

## Ecological assessment of executive dysfunction in the psychosis prodrome: A pilot study<sup>☆</sup>

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### Abstract

Individuals with psychosis have prominent executive functioning (EF) deficits on neuropsychological tests, but their relationship to EF deficits in daily life is unclear. This study evaluates behavioral manifestations of EF deficits, assessed by the Behavioral Rating Inventory of Executive Functioning (BRIEF), and their clinical correlates in individuals at ultra-high-risk for psychosis (UHR). UHR subjects showed significantly elevated BRIEF scores, particularly on the Working Memory scale. BRIEF scores were associated with positive symptoms and functioning, but not with neuropsychological performance. The BRIEF appears to capture unique aspects of executive dysfunction, possibly associated with illness progression and functioning in the psychosis prodrome.

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### 1. Introduction

Individuals with schizophrenia demonstrate cognitive deficits on performance-based measures of neuropsychological functioning, particularly in the domains of executive function (EF) and working memory (see Heinrichs and Zakzanis, 1998, for review). These EF deficits are associated with poor social and occupational functioning (Addington and Addington, 1999; Bell and Bryson, 2001), and more severe negative symptoms (Breier et al., 1991).

The “prodromal” or pre-psychotic phase of schizophrenia is characterized by the progressive deterioration of functioning and emergence of subthreshold psychotic symptoms. Individuals at ultra-high-risk (UHR) for developing psychosis demonstrate deficits on neuropsychological measures of EF (Hawkins et al., 2004; Lencz et al., 2005), which are associated with poor social and role functioning (Niendam et al., 2006b).

The Behavior Rating Inventory of Executive Function (BRIEF, Gioia et al., 2000a) assesses behaviors associated with executive dysfunction related to activities of daily living in children aged 5–18. Elevated BRIEF scores have been reported in children with psychiatric and neurological disorders typically associated with deficits on performance-based measures of EF, such as attention deficit disorder, traumatic brain injury, and Tourette's Syndrome (Gioia and Isquith, 2004; Mahone et al., 2002; Vriezen and Pigott, 2002).

The utility of the BRIEF as a measure of behavioral expressions of executive dysfunction in the psychosis prodrome has not been examined. Based on previous neurocognitive findings in UHR individuals and individuals with schizophrenia, we hypothesized that UHR participants will demonstrate elevated rates of behaviors associated with executive dysfunction, and that elevated BRIEF scores will be related to impairment in social and role functioning.

## 2. Methods

### 2.1. Participants

Subjects were 31 participants in an ongoing investigation of individuals at UHR for developing psychosis. Table 1 provides details on demographics and clinical presentation at baseline.

Participants were screened with the Structured Interview for Prodromal States (SIPS, McGlashan, 2001) for the presence of one of four prodromal syndromes, based on attenuated subthreshold psychotic symptoms, transient psychotic symptoms, or a substantial drop in social/role functioning in conjunction with a diagnosis of schizotypal personality disorder or presence of a first-degree relative with a psychotic disorder. Participants were excluded if they met DSM-IV (1994) criteria for an Axis I schizophrenia-spectrum diagnosis (i.e., Schizophrenia, Schizoaffective Disorder, Schizophreniform Disorder, or Delusional Disorder). Additional exclusion criteria include the presence of a neurological disorder, drug or alcohol abuse or dependence within the past 6 months, or Full Scale IQ below 70. Detailed information on recruitment, inclusion criteria, inter-rater reliability, and case consensus procedures are provided in Meyer et al. (2005) and Niendam et al. (2006b).

### 2.2. Measures

The participant's primary caregiver completed the BRIEF Parent form (Gioia et al., 2000a). The BRIEF is an 86-item questionnaire asking parents to rate their child's

Table 1

Demographics and clinical characteristics of the UHR sample ( $N=31$ )

