Mental Health, Cognition and Academic Performance in the 1st Year of Elementary Education

Natália Martins Dias¹
Alessandra Gotuzo Seabra²

¹Universidade Federal de Santa Catarina, Florianópolis, Santa Catarina, Brasil
²Universidade Presbiteriana Mackenzie, Sao Paulo, São Paulo, Brasil

Abstract

The study investigated 1) relationships and explanatory models of mental health indicators from cognitive abilities and 2) relationships between mental health indicators and academic performance one year later. Participants were 86 children, students of the 1st year of Elementary Education, evaluated in intelligence, inhibitory control (IC) and language. Parents and teachers completed the Strengths and Difficulties Questionnaire (SDQ). One year later, the children were re-evaluated in word recognition (WR) and arithmetic. The IC measures were related and could explain up to 21.9% of the variance in the SDQ indices completed by parents and teachers. The SDQ indices completed by teachers were related to WR and arithmetic performances, predicting up to 16.3% of the variance in school performance measures the following year. There was no IC mediation effect on the models generated. The findings suggest an interaction between specific cognitive skills, mental health indicators and academic performance.

Keywords: cognition; neuropsychological tests; functionality; behavior

Saúde Mental, Cognição e Desempenho Escolar no 1º Ano do Ensino Fundamental

Resumo

O estudo investigou 1) relações e modelos explicativos de indicadores de saúde mental a partir de habilidades cognitivas e 2) relações entre indicadores de saúde mental e desempenho escolar um ano depois. Participaram 86 crianças, estudantes do 1º ano do ensino fundamental, avaliadas em inteligência, controle inibitório (CI) e linguagem. Pais e professores responderam ao Questionário de Capacidades e Dificuldades (SDQ). Um ano depois, as crianças foram reavaliadas em reconhecimento de palavras (RP) e aritmética. As medidas de CI relacionaram-se e puderam explicar até 21,9% da variância em índices do SDQ respondido por pais e professores. Índices do SDQ respondido pelos professores relacionaram-se aos desempenhos em RP e aritmética, predizendo até 16,3% da variância nas medidas de desempenho escolar no ano seguinte. Não houve efeito de mediação de CI nos modelos gerados. Os achados sugerem uma interação entre habilidades cognitivas específicas, indicadores de saúde mental e desempenho escolar.

Palavras-chave: cognição, testes neuropsicológicos, funcionalidade, comportamento

Salud Mental, Cognición y Rendimiento Escolar en 1º Grado de Escuela Primaria

Resumen

El estudio investigó 1) las relaciones y modelos explicativos de los indicadores de salud mental a partir de las habilidades cognitivas y 2) las relaciones entre los indicadores de salud mental y el rendimiento escolar un año después. Participaron 86 niños, estudiantes del 1º grado de la Escuela Primaria, evaluados en inteligencia, control inhibitorio (CI) e lenguaje. Padres y maestros respondieron al cuestionario *Strengths and Difficulties Questionnaire* (SDQ). Un año más tarde, los niños fueron reevaluados en reconocimiento de palabras (RP) y aritmética. Las medidas de CI se relacionaron y explicaron hasta 21,9% de la varianza en los índices de SDQ atendidos por padres y maestros. Los índices de SDQ respondidos por los maestros se relacionaron con los rendimientos en RP Y aritmética, prediciendo hasta el 16.3% de la varianza en las medidas de rendimiento escolar al año siguiente. No hubo efecto de mediación de CI en los modelos. Los hallazgos sugieren una interacción entre habilidades cognitivas específicas, indicadores de salud mental y rendimiento escolar.

Palabras clave: cognición; pruebas neuropsicológicas; funcionalidad; comportamiento

The association between mental health problems and school difficulties has been investigated, given the worse prognosis associated with the co-occurrence of these conditions (Brännlund, Strandh & Nilsson, 2017; D'Abreu & Marturano, 2010; Darney, Reinke, Herman, Stormont, & Ialongo, 2013; Marturano, Toller, & Elias, 2005). According to Saur and Loureiro (2012), mental health problems in childhood, as well as in adolescence, usually manifest as behavioral, emotional and social problems, also affecting the individual's academic performance. Typically, these manifestations have been understood as broad categories of behavioral problems, based on an individual's reactions, such as externalizing and internalizing behavior problems, to stressors and environmental situations. While externalizing behaviors are characterized by actions

directed at the external environment, such as antisocial behavior, hostility, aggression, and hyperactivity, among others, internalizing behavioral problems are characterized by internal processes and subjective suffering, such as emotional symptoms, including anxiety, depression and somatization, among others (APA Dictionary of Psychology).

