in the NAT manual (Schwartz et al., 2003) and in prior studies (Schwartz et al., 2002; Sestito, Schmidt, Gallo, Giovannetti, & Libon, 2005). Studies have shown that NAT performance variables are not affected by education, gender, or motor problems (Bettcher,

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Giovannetti, & MacMullen, 2008; Buxbaum et al., 1998; Giovannetti et al., 2002; Kessler et al., 2007; Schwartz et al., 1998, 1999, 2002; Sestito et al., 2005).

The NAT requires participants to perform three different trials of everyday tasks with little guidance from the examiner. All of the objects needed for task completion are available on a U-shaped tabletop (Schwartz et al., 2002, 2003). The three trials include: (1) preparing a slice of toast with butter and jam and preparing a cup of coffee with cream and sugar; (2) wrapping a gift with target and visually/semantically similar distractor objects on the tabletop (e.g., gardening shears and scissors, stapler and scotch tape, etc.); (3) packing a lunchbox with a sandwich, drink, and snack, and packing a schoolbag with school supplies while several target objects (e.g., thermos lid, knife) are stored out of direct view in a drawer with potentially distracting objects (e.g., spatula, measuring tape, etc.). These trials were originally designed to assess the impact of two task goals (i.e., dual-task; Tasks 1 and 3), salient distractors (Task 2), and extended search for objects out of view (Item 3) on everyday action performance (Schwartz et al., 1998).

The NAT has good psychometric properties. It has good internal consistency (Cronbach's $\alpha = .79$), and has been shown to correlate with the Functional Impairment Measure (FIM), a disability measure based on clinicians' ratings ($r^2 = .5$) among individuals with stroke and TBI (Schwartz et al., 2002). NAT accomplishment scores and total error rates have both also been shown to significantly correlate with performance of activities of daily living (ADL)/instrumental ADL in the home among dementia patients (accomplishment $r = .34$; total error score $r = .45$; Giovannetti et al., 2002). Additionally, the NAT has high inter-rater reliability for coding of both accomplishment scores (median kappa = .98) and overall error rates (median kappa = .95).

NAT performance scoring procedures. The following dependent variables were obtained to evaluate overall performance: NAT Score, accomplishment score (Accomplishment), comprehensive error score (CES), and total time. All variables (described below) were obtained through analysis of videotapes of NAT performance. More details on each of these variables are provided in the NAT test manual (Schwartz et al., 2003) as well as prior publications (Buxbaum et al., 1998; Giovannetti et al., 2006, 2007; Kessler et al., 2007; Schwartz et al., 1998; 1999).

NAT Score: This variable ranges from 0 to 18, with higher scores indicating better performance. It is an overall measure of task performance, which incorporates the percent of task steps accomplished and the occurrence of a subset of 25 key errors. A total score of 18 is given when all task steps are accomplished (100% accomplishment), and less than four key errors are committed. A NAT Score of 14 or lower reflects impairment

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(i.e., <2 *SD* below the healthy control mean) (Schwartz et al., 2003; Sestito et al., 2005).

Accomplishment: The percentage of accomplished task steps. Accomplishment scores range from 0 to 100, with higher scores indicating greater accomplishment.

CES: A measure of the total number of errors committed in all three NAT trials. A range of error types were coded, including instances when a task step was not performed (i.e., omission error), instances when a step was performed inaccurately (i.e., commission error) and instances when an extra, irrelevant step was performed (i.e., action addition error). See past publications for details on the taxonomy used to classify NAT errors (Buxbaum et al., 1999; Giovannetti et al., 2008; Kessler et al., 2007; Schwartz et al., 2003, 1998, 1999).

Total Time: The total time taken to complete all three of the NAT trials (in seconds). Time to completion was calculated as the time elapsed between the point at which the participant initiated the task to the point at which the participant performed no further action.

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Planning scoring procedures. Planning variables included Planning Behaviours and Planning Time. These variables were scored from videotaped performances of the NAT. The NAT planning variables are novel and have not been reported in prior studies.

