Published in final edited form as:

J Clin Exp Neuropsychol. 2005 April ; 27(3): 255–277. doi:10.1080/13803390490515478.

Development and Validation of the Subjective Awareness of Neuropsychological Deficits Questionnaire for Children (SAND-C)

BRADLEY J. HUFFORD^{1,2} and PHILIP S. FASTENAU^{3,4}

¹ Department of Physical Medicine and Rehabilitation, Indiana University School of Medicine, Indianapolis, IN, USA

² Rehabilitation Hospital of Indiana, Indianapolis, IN, USA

³ Department of Psychology, Indiana University Purdue University Indianapolis (IUPUI), Indianapolis, IN, USA

⁴ Department of Psychiatry, Indiana University School of Medicine, Indianapolis, IN, USA

Abstract

Although lowered awareness of abilities has been associated with poorer outcome in adults with neurological compromise, a dearth of research exists examining whether lowered awareness exists in younger populations. Using findings from recent literature and expert opinion, a 47-item Subjective Awareness of Neuropsychological Deficits Questionnaire for Children (SAND-C) was created to assess awareness of cognitive functioning in 6 domains (attention, psychomotor, visual-spatial, language, memory, and executive functioning). Confirmatory factor analysis (CFA) of the SAND-C was conducted on a sample consisting of 365 healthy children and 48 children with epilepsy. The SAND-C was found to have strong reliability. Factor analysis confirmed the a priori 6 factor model, but the 6-factor model was only marginally better than a more parsimonious 1-factor solution. Post-hoc exploratory factor analyses indicate that the SAND-C may measure more constructs for adolescents than for younger children. The difference between younger and older children may reflect developmental changes in metacognitive awareness and abstraction about their own abilities.

Introduction

Lowered awareness of neuropsychological abilities refers to a propensity of neurologically compromised individuals to view themselves to be unchanged from their premorbid level of functioning, or to be less impaired than they actually are (Prigatano & Schacter, 1991). Impaired awareness of deficits has been noted by clinicians and theorists to be a significant impediment to successful rehabilitation and independent functioning after injury (Anderson & Tranel, 1989; Bergquist and Jacket, 1993; Lezak, 1988; Malec & Moessner, 2000).

The majority of research attempting to quantify lowered awareness of abilities and deficits has centered on adults with relatively static, rapidly resolving cerebral insults, such as traumatic brain injury (TBI). Allen and Ruff (1990) measured awareness by comparing subjective ratings of adults with severe TBI with their neuropsychological test performance. They found that subjects overestimated their sensorimotor and attentional abilities. Other researchers have

Address correspondence to: Bradley J. Hufford, Ph.D. Indiana University School of Medicine, Department of Physical Medicine and Rehabilitation, 541 Clinical Drive CL 368, Indianapolis, IN 46202. E-mail: bhufford@rhin.com.

This manuscript is an elaboration of a paper presented at the Annual Meeting of the American Epilepsy Society in Orlando, Florida, in December, 1999, and the Annual Meeting of the International Neuropsychological Society in Denver, Colorado, in February, 2000.

found that adults with TBI displayed lowered awareness for intellectual, memory, and speech/language deficits (Anderson & Tranel, 1989). This variability in the manifestation of lowered awareness of deficits likely stems from the fact that unawareness can arise from injury to many different brain regions, such as hetero-modal cortex (Mesulam, 2000), subcortical connections (Kaszniak & Zak, 1996), or diffuse areas (Lezak, 1988). Variability may also be due to different instruments and methodologies used to assess cognitive functions and awareness of the integrity of those functions.

Research has also focused on lowered awareness of neuropsychological abilities in adult populations with dynamic cerebral insults, such as epilepsy. During many different types of seizures, consciousness (and therefore awareness) is impaired (Commission on Classification and Terminology of the International League Against Epilepsy [ILAE], 1981). Awareness often may be compromised to such an extent that the individual is not cognizant of the fact a seizure has occurred (Blum, Eskola, Bortz, & Fisher, 1996).

In addition, there is evidence to suggest that persons with epilepsy experience lowered awareness of their memory functioning when observable seizures are not occurring. In research with adults with temporal lobe epilepsy (TLE), Prevey and colleagues (1988, 1991) found that, compared to control subjects without epilepsy, adults with both left and right TLE have a tendency to overestimate their ability to recognize material stored in long-term memory. These inaccurate predictions may be indicative of lowered awareness of memory functioning. Similarly, Deutsch, Saykin, and Sperling (1996) found that adults with left and right TLE significantly underestimated their actual memory ability (i.e., predicted that their memory actually would be worse than was observed on objective testing) compared to controls.

The research on awareness of deficits in epilepsy has focused predominantly on adult populations, to the exclusion of children and adolescents. Research on younger populations with epilepsy is needed because the results garnered from adult neuropsychological research may not consistently apply to children and adolescents (Reitan and Wolfson, 1993). In addition, epilepsy is a disorder that has a high occurrence among younger individuals. The prevalence rates for individuals under 20 years old is estimated to be approximately 1% (Hauser, 1994). The considerable number of young people affected by epilepsy is paralleled by substantial academic (e.g., Austin, Huberty, Huster, & Dunn, 1998, 1999), psychosocial (e.g., Austin, Risinger, & Beckett, 1992), and neuropsychological problems (Aldenkamp et al., 1993; Dodrill & Clemmons, 1984; Fastenau, Shen, Dunn, Perkins, Hermann, & Austin, 2004; Seidenberg, 1989) encountered in these groups. The observed neuropsychological deficits are of particular importance because they have been theorized to play a mediating role between subclinical seizures and psychosocial and academic difficulties, both directly and indirectly (Austin, 1997; Deonna, 1993; Fastenau, Dunn, & Austin, 2004). Lowered awareness may also prove to be an important mediator between subclinical seizure activity and academic and psychosocial functioning. However, to date, no research has been conducted on awareness of deficits in younger populations with epilepsy.

The purpose of this study is to create and validate an awareness of deficits questionnaire for use with children and adolescents ages 9–16. The first portion of the study was concerned with the creation and content validation of the Subjective Awareness of Neuropsychological Deficits Questionnaire for Children (SAND-C), a self-report measure for children and adolescents ages 9–16. The second portion of this study addressed the reliability and construct validity of the SAND-C in a large sample comprised of neurologically normal school children and youth with epilepsy.

Study 1: Content Validity

Content Sampling

The age range targeted for the SAND-C was 9 to 16 years old. Nine years was chosen as the youngest age, as these children have been demonstrated to have more developed executive functioning and self-monitoring skills than younger children (Newcombe, 1996; Passler, Issac, & Hynd, 1985). In addition, nine years of age corresponds to the cutoff age used on many standard neuropsychological tests to distinguish between younger and older child forms of testing stimuli.

The SAND-C items were designed to assess awareness of abilities in six neuropsychological areas (i.e., psychomotor, attention, executive functioning, learning and memory, language, and visual-spatial abilities). In creating item content, authoritative texts of childhood disorders, epilepsy in childhood, clinical child neuropsychology, child development, and developmental neuropsychology (Baron, Fennell, & Voeller, 1995; Broman & Michel, 1995; Kail & Cavanaugh, 1996; Reynolds & Fletcher-Janzen, 1997; Rourke, 1991; Rourke, Fisk, & Strang, 1986; Spreen, Risser, & Edgell, 1995) were consulted to ensure that items selected were representative of the six neuropsychological areas and were developmentally appropriate for ages 9–16.

Expert Appraisal

A total of 47 items were distributed to nine expert raters in the fields of clinical neuropsychology/child neuropsychology, developmental psychology, childhood disorders, methodology/research design, and childhood epilepsy for critical review. Experts were asked to use a 7-point rating scale (1 = strongly agree; 7 = strongly disagree) to rate the developmental appropriateness of the items, comprehensive nature of the survey, adequacy of the survey response choices, and appropriateness of the survey instructions. Five experts returned their ratings and comments. The experts' appraisal of the instrument was positive overall. All reviewers endorsed the potential value of the current project, and the overall design and content of the instrument. The changes suggested by these reviewers centered on wording and format of the questionnaire items. Based upon reviewer feedback, final changes were made to the survey format, instructions, and to the selection and wording of the 47 items included on the survey.

