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The Effect of Temperament and Neuropsychological Functioning on Behavior Problems in Children with New-Onset Seizures

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Abstract

The present study is part of a larger project that seeks to identify factors that predict children's behavioral, social, and cognitive adaptation to epilepsy. Children with seizures are more likely to have internalizing and externalizing behavior problems than either healthy children or children with other chronic illnesses. The present research examines risk factors for behavior problems. Early temperament and neuropsychological functioning, specifically executive function and language abilities, are evaluated as unique and moderating predictors of adverse behavioral outcomes in 229 children with a first recognized seizure. Parents assessed temperament, children were administered neuropsychological tests, and teachers evaluated behavior 36 months after seizure onset. Results revealed that early temperament and neuropsychological functioning, specifically executive function, predicted behavioral outcomes three years after seizure onset.

Keywords

epilepsy; seizures; behavior; child; new-onset; executive function; temperament

Epilepsy is one of the most common neurological disorders in childhood and is associated with an increased risk for problems with adjustment, including behavioral and cognitive deficits [1,2]. Children with seizures are nearly five times more likely to have behavior problems than control children and they have more behavior problems than children with other chronic conditions that do not involve the central nervous system [3-6]. This increased risk has been shown to precede the first recognized seizure [7,8]. Children with epilepsy tend to have more attention and internalizing behavior problems than externalizing problems [9-11].

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Temperament refers to early-appearing, biologically based characteristic patterns of emotional reactivity and self-regulation [12]. Specific temperamental factors have been shown to be risk factors for internalizing and externalizing problems both in healthy children and in children with seizures [13-16]. In an earlier study of the present sample of children with new-onset seizures, 72.6% of whom have epilepsy, we showed that retrospectively-assessed infant temperamental characteristics, such as difficultness (negative emotionality), unadaptability (negative reaction to novelty), and resistance to control (unmanageability) were related to both total and internalizing behavior problems, whereas only difficultness and resistance to control were associated with externalizing behaviors [14]. Although temperament was shown to be predictive of behavior at the time of seizure onset, it is unclear whether it remains predictive years after seizures have developed.

Children who have a chronic illness not involving the brain have less adaptive temperaments than healthy children [17]. Recent research has described the distinctive temperament and character patterns of children with epilepsy, including higher harm avoidance, and lower persistence, self-directedness, and cooperativeness than healthy age- and sex-matched controls [18]. Seizure type had the greatest influence on temperament, with children with generalized seizures having higher scores on self-directedness, cooperativeness, and self-transcendence. The existing research describing temperament in populations with chronic conditions has not addressed how the onset of a child's chronic illness may affect the child's temperament, or the parent's perception of the child's temperament.

Temperament components, such as effortful control, serve as an early reactive mechanism of controlling behavior [19]. As a child ages, this more reflexive means of control is affected by cortical development and increase in cognitive control capacities. Research has explored the relationship between self-regulatory behaviors that are related to temperament, such as effortful control, and those identified through neurocognitive models, such as attention and executive abilities [20,21]. The development of executive skills is impacted by effortful control. Dysfunction in these cognitive control and attention abilities is implicated in the development of negative behavioral outcomes such as clinically significant attention problems and delinquent behaviors [22,23].

Although neuropsychological deficits in children with epilepsy have long been recognized [8,24], recent research has sought to identify risk factors for neuropsychological dysfunction at the time of seizure onset. Using the sample of children from the present study, Fastenau et al. [25] identified multiple risk factors including recurring seizures, use of AEDs, a symptomatic/cryptogenic seizure type, and EEG abnormality. Compared to sibling controls, children with a new-onset seizure performed more poorly in all areas of neuropsychological functioning [25].