The co-occurrence of behavioral problems with learning difficulties seems to be common. For example, among children referred for care due to learning difficulties, two thirds also had associated emotional and/or behavioral problems (Marturano et al., 2005). In another study, the presence of learning difficulties was a significant predictor of externalization and internalization problems in children aged 7 to 11 years (Marturano & Elias, 2016). The authors advocate a reciprocal interaction in which mental health problems and school difficulties mutually influence each other during this stage of the life cycle. This co-occurrence of poor academic performance and behavioral problems places these children in a psychosocial risk situation, leading to worse prognosis and higher frequency of comorbidity with psychiatric disorders. Even in nonclinical samples, this association can predict an unfavorable developmental trajectory (D'Abreu & Marturano, 2010).

In addition to the concurrent relationships between these constructs, behavioral problems associated with childhood learning difficulties appear to have long-term negative outcomes and are related to internalizing problems in early adulthood (Masten et al., 2005). A longitudinal study identified that children with learning difficulties and behavioral problems had, over 11 years of follow-up, a higher probability of allocation to special education and mental health services and higher dropout rates (Darney et al., 2013).

The direction of the association between behavioral and learning problems can be inferred from some studies. On one hand, behavioral problems in preschool are associated with future school difficulties (D'Abreu & Marturano, 2010), that is, behavioral problems represent a risk condition for learning difficulties (Santos & Graminha, 2006). On the other hand, a recurring history of school failure may increase the chances of children presenting disruptive behaviors in adolescence, with children with attention problems and hyperactivity tending to present poorer reading performance later, while prosocial behaviors are directly associated with reading performance in the early grades (D'Abreu & Marturano, 2010). Analyzing this evidence,

it can be assumed that the relationship between learning and behavior problems is actually reciprocally causative (Marturano & Elias, 2016; Morgan, Farkas, Tufis, & Sperling, 2008).

In addition to the studies relating mental health indicators to learning difficulties, other studies have sought to analyze the relationship of these indicators with cognition and found evidence that intelligence and a set of skills called executive functions are associated with some mental health problems, such as externalizing behavior problems, at various ages (Pinsonneault, Parent, Castellanos-Ryan, & Séguin, 2015). Despite the different models, there is a relative consensus that intelligence can be understood as the individual's general ability to reason, think abstractly, plan actions, solve problems and learn from experience (Flores-Mendoza, 2010). Executive functions (EFs) refer to a set of skills that allow individuals to regulate their behavior and direct it toward the achievement of goals. In the scope of these skills, inhibitory control refers to the ability to inhibit impulses and automatic or inadequate responses (self-control) and to resist distraction, therefore including selective attention (Diamond, 2013; Friedman & Miyake, 2016).

Bellanti and Bierman (2000) found that preschool children with lower intelligence (IQ, assessed through the Blocks and Vocabulary subtests of the WISC) and higher inattention indices presented difficulties with social behavior when entering Elementary Education (EE). For the authors, this behavior would put these children at risk of social maladjustment and difficulties in establishing healthy peer relationships. More recently, a meta-analysis has shown a consistent relationship between EFs and externalizing behavior problems. More specifically, the results suggested that inhibitory control in particular seems to be already associated with behavioral problems in preschool children (Schoemaker, Mulder, Deković, & Matthys, 2013). These relationships seem to span several age groups throughout the life cycle and, even in adults, there is evidence of an association between internalizing and externalizing problems and cognitive failures in daily life, such as loss of commitment and forgetfulness, among others (Ferreira, Oliveira & Paula, 2018).

In the national context, the relationship between EFs and behavioral problems has already been verified in children between 3 and 6 years of age. In this study, the authors used the Strengths and Difficulties Questionnaire (SDQ) to obtain mental health indices, including both externalizing and internalizing

problems. Their findings consistently indicated that children who performed better in EF measures, including attention and inhibition, tended to be better evaluated by their parents and teachers in the SDQ, i.e., they had fewer behavioral problems (León, Martins, Dias, & Seabra, 2018).

Other evidence has also indicated language as a predictor of some mental health problems. Language skills (including compliance with language and grammar conventions, use of words and phrases, sentence structure, and ability to communicate effectively), assessed in children ages 7 to 13, predicted problems of externalizing behavior and inattention/hyperactivity, even after controlling for variables such as gender or socioeconomic status (SES). The results suggested that the direction of the effect seems to be from language to behavioral measures and not the other way around. In the same study, a new cohort was followed from 4 to 12 years and, once again, language measurement (receptive vocabulary, assessed by the Peabody Picture Vocabulary Test) showed an independent effect on the indices of behavioral problems. Again, the effects of language on the behavioral problem measures were greater than the effects of the behavioral problem measures on later language ability (Petersen et al., 2013).

In addition, among the children with specific language disorders, 54% had behavioral problems, with isolation being the most common problem among preschool children, and anxiety and/or depression and other social problems among older children (Maggio et al., 2014). Accordingly, internalizing problems may also be associated with atypical language development.