Readability

The readability of the instrument was assessed by using two readability features included in Microsoft Word 97. The first readability feature was Flesch Reading Ease, which assigned a rating of 0–100 to text passages, with higher scores indicating more readability. Scores of at least 60–70 are considered desirable according to the software literature. The second readability feature, Flesch-Kincaid Grade Level, generates a rating based on American grade levels. The average readability rating across all items was 88.9 ($SD = 8.3$), and ranged from 71.8 to 100. The average grade level for all items was 3.1 ($SD = 1.7$), and ranged from 0.0 to 5.9. Only four items were at the fifth grade reading level. In addition, a Junior High/High School English instructor determined that the wording and content of the SAND-C were appropriate for students in grades 4–12.

Final Instrument

In an attempt to minimize response sets, survey items were ordered so that several items from the same subscale (e.g., attention) were not listed consecutively. In addition, items were included that emphasized strengths (30 [64%] of the total items) of the individual as well as

weaknesses (17 [36%] of the total items). All items reflecting weaknesses were reversed scored. The final version of the SAND-C is included in the Appendix.

Study 2: Reliability and Validity of the SAND-C

Method

Participants—The SAND-C was administered to 455 children and adolescents from several populations: chronic epilepsy, recently diagnosed epilepsy, siblings of the recent-onset epilepsy group, and non-neurological school children. After reviewing the cases obtained, 31 cases were deleted from the group of non-neurological school children due to missing responses to SAND-C items. This group did not significantly differ from the included cases on age ($t = -1.836, p = .08$, 2-tailed), or gender (chi-square = 3.201, $p = .07$, 2-tailed).

The final total sample was composed of 424 participants. Demographic characteristics of the final sample are presented in Table 1. The populations with epilepsy and the siblings of the recent-onset epilepsy group constituted a convenient sample generated by one of the author's ongoing projects. The purpose of including different populations was to increase the variability of the responses and to increase the sample size for factor analysis. Inspection of means and standard deviations in Table 1 indicates that gains made in variability were minimal. However, inclusion of the epilepsy and sibling groups helped increase sample size to over 400. For confirmatory factor analysis using structural equation modeling, it has been determined that samples of 200 yield more replicable solutions than smaller samples, and that samples of 400 or more yield the most stable factor structures (Boomsma, 1983; Francis, 1988). Three subgroups contributed to the sample.

Chronic and Recent-Onset Epilepsy Samples: This study utilized children who were completing standardized neuropsychological tests in conjunction with two larger studies of children with recent-onset and chronic epilepsy. Children and adolescents with chronic epilepsy (those who have had a confirmed diagnosis of epilepsy for a minimum of six months) were identified and recruited from outpatient pediatric clinics, pediatric neurology practices, and school nurses throughout Indiana. Neuropsychological testing was conducted on average 4 years after formal diagnosis. Participants with recently diagnosed epilepsy (those who have experienced their first diagnostic seizures) were identified and recruited from EEG laboratories, emergency rooms, and primary care physicians from central Indiana within six weeks of their first seizure, but neuropsychological testing was conducted on average 18 months after formal diagnosis. All participants with epilepsy were considered to be medically stable at the time of neuropsychological testing.

It should be noted that, while it would be of interest to include the effects of seizure types and the effects of anticonvulsant medications in later analyses, doing so was considered to be far beyond the scope of the current study. In addition, investigating these variables would require subdivision of samples that are already small. Consequently, the chronic and newly diagnosed epilepsy samples are presented as unitary entities, with the understanding that seizure types and medications used may be important sources of variability.

To be included in the study, all participants with epilepsy were required to have an IQ greater than 70 and have no history of other chronic illnesses. Families were offered compensation for participation in the study; parents gave informed consent and children gave informed assent.

Non-Neurological Samples: Siblings of the recently diagnosed epilepsy group were also included. They were required to have at least one biological parent in common with the child with epilepsy, live in the same home as the child with epilepsy, have no chronic health conditions, and be the sibling closest in age to the child with epilepsy.

In addition to the small group of healthy siblings, a much larger sample of 365 non-neurological school children was composed of students enrolled in mainstream education classes in Grades 4–12 in a rural public school system. A consent form that had been approved by the IUPUI Institutional Review Board (IRB) and the School Corporation Board of Trustees was distributed to parents. A cover letter accompanied the consent form introducing the study and investigators, and assuring the parents that the questionnaire was approved by the Board of Trustees and that it contained no questions regarding sensitive issues (e.g., sexual behavior or drug use).

In the two elementary schools, teachers in Grades 4–6 distributed the consent forms to students in their homeroom classes. In the Junior and Senior High School, teachers in the English department distributed consent forms to students in all sections. Teachers in the English department were selected because all students in Grades 7–11 are required to take English, and the majority of students in Grade 12 are enrolled in elective English courses. No compensation was offered for participation in the study.

Once consent forms were collected from students, teachers were asked to read the instructions aloud and administer the survey to all interested students within a classroom at a single time. The instructions explained the method for completing survey items, asked students to complete their questionnaires independently and urged them to not discuss the study with students in other classes, in order to minimize the possibility of students biasing others' responses to the survey items.

Data Analysis

Reliability Analyses: Two items on the SAND-C (Item 18 and Item 27) were deleted from all subsequent analyses due to concerns about their non-normal distribution. The deletion of these two items made intuitive sense as well, as both items reflect uncommon difficulties that would be applicable to a very narrow range of participants. A reliability analysis (Cronbach's coefficient alpha) was then performed for the total scale and the 6 subscales on the 45 remaining items of the SAND-C using SPSS (Version 8.0) statistical software.

Confirmatory Factor Analyses: A confirmatory factor analysis (CFA) was then performed using the LISREL-VIII computer program to determine whether the items on the questionnaire group fit into the six a priori factors.

Results

Reliability Analysis of the SAND-C—Using the survey data from the 424 participants, Cronbach's alpha was .88 for the total 45-item scale, demonstrating good homogeneity among the scale items. The alpha coefficients for the six individual subscales of the SAND-C were modest to moderate: .48 for psychomotor, .56 for attention, .62 for visual-spatial, .62 for executive functions, .68 for memory, and .70 for language.

No item was found to detract from alpha for the total scale by more than .006, and no item detracted from alpha for its respective subscale by more than .02. Pearson product-moment correlations between each item and the total scale were significant and positive. Most ranged between .23 and .52 ($p < .01$, one-tailed), four ranged between .22 and .18 ($p < .05$, one-tailed).

Confirmatory Factor Analyses of the SAND-C—The factor loadings generated by the CFA on the 6-factor model are presented in Table 2. As shown in Table 3, chi-square and goodness-of-fit indices did not offer strong support for the 6-factor model. Inspection of modification indices did not suggest the addition of any path between variables that would result in a substantial decrease in chi-square.

Post-hoc Analyses

Confirmatory Factor Analysis with One Latent Factor: Due to the lack of strong support for the 6-factor model, a second CFA was conducted with one latent variable specified for the 45 observed variables. This second CFA was conducted to determine if the generated goodness-of-fit indices favored a more parsimonious one-factor solution over the six-factor solution. A one-factor solution was considered as a possible alternative, given the modest alphas for the individual factor scales and high correlations among the six proposed factors (r ranged from .35 to .83, $p < .01$, one-tailed), with one exception ($r = .18$, $p > .10$, one-tailed).

Factor loadings for the 45 items on the one latent variable are presented alongside the factor loadings for the 6-factor solution in Table 2. Chi-square and goodness-of-fit statistics for the 1-factor solution are presented in Table 3.

The difference of the chi-square results (169.1, $df = 15$) between the 6- and the 1-factor solutions was significant ($p < .005$). However, the finding of significant differences between the chi-square values generated by the two solutions is to be expected, due to the magnitude of the chi-square values in this instance. Inspection of the goodness-of-fit indices (GFI) and root mean square residuals (RMSR), which are roughly equivalent for the two models, indicate that the 6-factor and 1-factor solutions are comparable. The GFI and RMSR are indicative of modest support of the proposed solutions.