Planning Time (PT) was calculated as the time elapsed between the end of the examiner's instruction and the point at which the participant initiated the task. PT was measured as in previously reported neuropsychological tests of planning (Allain et al., 2005; Shallice, 1982; Unterrainer et al., 2003; Unterrainer & Owen, 2006; Wilson et al., 1996). As in other studies, PT had no upper limit.

Planning Behaviours (PB) were operationalised as behaviours that suggested consideration of future steps. In other words, all PB garnered evidence of forward thinking (e.g., gathering items before engaging in a subtask). It is important to emphasise that PB were not essential for successful task completion; they were conceptualised as evidence for a plan-driven *approach* to the task. The concept behind the PB coding scheme is similar to the evaluation of planning strategy/task approach on the published tests of planning where participants are scored for their ability to think ahead and plan their actions before actually performing them (e.g., TOL, SET/MSET, CET, ZMT). Given the nature of the NAT tasks, the PB codes for this study had to be developed specifically for the basic everyday tasks that comprise the test. However, the notion of capturing forward thinking by coding planning behaviours is very similar to the variable collected in widely used measures of planning (e.g., gathering materials before engaging in a NAT subtask is similar to coding accurate early moves on the TOL task).

Table 1 provides some examples of planning behaviours for each NAT trial. The total PB score ranged from 0 to 59 points across all three NAT trials, with 17 maximum points in each of the first two trials and 25 points in the third trial. Higher PB scores reflect more frequent planning behaviours (i.e., greater planning). Details on scoring all PB and PT are provided in the Appendix.

Reliability analysis of planning variables. Fifty percent of the entire sample was randomly selected for calculating inter-rater reliability of planning behaviours (PB). PB for these participants were coded by two independent coders, who were knowledgeable of the coding scheme. Inter-rater reliability for PB was evaluated using Cohen's kappa calculation. Planning time (PT) reliability was evaluated in a randomly selected subsample of 61 participants and assessed using Pearson's correlation coefficient. Inter-rater reliability values of .70 or higher are considered acceptable (Field, 2005). After inter-rater reliability was calculated, final scores for this subsample were determined by reconciling discrepancies. This process included discussion between the coders and review of videotapes when necessary.

The internal consistency of individual items that comprised the PB variable was analysed with Cronbach's alpha. Cronbach's alpha values of .70 or higher are considered to demonstrate acceptable reliability (Cronbach, 1951; Field, 2005).

Global cognitive functioning. The Mini-Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975), a 30-item measure that draws on a variety of cognitive abilities, was used to assess global cognitive functioning for both groups of participants. Scores on the MMSE are based on the number of correctly answered questions and range from 0 to 30 with higher scores indicating better global cognitive functioning.

Schizophrenia symptom severity. The severity of the positive and negative symptoms associated with schizophrenia were measured using the

TABLE 1
Examples of planning behaviour (PB) codes for all NAT trials

Trial 1	Toast and coffee
	Gathers materials or scans object(s) before starting
	Toasts bread before preparing coffee
Trial 2	Gift wrapping
	Gathers materials or scans object(s) before starting
	Measures wrapping paper for gift before cutting
Trial 3	Packing a schoolbag and lunchbox
	Gathers materials or scans object(s) before starting
	Prepares container for cookies before taking cookies out of package

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Scale for the Assessment of Negative Symptoms (SANS; Andreasen, 1984a) and the Scale for the Assessment of Positive Symptoms (SAPS; Andreasen, 1984b). The SAPS includes 34 items that comprise four scales (hallucinations, delusions, bizarre behaviour, and positive formal thought disorder). Each of the four scales yields a global rating that can range from 0 to 5, with higher ratings indicating greater symptom levels. SAPS total summary scores range from 0 to 20. The SANS includes 25-items that comprise five scales (alogia, affective blunting, avolition-apathy, anhedonia-asociality, attentional impairment). Each scale is assigned a global rating that can range from 0 to 5, with higher ratings indicating greater negative symptoms. Thus, SANS summary scores range from 0 to 25. SAPS and SANS items are rated on the basis of a clinical interview, direct observation, and any additional sources of information, including staff report. The psychometric properties for the SAPS and SANS are generally good (see Andreasen, 1984a,1984b; Norman, Malla, Cortese, & Diaz, 1996; Schuldberg, Quinlan, Morgenstern, & Glazer, 1990).