Despite the importance of knowing the relationships between cognitive skills, mental health indicators/behavioral problems and academic performance in childhood, especially due to the impact of these variables and their prediction on outcomes throughout the life cycle, this seems to be an area that still lacks studies in Brazil. For example, a search in the SciELO database from the crossing of the keywords *'learning'* or *'academic performance'* and *'behavioral problems'* or *'mental health'* without date restriction resulted in 33 articles, of which only five approached the theme of interest in this study (Beltrame & Boarini, 2013; Carneiro & Coutinho, 2015; Santos & Graminha, 2006; Santos, 2006; Stevanato et al., 2003). Among these, four addressed the prevalence of the occurrence or co-occurrence of mental health problems and school difficulties.

Investigating the relationship between mental health indicators, more specifically behavioral problems, cognition, and academic performance in a non-clinical sample of young age, may shed light on the association between these variables and outcomes in healthy children, in a stage of development in which preventive interventions can be implemented. The results could help to pinpoint which skills, for example, may be most relevant to future investigations or even candidates to be targets for interventions. Accordingly, this study aimed to investigate: 1) relationships between mental health indicators and performance in intelligence, executive functions (specifically, inhibitory control) and language, and explanatory models of mental health indices from cognitive skills assessed in children of the 1st year; and 2) relationships between mental health indicators in the 1st year and the academic performance of the children one year later, in the 2nd year, including explanatory models of academic performance from previous mental health indices, with and without mediation of the cognitive skills. It is hypothesized that cognitive skills, especially the measure of EFs, would be predictors of mental health indices and that these, in turn, would be associated with and may predict academic performance in the following year.

Method

Participants

Initially, 89 children, aged between 6 and 7 years, of both genders, all students of the 1st year of EE of a public school in the metropolitan region of São Paulo, were evaluated. Exclusion criteria adopted were the presence of indicators of intellectual disability (as assessed by the Columbia Mental Maturity Scale, considering percentile <4) and the presence of uncorrected sensory or motor alterations or with a diagnosis of syndromes or neurological and/or psychiatric disorders (according to the Questionnaire for Parents). Three children were excluded from the sample, one due to the presence of motor alterations that prevented the application of the tests (cerebral palsy) and two due to the diagnoses of Intellectual Disability and Attention Deficit Hyperactivity Disorder. The final sample therefore consisted of 86 children (58.1% girls), aged between 6 and 7 years (mean age = 6.48; *SD* = 0.50), students of the 1st year of EE. Of these, 70 children were reevaluated 1 year later (Stage 2), while attending the 2nd year of EE.

Instruments

Stage 1 (1st year of EE)

- **Questionnaire for Parents** (Qp; Dias, 2018): Questionnaire containing questions about the development and aspects of the general health of the child. It is completed by the parents/guardians and takes approximately 5 minutes to complete. The Qp information was used to identify cases that met the exclusion criteria.

- **Strengths and Difficulties Questionnaire** (SDQ; Goodman, 1997; Stivanin, Scheuer, & Assumpção Jr, 2008): This scale is used for screening for mental health problems in individuals aged 4 to 16 years. It covers the most prevalent areas of psychopathology in childhood and adolescence (Niclasen, Skovgaard, Andersen, Sømhovd, & Obel, 2013). It covers five areas: Emotional Symptoms, Behavioral Problems, Hyperactivity, Peer Problems, and Prosocial Behavior, totaling 25 items, scored on a three-point Likert-type scale. It is completed by parents and teachers, in an estimated 5 to 10 minutes. It presents evidence of validity for the Portuguese version (Stivanin et al., 2008). Scores in each subscale and in the total (sum of the first four scales) of the instrument were used. Except for the Prosocial Behavior subscale, higher scores denote greater difficulty in each domain.

- **Columbia Mental Maturity Scale** (CMMS; Alves & Duarte, 2001): Evaluates the general ability of nonverbal reasoning in children between 3y6m and 9y11m of age. The child is presented with boards with 3 to 5 drawings, with the task being to choose which drawing is different or not related to the others. To do this, the child must find out what is the underlying rule in the organization of the pictures. It presents good psychometric properties and normative data for the Brazilian population (Alves & Duarte, 2001). The application time is 15 to 20 minutes. Analysis of the raw score and percentile (<4) were used to identify children with indicators of intellectual disability for exclusion from the study.

Go/NoGo Task (Trevisan, 2010): Evaluates inhibitory control, including response inhibition and selective attention. The test is computerized, consisting of

screens showing red or blue squares. The child's task is to respond by pushing a button only when the stimulus (square) is red and to inhibit the response to the blue stimulus. The test consists of two parts, each with 40 items. In part A, the target stimuli correspond to 25% of the items, presented at a speed of 1200 ms (greater demand for attention). In part B, the target stimuli correspond to 75% of the items, presented at a speed of 800 ms (greater demand for inhibition). Thus, the Go-type items involve selective and sustained attention and the NoGo items involve response inhibition. The test is individually applied, lasting approximately 15 minutes. Validity evidence for childhood assessment can be found in the study by Trevisan (2010). The scores in both parts A and B, i.e. responses to both the Go-type and NoGo-type stimuli of the test, were used. The mean reaction time (RT) was also used in each part and in the total of the test.