Exploratory Factor Analyses: Due to the modest fit obtained via CFA, an exploratory factor analysis (EFA) was conducted to determine if the proposed factor structure would be supported when the variables were unconstrained, or if a meaningful alternate model would be suggested. To conduct the EFA, 212 of the 424 cases were randomly selected. Principal axis factoring (PAF) was then used as the method of factor extraction on this selected group (Gorsuch, 1983).

The number of factors was left unspecified. Eigenvalues over 1 were extracted. The scree plot of the items was used in addition to the eigenvalue ≥ 1 criterion as a general indicator of the number of factors to be specified (Gorsuch, 1983). Oblique rotation of the factors was selected as the rotation method of choice, because it allows for the underlying factors to be intercorrelated. Allowance for intercorrelations was considered to be desirable, due to the fact that individual neuropsychological measures tend to be highly inter-correlated (Ardila, Galeano, & Rosselli, 1998).

The five factors that emerged are presented in Table 4. Only items with loadings of .30 or greater (43 of the 45 items) were retained on individual factors (Gorsuch, 1983). Analysis of the factor content suggested the following labels: Factor 1, General Cognitive Functioning, was composed of 18 items that reflected a wide variety of cognitive domains, such as executive functioning, language, memory, and visual spatial skills. Factor 2, Attentional Functioning, was composed of 9 items that reflected attention dysfunction, such as difficulties with impulsivity, inattentiveness, memory difficulties, and restlessness (American Psychiatric Association, Diagnostic and Statistical Manual of Mental Disorders, 1994). Factor 3, Upper Extremity Motor Control, was composed of 3 items that reflect fine motor skills and control with the dominant hand. Factor 4, Visual-Spatial Perception/Processing/Memory, consisted of 7 items that centered primarily on visual perception and retention skills. Factor 5, Visual-Motor Functioning, consisted of 6 items that implied visual-motor integration. Items 6 and 28 did not demonstrate strong loadings ($< .30$, Gorsuch, 1983) with any factor, and were not included.

Cronbach's alpha was .88 for the total 43-item scale. Pearson product-moment correlations between each item and the total scale were positive and significant ($p < .05$, one-tailed). The alpha coefficients for the five individual subscales ranged from .57 for upper extremity motor

control to .82 for general cognitive functioning. No item detracted from alpha for the total scale by more than .002. Only one item detracted from alpha for its respective subscale by more than .002. Item 15 (“I am good at copying simple shapes without tracing”) detracted from the motor factor by more than .13. Deletion of Item 15 would increase the alpha coefficient for the upper extremity motor control subscale to .70; alpha for the total scale would remain essentially unchanged. Deletion of Item 15 should be considered if use of the 5-factor model is pursued in the future.

Confirmatory Factor Analysis with Five Latent Factors: To determine if the 5-factor solution generated from the EFA represented a replicable alternative to the proposed 6-factor model, a CFA was performed on the 212 participants that were not included in the EFA (Bryant & Yarnold, 1995). Although employing only half of the participants results in a sample size not considered optimal (Tabachnick & Fidell, 1996), $N = 212$ is within acceptable levels for conducting a CFA (Boomsma, 1983). The CFA of the 5 factor model resulted in a chi-square of 1442.0 ($df = 850, p < .01$), RMSR = .06, GFI = .75, Adjusted GFI = .73, and Parsimony GFI = .68. These results are comparable to the results of the 6-factor and 1-factor models discussed above, indicating no advantage of the 5-factor solution over the more parsimonious 1-factor model.

Exploratory Factor Analyses of Older and Younger Participants: Children have been shown to lack mastery of executive tasks, not approaching mastery of these tasks until approximately age 12 (Anderson, 1998; Passler, Isaac & Hynd, 1985). Because it was likely that developmental differences would exist between older and younger participants, the sample was divided into participants 12 years old and younger ($N = 148$), and those 14 and older ($N = 225$). The gap between ages was deemed desirable, to enable differences between the two groups to become more evident. EFA with PAF extraction and oblique rotation was conducted with each sample to determine if different factor structures emerged for the two groups. Demographic data for the younger and older groups are presented in Table 5.

Younger Children: The factors that emerged for younger children are presented in Table 6. The first factor consisted of 17 items that represented an assortment of cognitive functions, such as language, visual-spatial, psychomotor, memory, and executive functioning. The second factor consisted of 11 items reflecting attentional functioning, including attendant memory and coordination problems that are often seen in youths with attentional difficulties (DSM-IV, 1994). The third factor consisted of 6 items reflecting self-monitoring of behavior and performance, such as monitoring for mistakes, organizing activities, and focusing on one activity at a time.

Eleven items from the original 45-item scale (i.e., Item # 4, 6, 7, 14, 15, 19, 21, 23, 24, 39, 44) did not demonstrate strong loadings (i.e., .30 or greater, Gorsuch, 1983) with any factor, and were not included. Of the items that were deleted, 2 were originally conceived to be visual-spatial in nature, 2 executive, 1 attention, 2 memory, 2 motor, and 2 language.

Cronbach's alpha was .86 for the total 34-item scale. The alpha coefficients for the three individual subscales were .63 for self-monitoring, .75 for attentional functioning, and .83 for general cognitive functioning. No item was found to detract from alpha for the total scale by more than .001, and no item detracted from alpha for its respective subscale. Pearson product-moment correlations between each item and the total scale were significant and positive ($p < .05$, one-tailed) with the exception of one item (#33, “I say answers out loud before I am called on in class”). However, because Item #33 fits conceptually with the other attentional items on Factor 2, deletion of this item would not be recommended.

Older Children: The 6-factor solution for the EFA with older children is presented in Table 7. The first factor consisted of 9 items that appeared to reflect executive functions, such as problem solving, and attention functions, such as sustaining attention over time.

The second factor was composed of 5 items that suggested self-monitoring abilities, such as watching for mistakes, and impulsive behaviors, such as acting without thinking first. Factor 3 consisted of 6 items that suggested language functions, such as spelling and reading. The fourth factor consisted of 2 items that contained reference to fine motor control, specifically as it related to handwriting. Factor 5 was composed of 8 items that appeared to largely refer to memory and gross motor control. Factor 6 contained 6 items that suggested visual and motor functions, such as copying drawings, and remembering visual stimuli. Item 7 (“If I am asked to do something, I plan how I will do it before I start”), originally considered an executive item, may relate specifically to more visual tasks.

Nine items from the original 45-item scale (i.e., Item # 1, 3, 5, 9, 14, 20, 22, 28, 36) did not demonstrate strong loadings (i.e., .30 or greater, Gorsuch, 1983) with any factor, and were not included, leaving 36 items in the final scale. Of the items that were deleted, 4 were originally conceived to be visual-spatial in nature, 2 executive, 2 attention, and 1 language.

Cronbach’s alpha was .87 for the total 36-item scale. Alpha coefficients for the six individual subscales were .41 for self-monitoring/impulsivity, .68 for visual-motor, .73 for language, .74 for fine motor control, .76 for executive/attention, and .78 for memory and gross motor. No item was found to detract from alpha for the total scale by more than .001, and only one item detracted from alpha for its respective subscale by more than .008. That item was Item 19 (“I am good at physical sports”), which was found to detract from Factor 2 by .21. Conceptually, that item does not fit with the other items. Therefore, that item was deleted. Deletion of this item increased the alpha coefficient for the self-monitoring/impulsivity subscale to .62, but did not change the alpha for the total scale.

Pearson product-moment correlations between each item and the total scale were significant at $p < .01$ (one-tailed), with the exception of Items 26 and 44, which failed to reach significance ($p > .05$). Despite its nonsignificant factor loading with the total scale, Item 26 (“I have neat handwriting”) is one item composing a 2-item fine motor factor, and should be retained if the factor is to be retained. Additional motor control items may need to be added in the future, to increase the usefulness of the Motor Control factor. Item 44 (“Math is hard for me”) may reflect math reasoning in the high-school subsample; however, the nonsignificant item-total correlation and the fact that the item does not appear to directly assess executive or attentional functioning argues for possible deletion of the item in the future.

The model generated for older children explained a greater proportion of the total variance (33.95%) than did the model for younger children (22.9%), suggesting greater possible utility of the instrument with older children. Table 8 presents the means and standard deviations of the total 34 item scale for children ages 9–12, and of the total 35-item scale and 6 subscales for children 13 and older.