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Statistical analysis

This retrospective study used a two-group, cross-sectional design. All statistical analyses were conducted with Statistical Package for Social Sciences (SPSS) software, Version 16. Significance levels for all statistical analyses were set at .05 and were two-tailed. Normality of planning variable data for both groups was assessed and tested with the examination of histograms and boxplots, skewness and kurtosis, and the Kolmogorov-Smirnov and Shapiro-Wilk tests of normality. Planning behaviour and planning time data were not normally distributed, and non-parametric analyses were subsequently utilised. Between group analyses were conducted using Mann-Whitney *U* tests. Spearman Rank Order Correlations (r_s) were performed to analyse relations between NAT planning variables, NAT performance variables, and schizophrenia symptom severity. All non-parametric analyses were also run using parametric tests, and the results never differed between statistical methods. Therefore, analysis of variance (ANOVA) and covariance (ANCOVA) was used to evaluate the influence of covariates in between-group analyses. Cohen's *d* calculations were used to estimate effect sizes of between group analyses (0.2 = small, 0.5 = medium, 0.8 = large; Cohen, 1988).

RESULTS

Characteristics of the sample

As shown in Table 2, the two groups were not significantly different with respect to their mean age and the proportion of women/men. As expected,

TABLE 2
Demographic characteristics, global cognitive functioning, and action performance scores for both groups

	SZ (*n* = 48)		*Control* (*n* = 26)		*Analysis*	
	M	*SD*	*M*	*SD*	$\chi^2(1)$	*t-value*
Demographic Variables						
Age	43.75	10.72	49.15	23.34		1.11
Education	12.04	2.29	15.00	2.58		5.08*
Sex (%women)	48%		65%		1.43	
Global Cognitive Functioning						
MMSE	25.68	2.50	29.08	1.06		7.82*
Symptom Severity						
SAPS (n = 34)	10.74	4.65	–	–		–
SANS	12.15	4.40	–	–		–
Action Performance Variables						
NAT Score	14.13	2.87	17.73	0.60		6.31*
% Impaired	50%		0%		17.03*	
Accomplishment	89.06	10.14	99.65	1.29		8.37*
CES	11.87	8.63	2.62	2.55		6.84*
Total Time	1126.49	606.32	691.19	136.97		4.71*

*$p<.01$; MMSE = Mini Mental State Exam, SAPS = Scale for the Assessment of Positive Symptoms, SANS = Scale for the Assessment of Negative Symptoms, NAT = Naturalistic Action Test, CES = comprehensive error score. Between group differences for NAT Score, Accomplishment, CES, and Total Time remained significant when analysed with ANCOVA including education as a covariate, $F(2, 71)<11.63$, $p<.01$ for all.

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the groups differed in MMSE score, with the SZ group showing mildly to moderately impaired global cognitive functioning.

The groups also significantly differed on education, with controls having completed an average of three additional years of school. Ratings of positive (SAPS) and negative (SANS) symptoms showed moderate-level psychopathology among the SZ group. Of note, ratings of positive symptoms were not available for the entire sample, as this symptom measure was added later during data collection and was not considered a primary variable of interest in our early research on everyday action.

Education was significantly correlated with the planning behaviour (PB) variable, $r_s(72) = .28$, $p < .05$, but not with planning time, $r_s(72) = -.01$. Age and MMSE were not significantly related to NAT planning variables (all $r_s < .12$), and there was no significant difference between men and women on the NAT planning variables, $t(73) < 1.17$, $p > .25$ for both. Correlations assessing relations between planning variables and severity of

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schizophrenia were not statistically significant, but suggested modest relations in the expected direction between SAPS and planning time, $r_s(34) = -.23$, and between SANS and both planning behaviours, $r_s(48) = -.24$, and planning time, $r_s(48) = -.21$. The association between SAPS and planning behaviours was in the unexpected direction, $r_s(34) = .19$.