- **Peabody Picture Vocabulary Test** (PPVT, Capovilla & Capovilla, 1997): Evaluates the auditory receptive vocabulary. It was applied collectively in groups of five children, using an application book for each child and a list of words for the applicator. The notebook contains five practice items, followed by 125 test items. Each item consists of four black line drawings on white background. The applicator says a word and the child has to mark the picture, among the four presented, that corresponds to the spoken word. The application has an average duration of 30 minutes. Evidence of validity can be found in the study by Ferracini (2005). The total score was used in the test.

Stage 2 (2nd year of EE)

- **Word-Pseudoword Reading Competence Test** (WPRCT; Seabra & Capovilla, 2010): assesses the recognition of isolated words (WR) in children from EE I. The task is composed of 8 training items and 70 test items, with each item consisting of a picture and a written element. This can be a word or a pseudoword. The goal is to judge whether the written word matches the picture or not. There are 7 types of items, including regular and irregular correct ones, semantic, visual and phonological neighbors, and homophonic and strange pseudowords. The application lasts approximately 30 minutes. Data on the psychometric and

normative characteristics can be found in the test manual. The total score was used in the test.

- **Arithmetic Test** (AT; Seabra, Montiel, & Capovilla, 2013): assesses arithmetic competence (AC). It has six subtests that include spelling by extension of algebraically presented numbers and spelling of the algebraic form of numbers pronounced by the applicator, writing increasing and decreasing numeric sequences, comparing magnitude, calculating written and oral operations, and solving mathematical problems, i.e., it encompasses the numerical processing and calculation domains. The application time is 30 minutes. Validity and reliability evidence and standards are available in the study by Seabra, Dias and Capovilla (2013). The total score was used in the test.

Procedure

The study was approved by the Research Ethics Committee and those responsible for the institution and for the children signed the consent form. The children were evaluated at the school, during the regular period, in a room provided by the institution. In stage 1 of the study, the evaluation took place in three individual sessions, of approximately 20 minutes, with the application of the PPVT, CMMS and Go/NoGo. Parents were asked to respond to the SDQ and Qp. Also the teachers were asked to respond to the SDQ. Parents and teachers were able to take the instruments home and respond in the absence of the researchers. However, meetings were held at the school to clarify any doubts and provide assistance in completing the instruments. The teachers returned 100% of the questionnaires and the parents returned 80.23%. This first stage of data collection took place from mid-September to October of year 1 of the study. The same children were reevaluated the following year, after 12 months, again at the school itself, now as students of the 2nd year of EE. In this stage, 2 collective sessions were conducted in the classroom, lasting approximately 35 minutes, for the application of the WPRCT and the AT. A total of 81.4% of the sample (70 children of the initial 86) took part in the 2nd stage of the study.

Data analyses

Initially, descriptive analyses were carried out. For the SDQ, Pearson's correlation was performed between the measures of both respondents, paired sample t-test, comparing the responses of the parents and teachers, and the effect size of this comparison

was calculated from *d* for repeated measure designs (Morris & DeShon, 2008). Based on the results of this first stage, it was decided to conduct the subsequent analyses considering the respondents protocols independently. Pearson's correlation analysis was conducted between responses to the SDQ and the performances of the children in the intelligence, EF, and language measures. Significant correlations are highlighted in the tables in bold. To test explanatory models of the mental health indices (SDQ indices) from the children's performance in the cognitive skills, several multiple linear regression analyses (Enter mode) were conducted with each SDQ index as the dependent variable and the measures in the performance tests as the predictor variables. To explore the relationships between mental health scores and academic performance, Pearson's correlation analysis between the SDQ indices and AC and WR performance was conducted. Considering the results in the previous analyses, hierarchical multiple linear regression analyses were conducted to verify the prediction of the academic performance in the 2nd year (WR and AC) from the mental health indices in the 1st year, also verifying the mediation effect of the cognitive skills selected from the previous analysis of explanatory models of the mental health indices.

Results

Table 1 presents the descriptive statistics of the performances in the various measures. It also presents the result of the comparison between the responses of the parents and teachers to the SDQ. In order to achieve the first objective, correlation analyses were initially conducted between the SDQ indices, answered by parents and teachers, and the children's performance in intelligence, language and EF measures. These results are presented in Table 2.

No significant relationship was found between the mental health indices and the performance of the children in intelligence and language. Some low to moderate correlations were observed with the EF measure. Overall, the relationships between the SDQ indices answered by the parents tended to be related to the Go/NoGo performance measures (correct responses). Specifically, the Total, Peer Problems, and Prosocial Behavior indices had low to moderate relations with the performances in the Go items in part B of the test, and only Peer Problems had a low negative relation with the response time measure in Part B of the Go/NoGo.

Table 1.