A CFA is needed to establish the stability of this factor structure for older children; however, a CFA could not be conducted, due to a lack of an additional sample of older children. The proposed 6-factor structure generated for older children by this EFA must be regarded as preliminary without further empirical and factor-analytic corroboration.

Discussion

The present study represents the first known empirical attempt at creating a self-report instrument that measures awareness of neuropsychological functions in children and adolescents.

As predicted, the 45-item SAND-C was found to possess good reliability, and its reliance on empirical theory and expert opinion provided evidence of content validation. However, a CFA yielded modest support for the 6-factor model initially proposed, favoring a more parsimonious 1-factor solution. An alternative model derived by EFA (5-factor) likewise offered little advantage over the 1-factor model. Further exploratory analyses raise the possibility that the instrument measures awareness in younger children differently than it does in older children, but this possibility should be regarded as tentative pending further research. Therefore, the results of this study indicate that a total score derived from all items of the SAND-C should be utilized as an overall measure of awareness. Use of the theorized subscales or of the factors identified for younger and older children should be considered provisional and be reserved for investigational applications until further validated. In particular, the current preliminary data suggest that the 34 items outlined above should be used for children 9 to 12 years of age. Use of individual subscales is not recommended for this age group. For older children, the 35 items detailed above should be used for the total scale. Tentatively, the subscales outlined above could be used for more detailed analyses.

The lack of strong support for the proposed 6-factor model may have occurred for a number of reasons. First, it may be that the items on the SAND-C may reflect the multidimensionality of real-world behaviors. Inspection of items reveals that many may contribute to more than one domain. For instance, Item 15 ("I am good at copying simple shapes without tracing"), originally conceived to be a visual-spatial item, has a strong motor component as well. This possibility was investigated by first conducting an EFA to produce an alternate 5-factor structure, then conducting a CFA using the alternate model. The new model failed to provide a factor structure that represented an improvement over the 6- or 1-factor solutions, however.

A second possible explanation for the unidimensionality of the SAND-C is that children, particularly younger children who have not fully mastered abstract abilities and executive functioning tasks, are not able to effectively discriminate between neuropsychological domains. Preliminary support for this possibility comes from the results of the EFA done with younger and older participants. The EFA with children 12 years old and younger resulted in a 3-factor solution that was relatively general in nature (i.e., yielding factors representative of general cognition, attention, and self-monitoring), and that did not easily lend itself to comparison with specific neuropsychological domains. The solution yielded for children 14 years old and older, however, revealed six factors (i.e., executive/attention, impulse control and carefulness, language, fine motor control, memory and gross motor, and visual-spatial functions) that were more easily classified into neuropsychological functional domains. It should be noted that these results are highly preliminary. The use of EFA capitalizes on variability that may be sample specific, and, therefore, a solution can be rendered unreplicable, particularly when small samples are used. In the present case, due to sample size limitations, a CFA with a large sample of children ages 14 and older could not be performed to determine if this factor structure was stable over different groups.

Given these limitations, it is of interest to note that different age groups produce different factor structures, and that the factor structure of the older group is more easily interpreted into neuropsychological domains, and is consistent with previous research showing an emergence of higher-level cognition over the course of development (e.g., Anderson, 1998, Flavell, Green, Flavell & Lin, 1999). In particular, our findings of differences between younger and older children are consistent with the theories of Piaget, which propose that late childhood/early

adolescence is the time when children begin to advance from mental operations centering on the perceptible aspects of objects and events (concrete operational thought) to the use of abstract reasoning and concept formation (formal operational thought; Piaget, 1952). In addition, our results parallel the findings from the metacognition literature that a child's understanding about cognition undergoes considerable development as he or she progresses through childhood and adolescence (Flavell, 1985). Because mental processes increase in complexity over time, the combination of older and younger children in one sample may have obscured the discovery of factors in the original CFA.

Finally, it is possible that our predominantly healthy sample was too homogeneous across functional domains. The a priori factor structure may be better supported in a more heterogeneous sample of children with a variety of neurological conditions and neuropsychological strengths and weaknesses.

Future research using the SAND-C should begin by using CFA to test the original 6-factor model with older and younger participants, respectively. The finding in the present study that the two age groups demonstrated different factor structures on an EFA may indicate that the original model demonstrates acceptable GFI when used with a population that is more homogenous with respect to age. In addition, the results from the EFA conducted in the present study suggested possible alternate factor solutions that may be useful in the formulation of future awareness of abilities measures. It may be that different age ranges or school grade levels require the construction of different awareness of deficits instruments. Although this would limit comparability between age groups, it may prove useful for comparisons between different clinical groups in the same age range. Further investigation of factor structures and their use in different age ranges will provide information regarding whether the measurement of awareness of deficits is useful in younger ages, even if only for select abilities (e.g., of abilities such as paying attention and monitoring their own behavior), or if awareness research is more appropriate for youth farther along in the development of executive functions.

Acknowledgments

This research was supported in part by an Epilepsy Foundation of America Behavioral Sciences Fellowship, and a Dissertation Research Award from the American Psychological Association. In addition, this study utilized samples of children who participated in two larger studies: a study of children with chronic epilepsy, funded by a grant from the National Institute of Nursing Research (Joan Austin, DNS, RN, Principal Investigator) and a study of children with recent-onset epilepsy, funded by grants from the National Institute of Neurological Disorders and Stroke (Joan Austin, DNS, RN, Principal Investigator) and from the Epilepsy Foundation of America (Philip S. Fastenau, Ph.D., HSPP, Principal Investigator). The authors would like to acknowledge Drs. Joan R. Austin, John H. McGrew, Lisa L. Conant, Kathy E. Johnson, and Daniel J. Venezia, Jr., for providing their expert appraisal on the content and format of the survey instrument.

References

- Aldenkamp AP, Alpherts WC, Blennow G, Elmqvist D, Heijbel J, Nilsson HL, Sandstedt P, Tonnby B, Wahlander L, Wosse E. Withdrawal of antiepileptic medication in children—effects on cognitive function: The multicenter Holmfrid study. *Neurology* 1993;43:41–50. [PubMed: 8423909]
- Allen C, Ruff R. Self-rating versus neuropsychological performance of moderate versus severe head-injured patients. *Brain Injury* 1990;4:7–17. [PubMed: 2297602]
- American Psychiatric Association. Diagnostic and statistical manual of mental disorders. Vol. 4. Washington, DC: Author; 1994.
- Anderson S, Tranel D. Awareness of disease states following cerebral infarction, dementia, and head trauma: Standardized assessment. *The Clinical Neuropsychologist* 1989;3:327–339.
- Anderson V. Assessing executive functions in children: Biological, psychological, and developmental considerations. *Neuropsychological Rehabilitation* 1998;8(3):319–349.