Demographic variable	Descriptive statistics ( $n=31$ )
Age, mean (SD), (min–max)	15.68 (1.82), (12.50–18.50)
Years of education, mean, (SD), (min–max)	9.29 (1.85), (6–12)
Gender, $n$ (%)	
Males	18 (58.1%)
Females	13 (41.9%)
Race, $n$ (%)	
Caucasian	21 (67.7%)
African-American	2 (6.5%)
Latino	4 (12.9%)
Asian	2 (6.5%)
Other	2 (6.5%)
Clinical characteristics of sample	
Current GAF score, mean (SD), (min–max)	42.06 (15.78), (17–70)
SIPS Positive Symptom Total, mean (SD), (min–max)	12.68 (4.79), (5–21)
SIPS Negative Symptom Total, mean (SD), (min–max)	13.03 (6.07), (2–25)
WASI IQ, mean (SD)	103.6 (13.85)
Prodromal Syndrome Type, $n$ (%) <sup>a</sup>	
Attenuated Positive Symptom Syndrome	22 (71%)
Genetic Risk and Deterioration Syndrome	2 (6.5%)
Brief Intermittent Psychotic Syndrome	6 (19.4%)
Psychotic Syndrome	4 (12.9%)

<sup>a</sup>Some patients qualify for more than one SIPS Diagnostic category.

behavior on a 3-point Likert scale, “Never,” “Sometimes,” or “Often.” It yields 8 Scale scores and 3 Index scores, developed from a factor analysis in a normal population (Gioia et al., 2000b). The Behavior Regulation Index (BRI) is composed of the Inhibit, Shift, and Emotional Control scales. The Metacognition Index (MI) includes the Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor scales. The Global Executive Composite (GEC) Index incorporates all 8 scales. Computer scoring yields  $T$ -scores for each of the 8 scales and 3 Indices. Participants were classified as “clinically elevated” on a BRIEF scale or Index if their  $T$ -score was  $\geq 65$ . Prior to analysis, data were examined for departures from normality. Two BRIEF scales, the Shift and Plan/Organize scales, were not distributed normally, and were thus excluded from subsequent parametric analyses.

BRIEF Index scores were examined in relation to concurrent clinical, psychosocial, and neuropsychological measures. Because the correlational analyses are exploratory and intended for further hypothesis generation, a liberal threshold of  $p<0.05$  was chosen. The SIPS Positive and Negative Symptom scales were used as indicators of clinical symptom severity. The SIPS

Positive Symptom scale assesses unusual thought content, suspiciousness, perceptual disturbances/hallucinations, grandiosity, and disorganized communication. Symptoms of anhedonia, avolition, flat affect, decreased role functioning, and decreased verbal comprehension/abstraction are captured by the SIPS Negative Symptom scale. The Global Functioning Scale: Social (GFS: Social; Auther et al., 2006) and Global Functioning Scale: Role (GFS: Role; Niendam et al., 2006a) provide ratings of functioning in social and role domains, respectively, on two separate 10-point Likert scales, which are scored independently of symptom severity. Ratings for all of the above scales were based on the past month.

A neuropsychological assessment was also conducted (see Niendam et al., 2006b for details), including the following well-established measures of EF: WASI Matrix Reasoning (Wechsler, 1999), Trail Making Test B (Reitan and Wolfson, 1985), and verbal letter fluency (FAS, Benton and Hamsner, 1976). Participants' neuropsychological scores were converted to *z*-scores based upon published normative data.

### 3. Results

A repeated measures within-subjects MANOVA showed that the EF deficits in UHR subjects, as assessed by the BRIEF, varied by domain [ $F(1,30)=5.536$ ,  $p<0.01$ ]. Post-hoc comparisons demonstrated the Working Memory (WM) scale was significantly more elevated than the Inhibit, Initiate, Organize, and Monitor scales ( $p<0.003$  for all comparisons). Because of this significant elevation, the WM scale was entered into correlation analyses along with the Index Scores.

Fifty-eight percent of the UHR participants received a Global Executive Composite (GEC) score in the clinically elevated range ( $T\geq 65$ ), and 45% had clinical elevations

across all three Indices. Between 39% and 65% of the sample had elevated scores on the other clinical scales (Fig. 1).

No significant correlations were observed between BRIEF Index or WM scale scores and neuropsychological measures of EF (all  $p>0.10$ ), or SIPS Negative symptoms (all  $p>0.05$ ). However, the BRIEF BRI was significantly associated with severity of SIPS Positive symptoms ( $r=0.357$ ,  $p=0.049$ ), poorer social functioning ( $r=-0.381$ ,  $p=0.038$ ), and poorer role functioning ( $r=-0.367$ ,  $p=0.046$ ). Elevated scores on the BRIEF WM scale were also significantly related to poorer role functioning ( $r=-0.389$ ,  $p=0.034$ ).