Performance in the cognitive measures and responses of parents and teachers to the SDQ

Measures		*M*	*SD*	*r*	*t*	*p*	*d*
SDQ - Total	parents	7.99	4.59	.26*	4.092	<.001	.489
	teachers	5.26	4.54				
SDQ - Emotional symptoms	parents	1.93	1.47	.24*	2.191	.032	.276
	teachers	1.43	1.52				
SDQ - Behavioral problems	parents	1.30	1.35	.24*	3.172	.002	.354
	teachers	.71	1.15				
SDQ - Hyperactivity	parents	3.14	2.26	.40***	2.944	.004	.355
	teachers	2.26	2.29				
SDQ - Peer problems	parents	1.61	1.49	.29*	3.818	<.001	.422
	teachers	.86	1.25				
SDQ - Prosocial behavior	parents	8.07	1.83	.39***	-2.827	.006	.322
	teachers	8.72	1.60				
CMMS - raw score		33.06	7.25				
CMMS - Percentile		58.95	24.02				
PPVT		74.02	8.80				
Go/NoGo A - No Go stimuli score		.95	.12				
Go/NoGo A - Go stimuli score		.97	.11				
Go/NoGo B - No Go stimuli score		.72	.17				
Go/NoGo B - Go stimuli score		.91	.11				
Go/NoGo - A - RT		702.83	213.84				
Go/NoGo - B - RT		614.33	95.11				
Go/NoGo - RT		658.58	141.09				

Note. SDQ: Strengths and Difficulties Questionnaire; CMMS: Columbia Mental Maturity Scale (measure of intelligence; specifically nonverbal reasoning); PPVT: Peabody Picture Vocabulary Test (measure of language, specifically receptive vocabulary); Go/NoGo: Go/No-go task (measure of EFs); No go stimuli are stimuli to which the response must be inhibited (primarily measure inhibitory control); Go stimuli are stimuli that should be responded to (primarily measure attention); A and B refer to the parts of the instrument; RT: measures of reaction time in milliseconds.

*Pearson's r: * $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$*

d: 0.2 – 0.4: small; 0.5 – 0.7: medium; $\geq$0.8: large effect

On the other hand, the teachers' responses to the SDQ had a higher number of relations with the RT measures of the test. Specifically, the Total, Behavioral Problems, and Peer Problems indices had low to moderate relations with the time measures of the Go/NoGo. The Peer Problems index had low and significant relations with the NoGo items in Part A and Go items in Part B. In general, these relations showed that higher performances in the EF measure were associated with lower indices in the scales that evaluate difficulty and a higher index in the Prosocial Behavior scale. Regarding the time measures, longer RT was associated with lower indices in the difficulties scales. It should be highlighted that, for part B of the Go/NoGo, there was a

Table 2.

Correlation Matrix between SDQ Indices and performance in the cognitive measures

	SDQ											
	Total		Emotional symptoms		Behavioral problems		Hyperactivity		Peer problems		Prosocial behavior	
	Parents	Teachers	Parents	Teachers	Parents	Teachers	Parents	Teachers	Parents	Teachers	Parents	Teachers
CMMS	.09	-.04	.21	.01	.06	.01	.03	-.08	-.02	.01	.09	.12
PPVT	.05	-.14	.05	-.14	.08	.01	.10	-.18	-.12	-.06	.08	.21
Go/NoGo A - No Go stimuli	-.06	-.02	.12	.11	-.04	.04	-.19	-.01	.03	**-.25***	-.09	.08
Go/NoGo A - Go stimuli	-.01	-.11	.05	-.02	.04	-.03	.04	-.17	-.15	-.05	.17	.20
Go/NoGo B - No Go stimuli	.01	.02	.14	.02	.07	.11	-.12	-.01	.02	-.04	-.13	-.03
Go/NoGo B - Go stimuli	**-.33****	-.18	-.12	-.20	-.20	-.07	-.15	-.07	**-.49*****	**-.21***	**.31****	.16
Go/NoGo - A - RT	-.06	**-.25***	.06	-.06	-.06	**-.42*****	-.04	-.09	-.13	**-.26***	.04	.10
Go/NoGo - B - RT	-.11	-.15	.10	-.01	-.19	**-.25***	.03	-.05	**-.29***	-.21	.12	.03
Go/NoGo - RT	-.08	**-.24***	.08	-.05	-.11	**-.40*****	-.02	-.09	-.20	**-.27***	.07	.08

Note. SDQ: Strengths and Difficulties Questionnaire; CMMS: Columbia Mental Maturity Scale; PPVT Peabody Picture Vocabulary Test; Go/NoGo: Go/No-go Task, A and B refer to the parts of the instrument; RT: reaction time measures in milliseconds.

* $p <.05$ ** $p <.01$ *** $p <.001$

relationship between correct responses in the Go-type and RT items, suggesting that children who require more time tend to perform better in the test.