- Ardila A, Galeano L, Rosselli M. Toward a model of neuropsychological activity. *Neuropsychology Review* 1998;8(4):171–190. [PubMed: 9951709]
- Austin, J. K. (1997, Principal Investigator). *Epilepsy Outcomes In Youth: Neurological and Family Factors*. Grant funded by NIH/National Institute of Nursing Research (1 RO1 NR/OD04536–01)
- Austin JK, Huberty TJ, Huster GA, Dunn DW. Academic achievement in children with epilepsy or asthma. *Developmental Medicine and Child Neurology* 1998;40:248–255. [PubMed: 9593496]
- Austin JK, Huberty TJ, Huster GA, Dunn DW. Does academic achievement in children with epilepsy change over time? *Developmental Medicine and Child Neurology* 1999;41:473–479. [PubMed: 10454231]
- Austin JK, Risinger MW, Beckett LA. Correlates of behavior problems in children with epilepsy. *Epilepsia* 1992;33(6):1115–1122. [PubMed: 1464273]
- Baron, I.; Fennell, E.; Voeller, K. *Pediatric neuropsychology in the medical setting*. NY: Oxford University Press; 1995.
- Bergquist T, Jacket M. Awareness and goal setting with the traumatically brain injured. *Brain Injury* 1993;7:275–282. [PubMed: 8508184]
- Blum D, Eskola J, Bortz J, Fisher R. Patient awareness of seizures. *Neurology* 1996;47:260–264. [PubMed: 8710091]
- Boomsma, A. *On the robustness of LISREL against small sample size and non-normality*. Amsterdam: Sociometric Research Foundation; 1983.
- Broman, S.; Michel, M. *Traumatic head injury in children*. NY: Oxford University Press; 1995.
- Bryant, F.; Yarnold, P. Principal–components analysis and exploratory and confirmatory factor analysis. In: Grimm, LG.; Yarnold, PR., editors. *Reading and understanding multivariate statistics*. Washington, D.C: American Psychological Association; 1995. p. 99-137.
- Cohen, J.; Cohen, P. *Applied multiple regression/correlation analysis for the behavioral sciences*. Vol. 2. Hillsdale, NJ: Lawrence Erlbaum; 1983.
- Commission on Classification and Terminology of the International League Against Epilepsy. Proposal for revised clinical and electroencephalographic classification of epileptic seizures. *Epilepsia* 1981;22:489–501. [PubMed: 6790275]
- Deonna T. Annotation: Cognitive and behavioral correlates of epileptic activity in children. *Journal of Child Psychology and Psychiatry* 1993;34:611–620. [PubMed: 7688002]
- Deutsch G, Saykin A, Sperling M. Metamemory in temporal lobe epilepsy. *Assessment* 1996;3:255–263.
- Dodrill CB, Clemmons D. Use of neuropsychological tests to identify high school students with epilepsy who later demonstrate inadequate performances in life. *Journal of Consulting and Clinical Psychology* 1984;52:520–527. [PubMed: 6470277]
- Fastenau PS, Shen J, Dunn DW, Perkins SM, Hermann BP, Austin JK. Neuropsychological predictors of academic underachievement in pediatric epilepsy: Moderating roles of demographic, seizure, and psychosocial variables. *Epilepsia* 2004;45(10):1–12.
- Fastenau, PS.; Dunn, DW.; Austin, JK. Pediatric epilepsy. In: Rizzo, M.; Eslinger, PJ., editors. *Principles and practice of behavioral neurology and neuropsychology*. New York: Saunders/Churchill Livingstone/Mosby; 2004.
- Flavell, JH. *Cognitive development*. Vol. 2. Englewood Cliffs, N. J: Prentice-Hall; 1985.
- Flavell JH, Green FL, Flavell ER, Lin NT. Development of children's knowledge about unconsciousness. *Child Development* 1999;70:396–412. [PubMed: 10218262]
- Fordyce D, Roueche J. Changes in perspectives of disability among patients, staff, and relatives during rehabilitation of brain injury. *Rehabilitation Psychology* 1986;31:217–229.
- Francis D. An introduction to structural equation models. *Journal of Clinical and Experimental Neuropsychology* 1988;10:623–639. [PubMed: 3066797]
- Gorsuch, RL. *Factor analysis*. Vol. 2. Hillsdale, N.J: Lawrence Erlbaum Associates, Publishers; 1983.
- Hauser WA. The prevalence and incidence of convulsive disorders in children. *Epilepsia* 1994;25(Suppl 2):S1–S6. [PubMed: 8275976]
- Kail, RV.; Cavanaugh, JC. *Human development*. NY: Brooks/Cole; 1996.
- Kaszniak A, Zak M. On the neuropsychology of metamemory: Contributions from the study of amnesia and dementia. *Learning and Individual Differences* 1996;8:355–381.

- Kim W. Psychiatric aspects of epileptic children and adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry* 1991;30:874–886. [PubMed: 1757435]
- Lezak MD. Brain damage is a family affair. *Journal of Clinical and Experimental Neuropsychology* 1988;10(1):111–123. [PubMed: 3275687]
- Malec J, Moessner A. Self-awareness, distress, and postacute rehabilitation outcome. *Rehabilitation Psychology* 2000;45:227–241.
- Mesulam, MM. *Principles of behavioral neurology*. Vol. 2. Philadelphia: F. A. Davis; 2000.
- Newcombe, N. *Child development: Change over time*. Vol. 8. NY: Harper Collins; 1996.
- Passler M, Isaac W, Hynd G. Neuropsychological development of behavior attributed to frontal lobe functioning in children. *Developmental Neuropsychology* 1985;1(4):349–370.
- Piaget, J. *The origins of intelligence in children*. NY: International Universities Press; 1952.
- Piccirilli M, D'Alessandro P, Sciarma T, Cantoni C, Dioguardi M, Giuglietti M, Ibba A, Tiacchi C. Attention problems in epilepsy: Possible significance of the epileptogenic focus. *Epilepsia* 1994;35(5):1091–1096. [PubMed: 7925157]
- Prevey M, Delaney R, Mattson R. Metamemory in temporal lobe epilepsy: Self-monitoring of memory functions. *Brain and Cognition* 1988;7:298–311. [PubMed: 3401384]
- Prevey M, Delaney R, Mattson R, Tice D. Feeling-of-knowing in temporal lobe epilepsy: Monitoring knowledge inaccessible to conscious recall. *Cortex* 1991;27:81–92. [PubMed: 2055045]
- Prigatano, G.; Schacter, D. *Awareness of deficit after brain injury: Clinical and theoretical issues*. New York: Oxford University Press; 1991.
- Reitan, R.; Wolfson, D. *The Halstead-Reitan Neuropsychological Test Battery: Theory and clinical interpretation*. Vol. 2. Tucson, AZ: Neuropsychology Press; 1992.
- Reynolds, C.; Fletcher-Janzen, E. *Handbook of clinical child neuropsychology*. Vol. 2. New York: Plenum Press; 1997.
- Rourke, BP., editor. *Neuropsychological validation of learning disability subtypes*. New York: Guilford Press; 1991.
- Rourke, B.; Fisk, J.; Strang, J. *Neuropsychological assessment in children*. New York: Guilford Press; 1986.
- Seidenberg, M. Academic achievement and school performance of children with epilepsy. In: Hermann, BP.; Seidenberg, M., editors. *Childhood epilepsies: Neuropsychological, psychosocial and intervention aspects*. New York: John Wiley & Sons; 1989. p. 105-118.
- Spreen, O.; Risser, A.; Edgell, D. *Developmental neuropsychology*. New York: Oxford University Press; 1995.
- Tabachnick, BG.; Fidell, LS. *Using multivariate statistics*. Vol. 3. New York: Harper Collins College Publishers; 1996.

Appendix

Appendix

Directions

Below are some sentences that describe things that people do. Please read each sentence carefully. Then decide *how often* that sentence is true for you: *Almost never*, *Sometimes*, *A lot of the time*, or *Almost all of the time*. Circle the number under the answer that best describes what you think. There are no right or wrong answers. Just pick the answer that describes you the best. Try to answer every question.

EXAMPLES:

	Almost never	Some times	A lot of the time	Almost all of the time
A. I ride the bus to school.....	1	2	3	4

EXAMPLES:

	Almost never	Some times	A lot of the time	Almost all of the time
B. I listen carefully to my teacher.....	1	2	3	4

	Almost never	Some times	A lot of the time	Almost all of the time
1. I finish doing one thing before I start doing something else.....	1	2	3	4
2. When I make a mistake, I find it before someone else does.....	1	2	3	4
3. * When a picture is held upside down, I have trouble figuring out what it is.....	1	2	3	4
4. When I hear something 2 or 3 times, it really sticks in my mind.....	1	2	3	4
5. I am careful to check my work to make sure I did not make mistakes.....	1	2	3	4
6. * I drop things when I try to pick them up.....	1	2	3	4
7. If I am asked to do something, I plan how I will do it before I start.....	1	2	3	4
8. I can pay attention to one thing, even if other things are going on.....	1	2	3	4
9. When I am in a new place, I can tell which direction is north.....	1	2	3	4
10. * I forget things.....	1	2	3	4
11. I am good at finding my way around in new places.....	1	2	3	4
12. If I hear a story, I can remember it well later.....	1	2	3	4
13. I can learn things in class when I try my best.....	1	2	3	4
14. * It is hard for me to pay attention if I am bored.....	1	2	3	4
15. I am good at copying simple shapes without tracing.....	1	2	3	4
16. I can work fast with my hands.....	1	2	3	4
17. I am good at solving hard puzzles and brainteasers.....	1	2	3	4
18. * [†] I write some letters of the alphabet backwards.....	1	2	3	4
19. I am good at physical sports.	1	2	3	4
20. I understand what people are saying when they talk to me.....	1	2	3	4
21. * I forget what I am doing if I am interrupted.....	1	2	3	4
22. If half the pieces of a jigsaw puzzle were missing, I could still tell what the picture was.....	1	2	3	4
23. I am good at spelling words that I hear.....	1	2	3	4
24. I am good at games with lots of rules.....	1	2	3	4
25. When I read something out loud, I do not make mistakes.....	1	2	3	4
26. I have neat handwriting.....	1	2	3	4
27. * [†] I have trouble using a fork or a spoon.....	1	2	3	4
28. I am good at playing "Simon Says".....	1	2	3	4