NAT performance

Consistent with the results from a previously published study (see Kessler et al., 2007), participants with schizophrenia demonstrated worse performance than control participants on all NAT performance variables (Table 2). That is, SZ participants accomplished fewer task steps (Accomplishment), made more errors (CES), and took almost twice as much time to complete the NAT tasks compared to controls. Of note, all of these comparisons remained highly significant in ANCOVA that included education as a covariate. Based on the NAT Score cutoff of 14 (Sestito et al., 2005), 50% of the SZ group fell within the impaired range on the NAT. None of the control participants exhibited impaired performance.

Hypothesis 1: Reliability of NAT planning variables

As hypothesised, planning variables were reliably coded between two independent coders. The raters demonstrated 88.90% agreement in coding planning behaviours (PB) for a subsample of SZ and control participants (Cohen's kappa = .72). Raters also agreed on planning times; average planning times for each coder were quite similar (rater 1 = 4.2 seconds; coder 2 = 5.2 seconds) and highly significantly correlated, $r(61) = .87$, $p < .01$.

Evaluation of 71 items that comprised the planning behaviour score demonstrated good internal reliability (Cronbach's $\alpha = .84$). High internal reliability was demonstrated for items coded in each of the trials as well (Cronbach's $\alpha = .84$ for 21 items in Trial 1, Cronbach's $\alpha = .71$ for 21 items in Trial 2, and Cronbach's $\alpha = .81$ for 29 items in Trial 3). This shows cohesion among the items that comprise the planning behaviour (PB) variable.

Hypothesis 2: Between group analyses of NAT planning variables

As shown in Table 3, control participants demonstrated significantly more planning behaviours (PB) on the NAT compared to participants with SZ (effect size – medium). As stated earlier, education significantly differed across the groups and was significantly related to PB. Therefore, in order to evaluate the influence of education on this effect, we also ran univariate ANOVA and ANCOVA. Consistent with the nonparametric results reported

TABLE 3
Planning scores across both groups

	Schizophrenia (n = 48)		*Control (n = 26)*		*Analysis*	*Effect Size*
	M	(*SD*)	*M*	(*SD*)	*z-value*	*d*
Planning Behaviours (PB)	14.94	(6.11)	17.77	(5.54)	2.11*	0.47
Planning Time (PT)	5.68	(3.89)	4.81	(1.83)	0.52	0.26
Planning time proportion	0.53%	(0.34)	0.70%	(0.25)	2.20*†	0.52

*$p < .05$; †*t*-score.

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in Table 3, the ANOVA showed a significant group effect, $F(1, 71) = 3.38$, $p = .05$; however, this effect was no longer significant in the ANCOVA, which included education as a covariate, $F(1, 70) = 0.90$, $p = .36$.

There was no significant difference in planning time (PT) between the two groups. However, as shown in Table 2, there was a significant difference between groups on the total time taken to complete the NAT trials. When PT was examined as a proportion of total time on NAT tasks to account for the general slowness of schizophrenia participants, the SZ group showed proportionally less planning time. Although education did not correlate with the planning time variable or the planning time proportion, we examined the possible influence of education on the significance between group difference in planning time proportion using ANOVA and ANCOVA. Consistent with the nonparametric results reported in Table 3, the ANOVA showed a significant group effect, $F(1, 71) = 4.85$, $p < .05$. The group effect remained significant in the ANCOVA, which included education as a covariate, $F(1, 70) = 4.46$, $p < .05$.

Hypothesis 3: Relations between NAT planning variables and NAT performance variables

Correlations between NAT *planning* variables and NAT *performance* variables showed significant relations among the entire sample (see Table 4). First, PB and NAT Score were significantly correlated, such that participants with more planning behaviours also had higher NAT Scores. PB and Accomplishment also were significantly correlated, such that participants with more planning behaviours also completed a higher percentage of everyday task steps. There was also a significant correlation between the proportion of time spent planning on tasks and CES, such that participants with a higher proportion of time spent planning, had fewer everyday action errors. No other correlations were significant.