Executive functioning (EF) is a neuropsychological construct that refers to attention and behavioral control, among other cognitive capacities [26]. Children with seizures, including those with recent onset seizures, score significantly lower than controls on nearly all measures of EF [6,27] and were rated by parents as having more EF problems [6]. Poor performance on EF tasks was related to 1) overall cognitive functioning, 2) depressive symptoms, and 3) seizure variables, including seizure syndrome, age at onset, and AED treatment [27]. Even after accounting for overall cognitive functioning, children with seizures still had lower EF abilities [27]. This reduced cognitive ability may be related to poor behavioral outcomes. In a study of female adolescents with conduct problems, their EF mediated the relationship between temperament and aggressive behaviors; the combination of a difficult temperament and low executive functioning was strongly related to aggressive behaviors [28], supporting a potential moderating effect of neuropsychological functioning on temperament and behavior. Development of age-appropriate cognitive abilities,

especially those that serve a self-regulatory function such as EF, may lessen the behavioral risk associated with negative temperaments.

Other neuropsychological constructs, such as language, may also play a role in the development of behavioral difficulties. Children with identified language impairments have a higher rate of behavioral and attention difficulties than children without these deficits [29]. In addition, children with complex partial seizures who had poorer verbal abilities also had more behavior problems [30]. Matheny [31] argued that children with specific temperaments may be more vulnerable to language impairments, thus affecting cognitive development in the area of verbal intelligence, and ultimately behavior. In a model proposed by Austin and Caplan [32], individual deficits in cognitive and linguistic abilities, along with epilepsy and family factors, have both direct and indirect effects on behavioral outcomes.

The present study has two aims: 1) to investigate the unique contributions of retrospectively-assessed infant temperament and neuropsychological functioning assessed at seizure onset, specifically executive abilities and language, on behavior problems three years after the onset of seizures, and 2) to investigate the potentially moderating effect of neuropsychological functioning on the infant temperament-behavior relationship. Although other neuropsychological domains may contribute to later behavior problems, previous research suggests that the two constructs of executive functioning and language are likely to be the most predictive. It is hypothesized that more negative temperaments and lower neuropsychological functioning scores will be associated with more behavior problems. It is also hypothesized that the negative impact of an early negative temperament on later behavior problems is either enhanced when a child obtains low scores on tests of language and EF, or reduced when the child has high language and EF test scores.

Method

Participants

Children between the ages of 6 and 14 ($M = 9.5$ years, $SD = 2.6$) with a first recognized seizure were recruited as part of a three-year longitudinal study to identify factors that predict children's behavioral, social, and cognitive adaptation to epilepsy. The 350 children in the larger study were recruited from child neurology clinics in Cincinnati and Indianapolis (68.9%), from private neurologists in the community (10.5%), and through referrals from school nurses (20.6%). Children were excluded if their seizure was associated with a recent head injury, malignant brain tumor, toxic or metabolic condition, meningitis, or encephalitis. Additional exclusion criteria were: prior antiepileptic medication; complex febrile seizures; and other chronic health problem requiring long-term care. The IQ estimates in the larger study sample covered a broad range spanning from mild deficiency to the superior range with a mean and median that fall in the middle of the average range, which has been observed in other studies [2]. Children who were judged to be mentally handicapped (based on available IQ score < 80 or on placement in a full-time special education program) were excluded from this study's sample. Of the original 350 children in the large cohort, 264 (75.4%) were eligible for the current analysis by meeting the intellectual criteria and completing the 36-month behavioral measure. Of these 264, 229 (86.7%) were included in the sample for the present study because they had participated in the baseline neuropsychological assessment and completed the temperament measure, as well as the 36-month interview and behavioral assessment.

Parents of the participants had a mean of 14.1 years of education with a range of 9-20 years. The sample represents many seizure types, with 89.5% of children having only one seizure type. Eighty-nine percent of the selected sample had an MRI of the brain within six months

of their first recognized seizure (FRS). Of those, fewer than 15% had significant MRI abnormalities. Additional demographic and seizure data are presented in Table 1.