### 4. Discussion

This is the first study to examine everyday behavioral manifestations of executive dysfunction in individuals at UHR for psychosis. Results indicate a high proportion (58%) of UHR individuals show clinically significant behavioral signs of executive dysfunction according to parent report on the BRIEF. The pattern of elevations also indicates that behavioral difficulties associated with the BRIEF WM scale are particularly common in this group.

The Behavior Regulation Index (BRI) was associated with measures of social and role functioning. The BRI represents the ability to shift, inhibit, and modulate emotions and behavior. In UHR individuals, behavioral dysregulation associated with executive deficits may play a role in their ability to maintain adequate functioning in social and occupational realms. The BRIEF Working Memory Scale was also associated with a measure of role functioning. Examples of Working Memory items include: "Forgets what he/she was doing," and "has trouble remembering things, even for a few minutes." This suggests that behavioral manifestations of poor attention

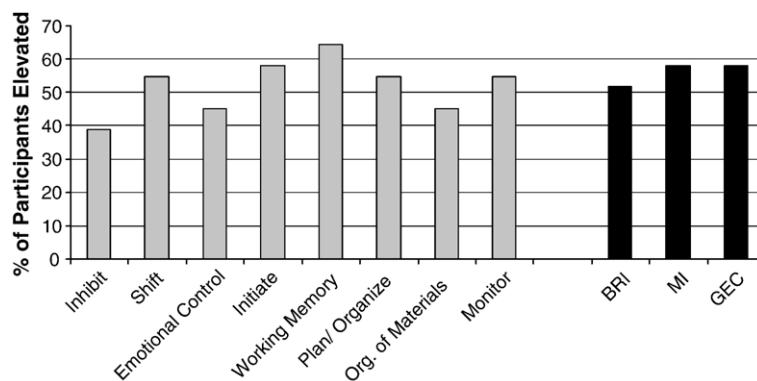


Fig. 1. Percentage of UHR individuals ( $N=31$ ) who show elevations on each BRIEF scale and Index.

and short-term memory may contribute to poor school/work performance during the prodromal phase of the illness. Furthermore, the BRI was also related to the severity of positive symptoms. This is unexpected, as previous work generally shows an association between neuropsychological measures and negative symptoms, but fails to show an association with positive symptoms (Breier et al., 1991; Niendam et al., 2006b). The BRI and WM scales of the BRIEF do not assess psychotic or sub-psychotic symptomatology, nor do they include items assessing social or role function. Therefore, this finding suggests that subthreshold psychotic symptoms may be associated with difficulties in effectively modulating emotions and behavior (e.g., the inhibition of inappropriate or competing responses), and that BRIEF items assessing working memory and basic regulation of behavior (e.g., establishment and maintenance of cognitive set, concentration and transition to new material) may be related to social and educational problems in these adolescents.

Scores on BRIEF Indices, as well as the WM scale, were not associated with participants' performance on common neurocognitive measures of EF. Although counterintuitive, these cognitive tests were not designed to measure EF as reflected by everyday behavior. Our findings are consistent with prior work in other clinical populations (Gioia and Isquith, 2004, Mahone et al., 2002, Vriezen and Pigott, 2002), as these studies have demonstrated that deficits on performance-based measures of EF are not correlated with BRIEF ratings of behavioral dysfunction.

Ecological validity of neuropsychological measures is an essential issue, given that the ability to work and live independently is a key quality of life issue for individuals with psychotic disorders (e.g., Semkovska et al., 2004). It has been suggested that the BRIEF provides an ecologically valid assessment of a child's behavior as it relates to EF, and is therefore more useful in predicting performance in activities of daily living. Furthermore, it has been proposed that the BRIEF may be more sensitive to certain types of executive deficits in children and adolescents that are not well captured by performance-based measures administered in a structured environment (Gioia and Isquith, 2004, Mahone et al., 2002, Vriezen and Pigott, 2002). The BRIEF may prove helpful in treatment planning that is focused on improving performance in individuals' real-world functioning.

The primary limitations of this study are the relatively small sample size, which limits statistical power, and the lack of a matched control group. Replication with a larger sample and matched control group is warranted. Longitudinal follow-up will also help elucidate how these

baseline deficits in the behavioral aspects of EF may be predictive of conversion to a psychotic disorder diagnosis, and how behavioral signs of executive dysfunction may relate to follow-up measures of neuropsychological performance, clinical severity and functional outcome.

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