As mentioned earlier, correlations and between-group results showed PB to be significantly related to level of education. Therefore, partial

TABLE 4
Correlations (r_s-values) between NAT planning and performance variables for the entire sample ($n = 74$)

	Planning Behaviours	*Planning Time Proportion*
NAT Score	.28*	.10
Accomplishment	.25*	.10
CES	−.16	−.30*

*$p < .05$; NAT = Naturalistic Action Test, CES = comprehensive error score.

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correlations, controlling for education, were also performed to evaluate the extent to which the significant relations between NAT planning variables and NAT performance variables were influenced by education. The *pattern* of relations did not change after controlling for education. The relation between planning time proportion and CES remained significant, $r_p = -.27$, $p = .02$. However, the *r*-values for NAT Score × PB and Accomplishment × PB were now slightly weaker trends, $r_p > .20$, $p < .09$ for both. All other correlations remained nonsignificant, $r_p < .12$ for all.[1]

DISCUSSION

Performance of everyday tasks was evaluated for evidence of planning/forward thinking in participants with schizophrenia and healthy controls. Planning behaviours and planning time were evaluated and reliably coded during the performance of everyday tasks using a novel scoring system developed for this study. Planning variables differed between participants with schizophrenia and healthy controls, with controls demonstrating more planning behaviours than participants with schizophrenia and longer planning times (when measured as a proportion of their total time spent on the everyday tasks). However, the difference in planning behaviours was no longer significant when accounting for differences in education between the groups. Overall, participants with schizophrenia performed worse on the tasks even after controlling for education (i.e., more errors and lower accomplishment), and planning variables were related to task performance. Participants who demonstrated more planning behaviours also demonstrated higher overall everyday action scores and accomplished a greater percentage of task

[1] We also explored these realtions for only the SZ group ($n = 48$), and found a similar pattern of relations, with the highest *r*-values for PB × NAT Score ($r_p = .22$), PB × ACCOMPLISHMENT ($r_p = .21$) and PB × CES ($r_p = .26$), and Planning time proportion and CES (−.20). All other r_p-values were <.14.

steps; however, partial correlation analyses showed this relation was partly influenced by education. Those with a higher planning time proportion made fewer everyday action errors, and this relation was not influenced by level of education.

This is the first study to our knowledge to directly assess planning behaviours in everyday tasks. Because this approach is novel, it was important to establish that planning variables could be extracted reliably from behaviours during task execution. Consistent with our first hypothesis, planning behaviours and planning time were reliability coded and showed high internal consistency. Of note is that planning behaviours cannot be judged as correct or incorrect and are not reflected in the standard NAT error scoring. Thus, our planning coding methods fall in line with the Boston/quantified process approach to neuropsychological evaluation, which emphasises that understanding *how* people with cognitive deficits perform tasks is equally important as knowing whether tasks are performed accurately (Kaplan, Fein, Morris, & Delis, 1991; Lezak, Howieson, & Loring, 2004). This novel approach to evaluating planning behaviour directly during everyday task execution holds promise for improving the ecological and face validity of planning assessments and evaluating the efficacy of rehabilitation strategies.

Our second hypothesis, that people with schizophrenia would exhibit fewer planning behaviours and less planning time than controls, was based on the well-documented executive functioning deficits in this patient population (Barch et al., 2001; Barch & Smith, 2008; Elvevåg & Goldberg, 2000; Velligan & Bow-Thomas, 1999). Our results generally supported this hypothesis, as the schizophrenia group demonstrated significantly fewer planning behaviours than controls. However, the planning behaviours variable was significantly related to years of education, such that individuals with more years of education demonstrated more planning behaviours, and on average, the control group completed three more years of education than the schizophrenia group (12 vs. 15 years). When education was included as a covariate in the between group analysis of planning behaviours, the group difference was no longer significant. As reported earlier, previous studies utilising the NAT have not found education to influence task performance or performance differences among groups (Schwartz et al., 2002; 2003). Furthermore, significant group differences held when education was entered as a covariate in between group analyses of NAT performance variables (e.g., errors, accomplishment, etc.) in the present study. Thus, the relation between planning behaviour and education suggests that education may differentially influence *how* someone performs everyday tasks but may not influence the accuracy of achieving task goals. We acknowledge, however, that the interpretation of these findings is limited by the cross-sectional experimental design of the study. That is, it is impossible to know whether three

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years of additional education may substantially improve planning skills or planning skills influence one's ability to succeed educationally.