Clinical and neuropsychological data were collected at baseline, which was within three months of the FRS, and at 18- and 36-months following the FRS. In an initial clinical interview at baseline, the primary caregiver (94.0% of whom were mothers) completed a set of questionnaires about current behavioral functioning, mood, emotional regulation, and retrospective infant temperament. They also provided the neurodevelopmental health history, and seizure history of their child. Interviews were also conducted every nine months after baseline to gather seizure and behavior information from primary caregivers. All medical records pertinent to the child's seizures and treatment were obtained after signed release of information was obtained from the parent. Informed consent was obtained from the primary caregiver of each participant, and assent was obtained from each child. Permission to contact the child's teacher was also obtained from each child's primary caregiver. The study was approved by the Institutional Review Boards of both Cincinnati Children's Hospital Medical Center and Indiana University-Purdue University Indianapolis, and is therefore, in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

Measures

Infant Temperament—During the initial clinical interview, the child's primary caregiver completed the Infant Characteristics Questionnaire – Retrospective Form (RICQ) to rate, retrospectively, the child's early temperament [33]. The RICQ is a shorter, retrospective version of the ICQ, which is a widely used parent-perception instrument [13]. The RICQ is a brief measure that consists of 16 items related to early temperament. These items are rated using 7-point Likert-type rating scales, with higher scores reflecting more negative temperaments. Three subscale scores are obtained: difficultness, unadaptability, and resistance to control. More detailed descriptions of these subscales are provided in Table 2. Cronbach's alpha was calculated for each of these subscales using data from the larger sample, and they ranged from 0.83 to 0.87. Scores for each dimension were the averages of the items they included. The RICQ is shown to be a valid measure, as it adequately estimates temperamental characteristics during infancy [13]. In the study by Bates and colleagues [13], mothers of typically-developing children completed the ICQ when their children were between 6 and 24 months of age; then, ten years later, the same mothers retrospectively assessed their children's infant temperament via the ICQ – Retrospective Form (RICQ). They found that the two reports, separated by 10 years, were significantly correlated in all three dimensions.

Behavior Problems—The child's teacher was asked to complete the Child Behavior Checklist Teacher's Report Form, TRF [34] based on the child's current behavior at baseline, 18, and 36 months following the child's FRS. To assess how baseline neuropsychological functioning and temperament predict later behavior problems, only the 36-month behavioral data were analyzed in the present study. Each item is rated on a 3-point scale: (0) *not true*, (1) *somewhat/sometimes true*, and (2) *very/often true*. Scores are computed for the three broadband scales: Total Behavior Problems, Internalizing Problems, and Externalizing Problems. Items measuring anxious/depressed behavior, withdrawn/depressed behavior, and somatic complaints together form the broadband dimension of internalizing behavior, whereas items measuring aggressive and rule-breaking behavior form the broadband dimension of externalizing behavior. The Total Behavior Problems dimension consists of the internalizing and externalizing subscales, as well as thought problems, attention problems, social problems, and other problems. For all three scales, a *T* score of 65 or above ($\geq 93^{\text{rd}}$ percentile) is considered significantly elevated [34]. The TRF and the parent

report form, the Child Behavior Checklist (CBCL), have been shown to have high reliability and validity. They show stability over time and provide standardized scores for age and gender [34]. The TRF has also been used extensively in children with epilepsy [35].

Past studies relied upon parents to rate their child's behavior problems [3,36-38]. In the present study, behavioral data were available from both the teacher and parent, although retrospective temperament data were only available from the parent. The parent's recollection of the child's early temperament may have been influenced by the child's present behavior. Therefore, to reduce the possibility of the shared variance between temperament and behavior problems being due to the informant, the parents' ratings of the child's infant temperament and the teachers' ratings of the child's behavior in the school setting¹, were used.

Neuropsychological Functioning—Child participants completed a comprehensive three-hour neuropsychological test battery that included standardized clinical measures of intelligence, language, immediate and delayed verbal and visual memory, executive functions, speeded fine motor dexterity, and academic achievement. Neuropsychological tests were administered at baseline, 18, and 36 months, although only the baseline assessment data were analyzed in the present study. The aim of the study was to identify baseline factors that predict later adverse behavioral outcomes. Baseline neuropsychological data are less confounded by the adverse effects of high seizure frequency and use of antiepileptic medication, allowing for identification of early cognitive risk factors for negative behavior. Testing was administered in a neurology or neuropsychology clinic by psychometrists who were trained, observed, and certified on the test battery by a pediatric neuropsychologist.