Subsequently, regression analyses were conducted using each of the SDQ indices as the dependent variables. All the measures of the intelligence, language and EF tests were entered as predictors and the Enter method was used to force the input of variables. In the case of the questionnaires answered by the parents, this analysis generated a model with significant fit only for the Peer Problems index of the SDQ. The performance in the Go-type stimulus of the Go/NoGo test and the RT in part B of the same test were the variables with significant contribution to the model. These results are presented in Table 3 in which, for reasons of space, only the variables that significantly contributed to the model are presented. In the case of the questionnaires completed by the teachers, the analysis generated a model for the Behavior Problems index. The RT measure in part A of the Go/NoGo test was the only variable with

a significant contribution in the model. This result is also shown in Table 3.

To fulfill the second objective, a correlation analysis between the SDQ indices and the performance of the children one year later in the WR and AC academic performance measures was conducted. This analysis returned some significant, usually low to moderate, relations, which are presented in Table 4. All the relations observed were with the indices of the SDQ completed by the teachers. In general, the relations were negative between the Total, Behavioral Problems, Hyperactivity and Peer Problems indices of the SDQ and both measures of academic performance.

To verify the prediction of academic performance by the SDQ indices, regression analyses were conducted in the cases where there was a significant correlation according to the previous analyses, namely the Total, Behavior Problems, Hyperactivity and Peer Problems indices. It was found that the Total index of difficulties in the SDQ was able to explain 16.3% of the

Table 3.

Explanatory models of mental health indices considering parental and teacher responses to the SDQ

Explanatory models of mental health indices from the parents' responses to the SDQ				
SDQ Index	Predictor variables of the model*	β	*p*	Adjusted R²
Peer problems	Go/NoGo B - Go stimuli	-.47	< .001	.219
	Go/NoGo - B - RT	-.33	.035	
Explanatory models of mental health indices from the teachers' responses to the SDQ				
SDQ Index	Predictor variables of the model*	β	*p*	Adjusted R²
Behavioral problems	Go/NoGo - A - RT	-.55	< .001	.138

Note. SDQ: Strengths and Difficulties Questionnaire; Go/NoGo – Go/No-go Task, A and B refer to the parts of the instrument; RT: reaction time measures in milliseconds.

*Only the variables with significant contributions included in the table.

Table 4.

Correlation matrix between SDQ Indices and measures of academic performance one year later

		Arithmetic competence	Word recognition
Total	parents	-.09	.01
	teachers	**-.42*****	**-.35****
Emotional symptoms	parents	.13	.17
	teachers	-.20	-.02
Behavioral problems	parents	-.02	.05
	teachers	**-.26***	**-.32****
Hyperactivity	parents	-.16	-.01
	teachers	**-.43*****	**-.38*****
Peer problems	parents	-.16	-.22
	teachers	**-.26***	**-.26***
Prosocial behavior	parents	-.02	.12
	teachers	.24	.19

* *p* <.05 ** *p* <.01 *** *p* <.001

variance in AC and 11.1% in WR; Behavioral Problems explained, respectively, 5.5% and 9.1% of the variance in AC and WR; Hyperactivity explained, respectively, 15.6% and 10.4% of the variance in AC and WR; and Peer Problems explained, respectively, 5.5% and 5.3% of variance in AC and WR, all with significant fits. With the inclusion of inhibition/attention measures (RTs in part A and in the Go/NoGo total, selected based on the findings in Table 2), there was no evidence of a mediation effect in any of the generated models, with the contribution of the new measure being null and not significant. These analyses were performed only with

the SDQ indices of the teachers, since there was no association between the questionnaires completed by the parents and the academic performance measures.

Discussion

The first hypothesis of this study, that cognitive skills such as intelligence, language, and especially EFs, would be associated and configure predictors of mental health indices was partially corroborated. No relationships were observed between the SDQ indices and performance in the intelligence and language

measures. Contrary to what was expected based on the literature reviewed (Bellanti & Bierman, 2000; Maggio et al., 2014; Petersen et al., 2013), this result suggests that, in this sample and considering the specific indices evaluated in the study, there was no association between these cognitive skills and childhood mental health problems.

However, EF measures, more specifically inhibitory control and attention, presented relationships with some mental health indices. Considering the indices of the SDQ completed by the parents, the results suggest that children more able to sustain attention demonstrated lower indices of Peer Problems and in the Total, as well as higher indices of Prosocial Behavior. Also children that took more time to respond in part B of the test were evaluated with lower indices of Peer Problems, suggesting that children who tend to respond faster, perhaps because they are more impulsive, tend to have worse relationships with colleagues. The positive relation between RT and performance in part B of the Go/NoGo suggests that slower responding children may be doing this in order to maintain a higher rate of accuracy in the test. Thus, the associations observed between the mental health indices and the performance and RT in the Go/NoGo seem consistent.