	Almost never	Some times	A lot of the time	Almost all of the time
29. When I see a word I do not know, I can still sound it out.....	1	2	3	4
30. I can think of more than one way to solve a problem.....	1	2	3	4
31. When I look at two containers, I can tell which one would hold more.....	1	2	3	4
32. * I have trouble sitting still.....	1	2	3	4
33. * I say answers out loud before I am called on in class.....	1	2	3	4
34. If I see a picture once, I remember what it looks like later.....	1	2	3	4
35. I write numbers and letters well.....	1	2	3	4
36. I have good aim.....	1	2	3	4
37. * I have trouble finding where I put things, like my assignments for school.....	1	2	3	4
38. I can pay close attention to something for a long time.....	1	2	3	4
39. * I read very slowly.....	1	2	3	4
40. I understand what I read.....	1	2	3	4
41. * I have trouble thinking of words I want to say.....	1	2	3	4
42. * I have to be reminded of things.....	1	2	3	4
43. * I say or do things without thinking first.....	1	2	3	4
44. * Math is hard for me.....	1	2	3	4
45. * It is hard to remember things from one week to the next.....	1	2	3	4
46. * I am clumsy.....	1	2	3	4
47. I can look at a model of a building, and copy it with blocks.....	1	2	3	4

* Note: reverse scored item.

† Items 18 and 27 were dropped from the Total Scale score and subscale scores after initial analyses. These items should not be included when computing a Total Scale score.

Table 1

Sample Characteristics

Variable	Group				
	Non-Neuro. ^a	Chronic ^b	Recent-onset ^c	Sib. ^d	Total Sample
<i>N</i>	365	30	18	11	424
Age					
<i>M</i>	14.2	12.5	11.2	13.8	13.9
(<i>SD</i>)	(2.6)	(1.9)	(1.9)	(3.5)	(2.6)
Range	9.0–19.0	9.2–15.5	8.5–15.8	8.3–19.5	8.3–19.5
% Female	61.4	40.0	44.4	36.4	58.5
Ethnicity (%)					
Caucasian	90.1	90.0	100	90.9	90.6
African-Amer.	0.3	6.7	0.0	9.1	0.9
Multi-ethnic ^e	5.5	3.3	0.0	0.0	5.0
Other	3.8	0.0	0.0	0.0	3.3
Missing	0.3	0.0	0.0	0.0	0.2
SAND-C Total ^f					
<i>M</i>	2.94	2.75	2.93	2.91	2.92
(<i>SD</i>)	(.35)	(.30)	(.46)	(.27)	(.35)

Note:

^aNote: Non-neurological school children.

^bChildren and adolescents with chronic epilepsy.

^cChildren and adolescents with recent-onset epilepsy.

^dNon-neurological siblings of the recent-onset epilepsy group.

^ePercent of participants reporting membership in more than one ethnic group.

^fSAND-C Total scores are based on all 47 items in the Appendix.

Table 2
Confirmatory Factor Analysis Results: Factor Loadings for One- and Six Latent Variable Solutions (N = 424)

Item	Six Factor Model						One Factor Model
	<i>Mem.^a</i>	<i>Att.^b</i>	<i>Mot.^c</i>	<i>Vis.^d</i>	<i>Exec.^e</i>	<i>Lang.^f</i>	
4	<u>.32</u>	.19	.18	.20	.30	.27	.31
10	<u>.36</u>	.32	.29	.25	.26	.30	.31
12	<u>.44</u>	.20	.14	.27	.37	.46	.45
13	<u>.26</u>	.30	.20	.19	.35	.28	.26
21	<u>.30</u>	.28	.14	.13	.20	.26	.26
34	<u>.42</u>	.24	.31	.49	.35	.36	.43
37	<u>.30</u>	.29	.21	.08	.22	.20	.25
42	<u>.38</u>	.34	.33	.17	.21	.30	.30
45	<u>.44</u>	.29	.32	.35	.30	.39	.39
1	.28	.33	.28	.25	.34	.20	.29
8	.45	<u>.54</u>	.60	.35	.40	.44	.52
14	.24	<u>.34</u>	.15	.11	.26	.12	.24
32	.23	<u>.37</u>	.21	.13	.29	.16	.29
38	.34	<u>.49</u>	.16	.30	.47	.29	.42
6	.21	.15	<u>.27</u>	.15	.15	.22	.23
16	.28	.17	<u>.43</u>	.46	.34	.32	.39
19	.14	.07	<u>.26</u>	.30	.08	.12	.20
26	.12	.17	<u>.24</u>	.06	.14	.20	.20
35	.31	.26	<u>.39</u>	.26	.27	.35	.35
46	.37	.35	<u>.37</u>	.22	.28	.18	.32
3	.25	.11	.13	<u>.23</u>	.14	.23	.23
9	.19	.24	.19	<u>.41</u>	.27	.12	.33
11	.26	.16	.17	<u>.40</u>	.30	.17	.32
15	.10	.17	.27	<u>.33</u>	.24	.20	.28
22	.28	.15	.16	<u>.37</u>	.25	.29	.34
31	.31	.22	.31	<u>.43</u>	.34	.33	.38
36	.28	.18	.39	<u>.45</u>	.29	.31	.38
44	.18	.23	.16	<u>.23</u>	.22	.04	.21

Six Factor Model

Item	Mem. ^a	Att. ^b	Mot. ^c	Vis. ^d	Exec. ^e	Lang. ^f	One Factor Model
47	.21	.18	.23	<u>.47</u>	.28	.19	.36
2	.20	.29	.16	.17	<u>.24</u>	.29	.23
5	.31	.37	.25	.21	<u>.33</u>	.27	.32
7	.16	.16	.08	.22	<u>.27</u>	.15	.24
17	.31	.29	.22	.44	<u>.59</u>	.33	.47
24	.34	.32	.18	.35	<u>.42</u>	.34	.40
28	.28	.22	.26	.30	<u>.33</u>	.32	.34
30	.36	.29	.24	.47	<u>.52</u>	.40	.48
33	.17	.30	.11	.02	<u>.15</u>	.09	.15
43	.27	.38	.24	.09	<u>.23</u>	.22	.24
20	.40	.25	.37	.31	.38	<u>.40</u>	.38
23	.20	.12	.24	.16	.22	<u>.33</u>	.29
25	.29	.27	.18	.20	.24	<u>.33</u>	.31
29	.38	.20	.27	.34	.41	<u>.50</u>	.45
39	.32	.18	.18	.14	.23	<u>.42</u>	.34
40	.48	.33	.22	.31	.46	<u>.58</u>	.52
41	.47	.33	.36	.29	.32	<u>.35</u>	.34

Note:

^aNote: Memory Factor.^bAttention Factor.^cPsychomotor Factor.^dVisual Spatial Factor.^eExecutive Functioning Factor.^fLanguage Factor. Underlining indicates proposed factor loading for the 6-factor model.

Table 3
Confirmatory Factor Analysis Results for 6-Factor and 1-Factor Models (N = 424)

Solution	Chi-Square	df ^a	RMSR ^b	GFI ^c	AGFI ^d	PGFI ^e
6-Factor	2174.6 [*]	930	0.05	0.79	0.77	0.71
1-Factor	2343.7 [*]	945	0.05	0.77	0.75	0.70

Note:

- ^aNote: Degrees of freedom.
- ^bRoot Mean Square Residual.
- ^cGoodness-of-fit index.
- ^dAdjusted Goodness-of-fit index.
- ^eParsimony Goodness-of-fit index.
- ^{*} $p < .01$.