All instruments are well-established in the field and have high reliability and validity. Each instrument was administered according to the standardized procedures for each test and scores were converted to age-corrected standardized scores using the best available national norms for all tests except WRAML Design Copy, which was designed by this study's research group and for which no norms are available. The battery included the following tests: Clinical Evaluation of Language Fundamentals, 3rd Edition, CELF-3 [39]; *Comprehensive Test of Phonological Processing*, CTOPP [40]; *Conners' Continuous Performance Test, 2nd Edition*, CPT-II [41]; *Kaufman Brief Intelligence Test*, K-BIT [42]; Coding and Symbol Search Subtests of the Wechsler Intelligence Scale for Children, 3rd Edition, WISC-III [43]; *Wide Range Assessment of Memory and Learning*, WRAML [44]; *WRAML Design Copy*; and the *Wisconsin Card Sorting Test*, WCST [45].

Based on a prior factor analysis of the present neuropsychological test data [46], the battery of neuropsychological measures used was distilled into four primary factors: (1) Language, (2) Processing Speed, (3) Executive/Attention/Construction, which will hereafter be referred to as EF for the sake of clarity, and (4) Verbal Memory and Learning [46]. Verbal concept formation, phonological awareness, and phonological memory loaded onto the first factor labeled as Language. The Processing Speed factor consisted of measures of psychomotor speed and rapid naming. Factor 3, EF, consisted of measures of sustained attention, problem solving, and visual-construction. The fourth factor, Verbal Memory and Learning, consisted of measures of rote verbal learning and story recall [46]. Higher factor scores indicate greater neuropsychological ability.

¹There were significant positive correlations between each of the teacher reports of behavior problems and the parent reports on the CBCL (all $p < .0001$).

Analyses

For each of the three TRF broadband behavior subscales, a predictive model was developed that included the infant temperament variables and the neuropsychological factors as predictors. The three regressions, one for each behavior subscale, included the component main effects of all predictor variables. To reduce the number of predictors in each model, only two temperament subscale variables were used in each model. These variables were identified based upon theoretical considerations and previous research describing their association with specific behavioral outcomes [14]. For internalizing problems, difficultness and unadaptability were the temperament variables entered, whereas for externalizing problems, difficultness and resistance to control were included. All three temperament variables were included in the model of total behavior problems. The models were also run as moderated models including the temperament and neuropsychological functioning (Language and EF) two-way interaction term. To reduce the effects of multicollinearity between the component main effects and the interaction terms, the interaction terms were centered [47]. Means for the individual independent variables were calculated and this mean was subtracted from each individual's score. Statistical tests were always two-sided, with $\alpha = .05$.

Results

As a group, the children in the present sample did not have overtly problematic infant temperaments, as judged by inspection of the mean scores on these measures [13]. For all three temperament dimensions, the means fell between 3 and 4 on the 7-point scale, with a score of 7 indicating a more negative temperament. Their IQ scores, as estimated by the K-BIT, were average ($M = 104.32$, $SD = 12.66$). Similarly, the participants had neuropsychological factor scores that were in the average range. Child behavior problems were average compared to children in the normative sample of the TRF (mean total behavior T -score = 49.14). The percentage of children with clinically elevated behavior problems, T scores ≥ 60 [34], was slightly less than sixteen percent for internalizing problems, about 12% for externalizing problems, and about 16% for total behavior problems. Means and standard deviations for infant temperament scores, neuropsychological factors, and behavior problems scores, are presented in Table 3.

All three models are presented with all main effects and the interaction terms.