Along this line, it is important to consider that education level is strongly affected by schizophrenia. The disease strikes in late adolescence/early adulthood and often precludes college admission or completion, thereby stunting educational achievement. For this reason, many investigators rely on parental level of education or estimates of premorbid IQ rather than education level in order to index expected level of functioning (Keefe, Eesley, & Poe, 2005). Unfortunately, we do not possess these data for our participants; as such, it is difficult to know for certain whether the groups were comparable in terms of premorbid intellectual functioning. Future everyday action research should equate schizophrenia and control groups on parental education level or reading level estimates of IQ to address the open questions concerning education, schizophrenia, and planning.

Many studies of planning emphasise planning time, which is the period between instruction and task initiation that is believed to reflect the amount of time spent deliberating on the problem or task at hand (Allain et al., 2005; Shallice, 1982; Unterrainer et al., 2003; Unterrainer & Owen, 2006; Wilson et al., 1996). Planning time has not been extensively studied in people with schizophrenia, but the few studies that do examine this variable show no differences between schizophrenia and other groups (Pantelis et al., 1997). Contrary to our second prediction, but consistent with the past reports, we observed no significant difference in planning time between groups. Upon further consideration, however, we were dissatisfied with the straightforward planning time variable, as it did not account for possible bradyphrenia among the schizophrenia participants. Participants with schizophrenia took longer to complete the NAT tasks than healthy controls; thus bradyphrenia in the schizophrenia group may have masked differences in planning time. In fact when time spent planning was examined as a proportion of total time spent on the everyday action tasks, there was a significant difference between the groups. Participants with schizophrenia spent proportionally less time planning and more time executing the tasks.

Our third hypothesis was that relations between planning variables and performance variables would show that more planning behaviours and greater planning time would be associated with better performance of everyday tasks (e.g., greater task accomplishment and fewer errors). Results showed three significant relations between planning and performance variables that supported our hypothesis. Participants who demonstrated more planning behaviours obtained better overall scores on the NAT and accomplished more task steps. Participants who spent a greater proportion of time planning committed fewer errors on everyday tasks. Although *r*-values between planning behaviours and performance variables were somewhat weaker in partial correlation analyses that controlled for education, the

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overall pattern of correlations was strikingly similar. Taken together, these results support the theoretical motivation of many rehabilitation strategies that promote planning and deliberation to improve daily functioning.

When exploring the characteristics of the sample, we examined relations between schizophrenia symptom severity and planning variables. Although none of the analyses reached statistical significance, *r*-values suggested modest relations that were consistently in the expected direction for ratings of negative symptoms (SANS). We acknowledge that (1) the findings were weak, (2) the analyses were underpowered because of missing data, and (3) this issue was not the central focus of this paper; however, these preliminary findings suggest that positive/negative symptoms and planning abilities are not overlapping features of schizophrenia. Furthermore, the pattern of observed relations suggest that associations between planning abilities and the severity of negative symptoms may be more meaningful than relations between planning and positive symptoms. Again, this interpretation is admittedly speculative; however, this notion is consistent with past literature showing a differential relation between negative symptoms (but not positive symptoms) and measures of cognitive/executive function (Green, 1996; Green, Kern, Braff, & Mintz, 2000).