Table 4
Exploratory Factor Analysis, Principal Axis Factoring with Oblique Rotation (With the Highest Factor Loading for Each Item Underlined)
(N = 212)

	1	2	3	4	5
Factor 1: General Cognitive Functioning.					
2. When I make a mistake, I find it	<u>.45</u>	.12	.01	.04	.06
4. When I hear something it sticks in my mind	<u>.36</u>	.05	.05	-.10	.14
5. I am careful to check my work	<u>.41</u>	.20	.22	.09	-.02
7. If I am asked to do something, I plan how	<u>.31</u>	.01	-.11	-.06	.04
8. I can pay attention to one thing	<u>.36</u>	.25	.05	-.19	.10
12. If I hear a story, I can remember it well	<u>.53</u>	-.10	.06	-.21	-.18
13. I can learn things in class when I try	<u>.42</u>	.12	-.00	.06	.02
17. I am good at solving hard puzzles	<u>.36</u>	.07	.03	-.07	.29
20. I understand what people are saying	<u>.31</u>	.02	.15	<u>-.31</u>	.05
23. I am good at spelling words that I hear	<u>.42</u>	-.08	.07	.05	-.14
24. I am good at games with lots of rules	<u>.46</u>	.07	-.06	-.01	.21
25. When I read aloud, I do not make mistakes	<u>.32</u>	.03	.07	-.18	-.19
29. I can sound out words I do not know	<u>.43</u>	-.10	.08	-.27	-.04
30. Can think of >1 way to solve a problem	<u>.63</u>	-.09	.01	-.07	.02
31. Can tell which of 2 containers holds more	<u>.32</u>	-.03	.06	-.17	.19
38. I can pay close attention for a long time	<u>.57</u>	.19	.02	.13	.05
40. I understand what I read	<u>.55</u>	-.03	.11	-.23	-.12
47. Can copy a building model with blocks	<u>.30</u>	-.08	-.03	-.12	.21
Factor 2: Attentional Functioning.					
1. I finish one thing before I start another	.19	<u>.36</u>	.11	.02	.16
10. I forget things	.02	<u>.40</u>	-.15	-.34	.13
14. It is hard to pay attention if I am bored.	.11	<u>.44</u>	.15	.02	-.07
32. I have trouble sitting still.	.07	<u>.56</u>	.08	-.08	-.03
33. I say answers before I am called on	-.02	<u>.38</u>	.14	.03	-.10
37. I have trouble finding where I put things	-.01	<u>.44</u>	-.02	-.15	.13
42. I have to be reminded of things	-.11	<u>.40</u>	.06	-.38	.12
43. I say or do things without thinking first	.18	<u>.53</u>	-.01	.06	-.13
46. I am clumsy	.13	<u>.42</u>	-.17	-.20	.26

	1	2	3	4	5
Factor 3: Upper Extremity Motor Control.					
15. I am good at copying without tracing	.13	-.06	<u>.32</u>	-.14	.18
26. I have neat handwriting	-.10	.14	<u>.72</u>	.12	-.00
35. I write numbers and letters well	-.08	.10	<u>.70</u>	-.20	.10
Factor 4: Visual-Spatial Perception/Processing/Memory					
3. When a picture is upside down, I have trouble	.04	-.14	-.00	<u>-.48</u>	-.00
21. I forget what I am doing if interrupted.	.04	.15	-.05	<u>-.53</u>	-.07
22. If half a jigsaw puzzle were missing, I could	.17	-.15	.12	<u>-.32</u>	.19
34. If I see a picture once, I remember it later.	.24	-.14	.11	<u>-.32</u>	.21
39. I read very slowly.	.20	-.06	.08	<u>-.40</u>	-.34
41. I have trouble thinking of words I want	-.04	.18	.11	<u>-.56</u>	.02
45. It is hard to remember things from one week	-.10	.20	.07	<u>-.54</u>	.15
Factor 5: Visual-Motor Functioning.					
9. In a new place, I can tell which direction is north.	.27	.09	-.08	-.03	<u>.31</u>
11. I am good at finding my way in new places.	.31	-.09	-.15	-.11	<u>.31</u>
16. I can work fast with my hands.	<u>.35</u>	-.08	-.07	-.00	<u>.33</u>
19. I am good at physical sports.	-.02	-.06	-.09	-.01	<u>.44</u>
36. I have good aim.	.21	-.17	-.08	-.13	<u>.42</u>
44. Math is hard for me.	-.07	.18	-.08	.00	<u>.41</u>
Eigenvalues	7.82	2.10	1.44	1.14	1.05
Proportion of Variance Explained	17.39	4.68	3.22	2.54	2.34

Table 5
Description of the Sample Used in Exploratory Factor Analyses

Variable	Group				Total Sample
	Non-Neuro. ^a	Chronic ^b	Recent-onset ^c	Sib. ^d	
Age < 12 years					
<i>N</i>	120	11	13	4	148
Age					
<i>M</i>	11.2	10.3	10.3	10.2	11.0
(<i>SD</i>)	(0.9)	(0.8)	(1.1)	(1.5)	(1.0)
Range	9.0–12.0	9.2–11.8	8.5–11.4	8.3–11.8	8.3–12.0
% Female	63.3	27.3	38.5	75.0	58.8
Ethnicity (%)					
Caucasian	86.7	81.8	100	75.0	87.2
African-Amer.	0.0	9.1	0.0	25.0	1.4
Multi-ethnic ^e	8.3	9.1	0.0	0.0	7.4
Other	4.1	0.0	0.0	0.0	3.4
Missing	0.8	0.0	0.0	0.0	0.7
SAND-C Total ^f					
<i>M</i>	2.95	2.78	2.92	2.80	2.93
(<i>SD</i>)	(.33)	(.36)	(.53)	(.07)	(.35)
Age > 14 years					
<i>N</i>	211	8	1	5	225
Age					
<i>M</i>	16.1	14.7	15.8	16.9	16.0
(<i>SD</i>)	(1.3)	(0.4)	(0.0)	(1.8)	(1.4)
Range	14.0–19.0	14.3–15.5	–	15.0–19.5	14.0–19.5
% Female	59.2	50.0	100	0.0	57.8
Ethnicity (%)					
Caucasian	91.9	87.5	100	100	92.0
African-Amer.	0.0	12.5	0.0	0.0	0.4
Multi-ethnic ^e	4.3	0.0	0.0	0.0	4.0
Other	3.8	0.0	0.0	0.0	3.5

Variable	Group			
	Non-Neuro. ^a	Chronic ^b	Recent-onset ^c	Sib. ^d
SAND-C Total ^f				
<i>M</i>	2.91	2.67	2.78	3.11
<i>(SD)</i>	(.35)	(.28)	–	(.28)
Total Sample				
				2.91 (.35)
Note:				
^a — = no data available Non-neurological group.				
^b Chronic epilepsy group.				
^c Recent-onset epilepsy group.				
^d Non-neurological siblings of the recent-onset epilepsy group.				
^e Percentage of respondents who reported membership in more than one ethnic group.				
^f SAND-C Total scores are based on all 47 items in the Appendix.				