Infant Temperament

The three temperament subscales were significantly positively correlated. As reported previously [14], temperamental factors were significantly positively associated with later behavior problems in the present sample of children with seizures; however, the present study builds upon the earlier research by describing temperament characteristics that contribute to behavior three years after seizure onset. Specifically, the temperamental dimension of unadaptability made a unique contribution to the prediction of internalizing behavior problems with children with higher scores on unadaptability having higher internalizing behavior problems scores. Unadaptability was not significant in the prediction of total behavior problem scores. Resistance to control was a significant positive predictor in both the externalizing behavior problems and total behavior problems models. Difficultness was not significant in predicting internalizing, externalizing, or total behavior problems (see Table 4).

Neuropsychological Functioning

The hypothesis that neuropsychological functioning would uniquely contribute to the prediction of child behavior problems was partially supported. With internalizing behavior

problems as the dependent variable, only EF was significant, such that high EF was associated with higher behavior problem scores. Similarly, in the models predicting externalizing and total behavior problems, the EF factor was again a positive predictor. The Language factor did not make a unique contribution in any of the three behavioral models.

The Moderating Effect Of Neuropsychological Functioning

The hypothesis that neuropsychological functioning would moderate the relationship between retrospective infant temperament and child behavior problems was not supported.

Discussion

Results revealed that negative temperamental characteristics were significant in predicting behavior problems three years after seizure onset. Unadaptability (novelty distress, perhaps an early marker of anxiety) predicted internalizing problems; resistance to control (unmanageability, perhaps an early marker of impulsivity) predicted externalizing problems, as well as total behavior problems. The previous study on the present sample of children found that all three temperament characteristics predicted internalizing and total behavior problems at the time the child presented with seizures, and difficultness and resistance to control predicted externalizing behavior [14]. Therefore, although children who are rated high on difficultness, thus described as negatively emotional, are at risk early in the course of the disorder, they are not at risk for behavior problems years later. Unadaptability and resistance to control may represent early characteristics that put children at risk for relatively longer term poor behavior outcomes.

Children who were rated as unadaptable as infants experienced distress when confronted with new experiences, like foods, people, or places. Children experiencing novelty distress likely are fearful in various situations and adopt a pattern of behavioral inhibition to minimize these negative reactions [48]. This inhibited behavior can manifest as anxious tendencies as the child gets older. The more inhibited pattern of responding that is characteristic of internalizing children may partly buffer children from the problematic behavioral tendencies associated with externalizing problems [49]. In addition, these children may react more negatively to the novel onset of a seizure disorder, further increasing their risk for internalized behaviors later. A resistant-to-control temperament, found to put a child most at risk for aggressive and delinquent behaviors, can be characterized by impulsivity, reward-seeking, and non-compliance, thus increasing the risk for conflict with others. This type of temperament and related variables, such as impulsivity, is not only predictive of externalizing behaviors in this sample of children with seizures, but is also associated with externalizing behaviors in a typically-developing sample [49,50]. In the present study, temperaments described as resistant-to-control were also predictive of total behavior problems, indicating that these children may be more likely to experience difficulties maintaining their attention and engaging with others socially. The increased behavioral risk associated with this early temperamental characteristic could be exacerbated by the onset of seizures. The present study builds upon the existing knowledge by examining which early temperament factors predict behavior three years after seizures are first recognized, and if they are affected by the child's neuropsychological functioning.

The study also found that children who scored lower on executive (EF) abilities were at greater risk for internalizing, externalizing, and total behavior problems. Children with seizures perform poorly on measures of executive functioning, and this is even true for children with recent onset epilepsy, despite scores in the average range on intellectual functioning [6,27]. This impairment of executive abilities supports an existing tendency for cognitive self-regulatory problems in children with seizures. Difficulty in planning, modulating one's attention, or inhibiting behaviors appears to be related to later aggressive

and rule-breaking behaviors [28]. Children who are not as responsive to instruction, tend to be 'self-driven', and difficult to control are likely to exhibit negative behaviors in multiple settings. Cognitive and emotional dysregulation, related to EF deficits, make an individual vulnerable to internalizing behaviors, such as depressive and anxious mood symptoms. Low EF neuropsychological scores also predicted higher total behavior problems in this sample. A child with lower executive abilities may be more at risk for the additional behaviors included in the total behavior problems score, such as attention, thought, and social problems.