As previously mentioned, many cognitive rehabilitation approaches aim to improve planning abilities (Burgess & Robertson, 2002). For example, Goal Management Training (GMT; Levine et al., 2000) proposes a six-step protocol to promote deliberation and planning in the execution of everyday tasks. Individuals are trained to stop and consider what they are doing, define the main task at hand, list the steps necessary to do the task, consider whether they know how to do the steps, actually do the task, and then check or evaluate if they have done what they intended to do (Levine et al., 2000; Sohlberg & Mateer, 2001). Several other programmes also emphasise planning through self-instruction, systematic problem solving and self-monitoring (WSTC; Sohlberg & Mateer, 2001; SWAPS; Rehabilitation Research and Training Center on Traumatic Brain Injury Interventions, personal communication, June 30, 2007), and/or by minimising time demands during task execution (Time Pressure Management; Fasotti, Kovacs, Eling, & Brouwer, 2000). These approaches have shown promise for individuals with brain injury and stroke, but they have not been extensively studied in people with schizophrenia. Our preliminary findings suggest that these rehabilitation approaches may also be beneficial for improving everyday functioning in people with schizophrenia. Furthermore, the methods that we have developed to assess planning may be useful for evaluating the processes that are targeted by these rehabilitation strategies. In other words, analyses of the planning variables described in this study may elucidate whether interventions improve functional outcomes by promoting forward thinking or some other cognitive process.

There is still much to understand about planning in everyday tasks. This pilot study was limited by a relatively small sample size and inclusion of only a single patient group. The extent to which these results may generalise to other patient populations is unknown. It is also unknown whether everyday action planning and planning on traditional neuropsychological measures (e.g., ZMT, TOL, etc.) evaluate overlapping or unique planning processes. Future studies should address these unresolved issues.

These limitations notwithstanding, this is the first study to evaluate planning abilities in relatively simple everyday tasks among participants with schizophrenia. While there is a great deal of work left to be done on this topic, our study sets forth a method to evaluate planning in everyday tasks that may be used across various patient populations, as well as healthy controls. Results from our pilot study also showed that the approach to everyday action tasks differed between schizophrenia and control groups and that these differences were also related to successful performance of everyday action tasks. These preliminary findings imply that interventions designed to improve deliberate planning of everyday tasks should be featured in cognitive rehabilitation programmes for people with schizophrenia.

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APPENDIX: EVERYDAY ACTION PLANNING CODING RUBRIC

Planning Time (Trials 1–3)

- Record start time immediately after experimenter finishes saying "get started"
- Record initiation time when the participant touches any object after start time
- Calculate planning time (initiation time – start time)

Planning Behaviours (Trial 1; maximum points = 17)

- Gathers materials in workspace before putting anything in coffee mug or before putting anything on toast/bread (2 points for gathering with 1 point added per object; maximum 13 points)
- or
- Scans for objects before beginning the subtask (scanning is coded only for overt head movement to left and/or right side of table; do not rely on eye movement (1 point per side of table scanned; maximum 2 points)
- Begins Task 1 by toasting bread (1 point)
- Uses clean utensil for jam (1 point)

Planning Behaviours (Trial 2; maximum points = 17)

- Gathers materials in workspace before selecting the gift (2 points for gathering with 1 point added per object; maximum 8 points)
- or
- Scans for objects before beginning the subtask (scanning is coded only for overt head movement to left and/or right side of table; do not rely on eye movement (1 point per side of table scanned; maximum 2 points)
- Moves distracter objects away from workspace in the beginning of the task before placing the gift in the box (1 point per distractor object; maxium 5 points)
- Measures wrapping paper before wrapping gift by bringing gift and wrapping paper together in the workspace (1 point)
- Pre-cuts scotch tape (i.e., cuts pieces and places hanging along the table, their hand, etc, and then uses the tape; 1 point)

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Planning Behaviours (Trial 3; maximum points = 25)

- Gathers materials in workspace before beginning the sandwich (mustard or bologna on bread), drink (before juice bottle opened), or the snack (before cookies collected) or beginning the school bag (2 points for gathering plus 1 point added per object; maximum 20 points)
- or
- Scans for objects taken before beginning the subtask (scanning is coded only for overt head movement to left and/or right side of table; do not rely on eye movement (1 point per side of table scanned per subtask; maximum 2 points)
- Removes objects from drawer for future activity (1 point).
- Checks if cap fits the thermos before adding juice to thermos (1 point)
- Prepares container/foil for cookies before cookies are removed from package (1 point)

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