Considering the indices of the SDQ completed by the teachers, the findings suggest that children with better attention and response inhibition abilities present a lower index of Peer Problems. Furthermore, the results showed that children who required more time to answer both parts of the test (our hypothesis being that they are less impulsive) presented lower indices of difficulty, including Behavioral and Peer Problems. These results are partially supported by the regression analyses. In fact, attentional ability, based on the response to the Go stimuli and the response speed, was the only significant predictor capable of explaining variance in the Peer Problems index, considering the responses of the parents. From the teachers' responses, the response time measure in part A of the Go/NoGo (part with greater attentional demand) integrated the model generated, suggesting that the response time may predict variance in the Behavioral Problems index. These findings corroborate the understanding of the previous relations that slower (possibly more contemplative, less impulsive) response times are associated with better behavioral outcomes.

Taken together, the results of the correlation and regression analyses suggest a relatively consistent relationship between cognitive skills, especially inhibition/

attention, and mental health indices, as measured by the SDQ. From the theoretical perspective, this result was expected given the role of EFs in general and inhibitory control in particular in self-control, regulation of behavior, adaptation of the individual to the environment and adjustment in interpersonal interactions, as already discussed by authors such as Diamond (2013), Friedman and Miyake (2016), and Rueda and Paz-Alonso (2013). Even considering preschool children, studies have already indicated the consistent relationship between inhibitory control skills and externalizing behavior problems (Pinsonneault et al., 2015; Schoemaker et al., 2013). The results of the present study reinforce this association and provide evidence for the relation also with prosocial behavior.

None of the present findings indicate an association between the EF measure and internalizing problems, represented in the Emotional Symptoms index of the SDQ. Given the role of EFs in emotional regulation (Rueda & Paz-Alonso, 2013), this relationship would be expected, although in fact there is more evidence of the relationship between EFs and externalizing problems (Schoemaker et al., 2013). It can therefore be questioned whether deficits in EFs would lead to changes that could be documented by observational instruments such as the SDQ. Perhaps self-report instruments or other measuring instruments, more specifically focused on internalizing behaviors, would be more sensitive, an assumption that should be tested in future studies.

The second hypothesis of the study was that mental health indices would be associated and could predict academic performance in the following year, as suggested by previous studies (D'Abreu & Marturano, 2010; Santos & Graminha, 2006). This hypothesis was confirmed only in relation to the evaluation by the teachers. In addition to the SDQ total index, all externalizing problem scales, i.e., Behavioral Problems, Hyperactivity, and Peer Problems, were significant predictors of later academic performance in both WR and AC. The results corroborate some evidence that behavioral problems are associated and may represent a risk condition for future learning difficulties (D'Abreu & Marturano, 2010; Santos & Graminha, 2006). However, this does not rule out the hypothesis that these variables have a reciprocal influence on each other, as suggested in previous studies (Marturano & Elias, 2016; Morgan et al., 2008).

Mediation effects were not observed. What the data suggest is that the performance in inhibitory/

attention control is a predictor of behavioral problems (Diamond, 2013; León et al., 2018; Pinsonneault et al., 2015; Rueda & Paz-Alonso, 2013 Schoemaker et al., 2013); These, in turn, are predictors of academic performance (D'Abreu & Marturano, 2010; Marturano & Elias, 2016; Morgan et al., 2008; Santos & Graminha, 2006).

Regarding the differences observed when considering the SDQ completed by the parents and by the teachers, the literature has already highlighted the low agreement between raters on behavioral measure scales, which has been attributed to factors such as the environment and observation contexts or characteristics of the raters themselves (Major & Seabra-Santos, 2014). Specifically with regard to the SDQ, a recent study found that the scale is more appropriate for teachers when compared to parents, with better indices of fit to the theoretical model and better indices of internal consistency (Niclasen et al., 2013). In the present study, the teachers' responses presented a greater number of relations with the other variables. This may be due to the better psychometric quality of the scale for these respondents (Niclasen et al., 2013) or to the fact that teachers are more sensitive in discriminating certain behaviors, being better able to assess the child's behavior.

The study has limitations, such as the limited time period (1 year), the relatively small sample and being restricted to a single school, sharing conditions such as neighborhood of residence and SES, for example, which may have conditioned some of the findings. Due to the relatively small sample size and to the number of correlations conducted, some correlations may be spurious, therefore generalizations should be made with caution. Future research should consider evaluating these correlations as a function of some variables, such as SES and type of school, hypothesizing that the correlations would be distinct at different levels of these variables. In addition, it may be relevant to include different EF measures to further investigate whether and which skills could mediate the relation between mental health problems and academic performance. Despite the limitations, it is considered that the study adds to those of the national literature in the area (Beltrame & Boarini, 2013; Carneiro & Coutinho, 2015; Santos & Graminha, 2006; Santos, 2006; Stevanato et al., 2003) by demonstrating the relation between inhibition and attention abilities and mental health problems (e.g. León et al., 2018), in a cross-sectional cohort, and the association between mental health problems and academic performance (e.g. Marturano & Elias, 2016), in a longitudinal cohort.