There were no significant interactions between any of the temperament characteristics and any of the neuropsychological factors in predicting internalizing, externalizing, or total behavior problems, indicating that the association between infant temperament and behavior problems does not vary based on the child's neuropsychological scores.

It is important to note that the neuropsychological functioning of the children in this sample was assessed within 4.2 months of their first recognized seizure. With the exclusion of children with intellectual disabilities, the present sample consists of children who are generally healthy and of normal intelligence. Additionally, the cognitive difficulties that can result from increased seizure activity and use of antiepileptic medication are not likely to have had an effect at this early stage of the disorder. Although it has been found that children with new-onset epilepsy perform more poorly than healthy children on a number of cognitive measures [51,52] their lower scores on the measures are within normal limits and do not represent a significant deficiency. The present study similarly found that the neuropsychological scores of the children with seizures were within approximately two standard deviations of the mean factor scores. Overall the sample does not have executive deficits; however, a small percentage of children within the sample had some executive difficulties with 10.0% having EF factor scores greater than one standard deviation below the mean, and 5.7% have EF factors more than 1.5 standard deviations below the mean.

The current study has certain limitations. Children excluded from the analyses due to missing baseline data or low IQ may have more behavior problems than those in the remaining subsample. The findings from the present subsample could be assumed to underestimate the severity of behavior problems in children with seizures. Another potential limitation is that the resulting R^2 s are relatively low. Although temperament and neuropsychological functioning, specifically EF, contribute to the prediction of behavior, they do not fully explain behavior problems three years after seizure onset. The heterogeneity of the sample, with regard to seizure type, seizure syndrome, and MRI abnormalities, is representative of children presenting with a first seizure. Therefore, the generalizability of the results in that respect represents a relative strength. However, it could be argued that investigation of the unique contribution of seizure variables may contribute to the understanding of adverse behavioral outcomes. While this may be true, given the number of different seizure types in our heterogeneous sample, follow-up analyses could not be conducted. The retrospective nature of the temperament measure inherently presents a limitation. Parents' recollections will not perfectly represent their perceptions of temperament in infancy, but the evidence suggests that what they recollect later corresponds to what they would have reported at the time [13]. Even if it is assumed that the temperament variables used in this study reflect concurrent ratings of temperament, the findings are informative. The child's current behavior may influence a parent's perception of infant temperament and result in a negative bias. However, teacher ratings of behavior three years after seizure onset were evaluated, thus reducing the likelihood that the shared variance between the ratings is attributable to informant effects alone.

The results of the present study are based on a heterogeneous sample of children who first present with seizures, allowing for a description of baseline functioning. The longitudinal design of the study permits identification of baseline risk factors that may contribute to adverse outcomes, such as behavior, three years later. Different domains of temperament were found to differentially predict behavior problems over a three-year period. EF was also found to be predictive of behavior problems. Risk factors and outcomes were all measured using reliable and valid instruments, indicating a relative strength of the study. Future studies should simultaneously explore multiple causative factors in the development of internalizing and externalizing behavior problems in this population. Specifically, factors related to seizure type, caregiving behaviors, and family environment, may help identify those children most at risk for behavioral problems. Identifying these factors associated will lead to improved recognition, treatment, and quality of life for these children.

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Table 1
Child Demographic and Seizure Data (N = 229)