Table 6
Exploratory Factor Analysis, Principal Axis Factoring Extraction with Oblique Rotation (With the Highest Factor Loading for Each Item Underlined) for Participants Age < 12 (N = 148)

	1	2	3
Factor 1: General Cognition			
3. When a picture is upside down, I have trouble	<u>.37</u>	-.06	-.12
11. I am good at finding my way around new places	<u>.49</u>	-.18	.08
12. If I hear a story, I can remember it well	<u>.35</u>	.01	.22
16. I can work fast with my hands	<u>.40</u>	.15	.21
17. I am good at solving hard puzzles	<u>.42</u>	-.06	.14
20. I understand what people are saying	<u>.36</u>	.37	.06
22. If half a jigsaw puzzle were missing, I could	<u>.50</u>	.02	.00
28. I am good at playing "Simon Says"	<u>.57</u>	.14	-.14
29. I can sound out words I do not know	<u>.56</u>	.11	-.06
30. Can think of >1 way to solve a problem	<u>.46</u>	-.09	.30
31. Can tell which of 2 containers holds more	<u>.34</u>	-.04	.25
34. If I see a picture once, I remember it later	<u>.31</u>	-.03	.26
36. I have good aim	<u>.53</u>	-.16	.16
40. I understand what I read	<u>.42</u>	.20	.23
41. I have trouble thinking of words I want	<u>.41</u>	.35	-.17
45. It is hard to remember things from one week	<u>.32</u>	.28	-.06
47. Can copy a building model with blocks	<u>.42</u>	-.28	.18
Factor 2: Attentional Functioning			
8. I can pay attention to one thing	.09	<u>.43</u>	.29
10. I forget things	.08	<u>.44</u>	.24
13. I can learn things in class when I try	-.11	<u>.39</u>	.23
26. I have neat handwriting	.02	<u>.36</u>	-.02
32. I have trouble sitting still	.00	<u>.39</u>	.06
33. I say answers before I am called on	-.18	<u>.51</u>	-.02
35. I write numbers and letters well	.21	<u>.51</u>	-.08
37. I have trouble finding where I put things	.01	<u>.43</u>	-.08
42. I have to be reminded of things	.19	<u>.49</u>	.05
43. I say or do things without thinking first	-.03	<u>.39</u>	.12
46. I am clumsy	.07	<u>.58</u>	-.03
Factor 3: Self-Monitoring of Behavior and Performance			
1. I finish one thing before I start another	.09	.15	<u>.47</u>
2. When I make a mistake, I find it	-.10	.02	<u>.41</u>
5. I am careful to check my work	.01	.20	<u>.52</u>
9. In a new place, I can tell which direction is north	.03	-.13	<u>.45</u>
25. When I read aloud, I do not make mistakes	.03	.07	<u>.43</u>
38. I can pay close attention for a long time	.03	.19	<u>.47</u>
Eigenvalues	6.62	2.33	1.37
Proportion of Variance Explained	14.70	5.18	3.04

	1	2	3

Table 7

Exploratory Factor Analysis, Principal Axis Factoring Extraction with Oblique Rotation (With the Highest Factor Loading for Each Item Underlined) for Participants Age > 14 (N = 225).

	1	2	3	4	5	6
Factor 1: Executive/Attention						
4. When I hear something it sticks in my mind	<u>.37</u>	.10	-.07	-.03	.12	-.03
8. I can pay attention to one thing	<u>.37</u>	-.04	-.26	.14	-.15	.02
11. I am good at finding my way in new places	<u>.37</u>	-.25	.10	.04	-.11	-.18
13. I can learn things in class when I try	<u>.56</u>	.05	-.15	-.03	.08	.03
17. I am good at solving hard puzzles	<u>.51</u>	.01	-.16	-.11	.00	-.23
24. I am good at games with lots of rules	<u>.50</u>	-.24	.21	-.01	-.10	-.05
30. Can think of >1 way to solve a problem	<u>.43</u>	.05	-.23	-.12	-.02	-.27
38. I can pay close attention for a long time	<u>.46</u>	.29	-.07	.02	.02	-.08
44. Math is hard for me	<u>.43</u>	.06	.30	.05	-.08	.05
Factor 2: Impulse Control/Carefulness						
2. When I make a mistake, I find it	.22	<u>.30</u>	-.17	.06	.04	-.08
(19. I am good at physical sports.) ^a	.12	<u>-.46</u>	.10	.18	-.22	-.05
32. I have trouble sitting still	.02	<u>.49</u>	.08	.10	-.32	-.00
33. I say answers before I am called on	.03	<u>.44</u>	-.04	.06	-.07	-.03
43. I say or do things without thinking first	.04	<u>.51</u>	.05	.08	-.32	.04
Factor 3: Language Functions						
12. If I hear a story, I can remember it well	.14	-.04	<u>-.54</u>	-.09	-.06	-.10
23. I am good at spelling words that I hear	.12	-.05	<u>-.37</u>	.22	-.05	.05
25. When I read aloud, I do not make mistakes	-.04	-.00	<u>-.33</u>	.16	-.07	-.07
29. I can sound out words I do not know	.23	-.01	<u>-.43</u>	.16	-.03	.11
39. I read very slowly	-.07	.04	<u>-.63</u>	.10	-.18	.08
40. I understand what I read	.23	.12	<u>-.62</u>	.09	-.05	-.07
Factor 4: Fine Motor Control						
26. I have neat handwriting	-.09	.02	-.05	<u>.85</u>	.09	.15
35. I write numbers and letters well	-.11	.01	-.10	<u>.67</u>	-.06	-.16
Factor 5: Memory and Gross Motor Functions						
6. I drop things when I try to pick them up	-.19	.07	-.06	-.04	<u>-.33</u>	-.28
10. I forget things	.01	-.02	-.01	-.07	<u>-.68</u>	-.06

	1	2	3	4	5	6
21. I forget what I am doing if interrupted	.10	-.05	-.14	-.11	<u>-.55</u>	-.03
37. I have trouble finding where I put things	.04	.12	-.07	.09	<u>-.37</u>	.06
41. I have trouble thinking of words I want	.04	.15	-.17	.10	<u>-.42</u>	-.18
42. I have to be reminded of things	.06	-.08	-.12	.13	<u>-.66</u>	.19
45. It is hard to remember things from one week	.10	-.04	-.10	.20	<u>-.52</u>	-.05
46. I am clumsy	-.02	.15	.18	-.02	<u>-.49</u>	-.27
Factor 6: Visual-Spatial Functions						
7. If I am asked to do something, I plan how	.15	.14	-.02	-.16	-.02	<u>-.33</u>
15. I am good at copying without tracing	-.09	.20	-.03	.26	.26	<u>-.53</u>
16. I can work fast with my hands	.15	-.02	.10	-.05	.19	<u>-.61</u>
31. Can tell which of 2 containers holds more	.01	-.03	-.07	.03	-.19	<u>-.45</u>
34. If I see a picture once, I remember it later	.03	-.18	-.19	.05	-.18	<u>-.47</u>
47. Can copy a building model with blocks	.01	-.06	-.03	-.08	-.07	<u>-.56</u>
Eigenvalues	7.72	2.03	1.72	1.5	1.27	1.00
Proportion of Variance Explained	17.2	4.50	3.82	3.41	2.81	2.21

^aIn the application of this instrument, Item 19 should be excluded.

Table 8

Means and Standard Deviations for SAND-C Total Scale and Subscales By Age Group

	Age Group		
	9–12 years (N = 144)	13–15 years (N = 141)	16–19 years (N = 118)
Total Scale	2.93 ^a (.37)	2.92 ^b (.36)	3.00 ^b (.37)
Subscales:			
1. Executive/Attention (items 4, 8, 11, 13, 17, 24, 30, 38, 44)	— ^c	2.85 (.51)	2.94 (.50)
2. Impulse Control/Carefulness (items 2, 32, 33, 43)	— ^c	2.86 (.55)	2.82 (.61)
3. Language Functions (items 12, 23, 25, 29, 39, 40)	— ^c	2.95 (.56)	3.07 (.55)
4. Fine Motor Control (items 26, 35)	— ^c	2.93 (.86)	2.94 (.87)
5. Memory and Gross Motor Functions (items 6, 10, 21, 37, 41, 42, 45, 46)	— ^c	3.20 (.43)	3.23 (.51)
6. Visual-Spatial Functions (items 7, 15, 16, 31, 34, 47)	— ^c	2.68 (.524)	2.84 (.575)

Note: — = no data available.

^aTotal SAND-C for subjects ages 9–12 consisted of the following items: 1, 2, 3, 5, 8, 9, 10, 11, 12, 13, 16, 17, 20, 22, 25, 26, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 45, 46, 47.

^bTotal SAND-C for subjects ages 13 and older consisted of the following items: 2, 4, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17, 21, 23, 24, 25, 26, 29, 30, 31, 32, 33, 34, 35, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47.

^cFor 9–12 year olds, the SAND-C is best regarded as a unidimensional scale; subscale scores do not appear to be valid in this group.