	<i>N</i>	<i>Percent</i>
<i>Gender</i>		
Male	114	49.8%
Female	115	50.2%
<i>Race</i>		
White	195	85.2%
African-American	29	12.7%
Hispanic	2	0.9%
Asian	1	0.4%
Native American	1	0.4%
Other	1	0.4%
<i>Seizure Type</i>		
General Tonic Clonic	52	22.7%
Absence	33	14.4%
Elementary Partial (EP)	12	5.2%
Complex Partial (CP)	61	26.6%
Atonic, Akinetic, Myoclonic	2	0.9%
EP with Secondary Generalization	20	8.7%
CP with Secondary Generalization	45	19.7%
Unknown	4	1.8%
<i>Seizure Syndrome</i>		
Partial – Idiopathic	45	19.7%
Partial – Symptomatic	15	6.6%
Partial – Cryptogenic	88	38.4%
Generalized – Idiopathic	64	27.9%
Generalized – Cryptogenic/Symptomatic	4	1.7%
Undetermined	13	5.7%
<i>MRI Abnormalities</i>		
No MRI conducted	26	11.3%
No abnormalities present	135	59.0%
At least one MRI abnormality present but none classified as significant	37	16.2%
At least one significant MRI abnormality	31	13.5%

Table 2
Infant Characteristics Questionnaire – Retrospective Form (RICQ) Subscale Descriptions

<i>Difficultness</i>
<ul style="list-style-type: none">• Frequency of fussiness or irritability• Changeability of mood• Intensity of crying or fussiness• Overall difficulty
<i>Unadaptability</i>
<ul style="list-style-type: none">• Negative responsivity to new foods, people, and places• Ability to adapt to new experiences• Frequency of playing well during independent play
<i>Resistance to Control</i>
<ul style="list-style-type: none">• Persistence in playing with an object when told not to• Frequency of continuing to go someplace when told “stop” or “no-no”• Frequency of feeling upset when removed from something of interest

Table 3
Means and Standard Deviations for Variables in Behavior Models (N = 229)

	<i>M</i>	<i>SD</i>
<i>Infant Temperament</i> ¹		
Difficultness	3.43	1.11
Unadaptability	3.08	1.44
Resistance to control	3.48	1.51
<i>Neuropsychological Factor Scores</i> ²		
Language ³	0.05	0.82
Processing Speed ⁴	0.09	0.84
Executive/Attention/Construction (EF) ⁵	−0.01	0.77
Verbal Memory and Learning ⁶	0.07	0.76
<i>Behavior Problems (T scores)</i> ⁷		
Total behavior problems	49.49	10.26
Internalizing problems	48.67	10.58
Externalizing problems	49.14	11.03

¹ A retrospective infant temperament measure (RICQ) was completed by parents at baseline

² A comprehensive neuropsychological battery was administered to participants at baseline

³ Language is derived from measures of verbal concept formation, phonological awareness, and phonological memory

⁴ Processing Speed is derived from measures of psychomotor speed and rapid naming

⁵ EF is derived from measures of attention, problem solving, and visual-construction

⁶ Verbal Memory and Learning is derived from measures of rote verbal learning and story recall

⁷ Teachers' ratings of behavior problems (TRF) were obtained 36 months after baseline

Table 4
Regression Analyses Predicting 36-month Behavior Scores

	Internalizing Problems	Externalizing Problems	Total Problems
Variable	<i>Standardized b</i>	<i>Standardized b</i>	<i>Standardized b</i>
Difficultness	0.01	0.10	0.06
Unadaptability	0.20 **	-	0.12
Resistance to Control (RTC)	-	0.18 *	0.18 *
Language	0.07	0.06	0.05
Executive/Attention/ Construction (EF)	-0.25 **	-0.29 ***	-0.30 ***
Difficultness x Language	-0.05	-0.07	-0.05
Difficultness x EF	-0.07	-0.02	-0.06
Unadaptability x Language	-0.02	-	0.03
Unadaptability x EF	0.01	-	-0.02
RTC x Language	-	-0.14	-0.13
RTC x EF	-	0.07	0.11
Adjusted R^2	0.07	0.12	0.14
F	3.00 ***	4.88 ***	4.41 ***

For the internalizing and externalizing models, only two of the three temperament variables were included, as noted in Method section.

The *Standardized b*'s are standardized beta weights that indicate that as the predictor variable increases by one SD, all other variables held constant, the dependent variable increases by the *b*. For example, as unadaptability increases by one SD, internalizing problems increase by two-tenths of a SD.

*
 $p < .05$

**
 $p < .01$

 $p < .001$