The finding that behavioral problems at the end of the 1st year of EE, as reported by the teachers, are relatively associated with academic performance at the end of the 2nd year suggests that attention should be given to observations about the behavior at the start of EE, as this may be an important predictor of future difficulties. In view of the negative outcomes associated with the co-occurrence of behavioral and academic performance problems (D'Abreu & Marturano, 2010; Darney et al., 2013; Masten et al., 2005), these results should encourage preventive interventions to be considered, attempting to minimize difficulties throughout the schooling. For example, inhibition/attention abilities may be taken as potential targets for interventions, which may be critical in promoting better adjustment and healthier relationships, with the potential to minimize school failure and prevent long-term negative outcomes.

References

Alves, I., & Duarte, J. (2001*). Escala de Maturidade Mental Columbia*. São Paulo: Casa do Psicólogo.

APA Dictionary of Psychology (sd). [página da web]. Recuperado de https://dictionary.apa.org/externalizing-internalizing

Bellanti, C. J., & Bierman, K. L. (2000). Disentangling the Impact of Low Cognitive Ability and Inattention on Social Behavior and Peer Relationships. *Journal of Clinical Child Psychology, 29*(1), 66–75. doi: 10.1207/S15374424jccp2901_7

Beltrame, M. M., & Boarini, M. L. (2013). Saúde mental e infância: reflexões sobre a demanda escolar de um CAPSi. *Psicologia: Ciência e Profissão, 33*(2), 336–349. doi: 10.1590/S1414-98932013000200007

Brännlund, A., Strandh, M., & Nilsson, K. (2017). Mental-health and educational achievement: the link between poor mental-health and upper secondary school completion and grades. *Journal of Mental Health, 26*(4), 318-325.

Capovilla, F. C. & Capovilla, A. G. S. (1997). Desenvolvimento linguístico da criança dos dois aos seis anos: Tradução e estandardização do Peabody Picture Vocabulary Test de Dunn & Dunn, e da Language Development Survey de Rescorla. *Ciência Cognitiva: Teoria, Pesquisa e Aplicação, 1*, 353-380.

Carneiro, C., & Coutinho, L. G. (2015). Infância e adolescência: como chegam as queixas escolares à saúde mental? *Educar Em Revista, 56*, 181–192. doi: 10.1590/0104-4060.37764

D'Abreu, L. C. F., & Marturano, E. M. (2010). Associação entre comportamentos externalizantes e baixo desempenho escolar: uma revisão de estudos prospectivos e longitudinais. *Estudos de Psicologia, 15*(1), 43–51. doi: 10.1590/S1413-294X2010000100006

Darney, D., Reinke, W. M., Herman, K. C., Stormont, M., & Ialongo, N. S. (2013). Children with co-occurring academic and behavior problems in first grade: Distal outcomes in twelfth grade. *Journal of School Psychology, 51*(1), 117–128. doi: 10.1016/j. jsp.2012.09.005

Diamond, A. (2013). Executive functions. *Annual Reviews, 64*, 135–168. doi: 10.1146/ annurev-psych-113011-143750

Dias, N. M. (2018). *Questionário para pais*. Produto técnico (não publicado) desenvolvido.

Ferracini, F. (2005). *Evidências de validade de instrumentos para avaliação de linguagem oral em pré-escolares*. Dissertação de Mestrado. Universidade São Francisco, São Paulo.

Ferreira, A. A., Oliveira, W. G. A., & Paula, J. J. (2018). Relações entre saúde mental e falhas cognitivas no dia a dia: papel dos sintomas internalizantes e externalizantes. *Jornal Brasileiro de Psiquiatria, 67*(2), 74-79.

Flores-Mendoza, C. E. (2010). Inteligência. In L. Malloy-Diniz, D. Fuentes, P. Mattos & N. Abreu (Orgs.), *Avaliação Neuropsicológica* (pp. 58-66). Porto Alegre: Artmed.

Friedman, N. P., & Miyake, A. (2016). Unity and Diversity of Executive Functions: Individual Differences as a Window on Cognitive Structure. *Cortex*. doi: 10.1016/j.cortex.2016.04.023

Goodman, R. (1997). The Strengths and Difficulties Questionnaire: A Research Note. *Journal of Child Psychology and Psychiatry, 38*(5), 581–586. doi: 10.1111/j.1469-7610.1997.tb01545.x

León, C. B. R., Martins, G. L., Dias, N. M., & Seabra, A. G. (2018). Executive functions in preschool children: development and relationships with language and behavior. *Psicologia: teoria e prática, 20*(3),

121-137. doi: 10.5935/1980-6906/psicologia. v20n3p121-137

Maggio, V., Grañana, N. E., Richaudeau, A., Torres, S., Giannotti, A., & Suburo, A. M. (2014). Behavior problems in children with specific language impairment. *Journal of Child Neurology, 29*(2), 194–202. doi: 10.1177/0883073813509886

Major, S., & Seabra-santos, M. J. (2014). Parents and / or Teachers? Inter-Ratter Agreement on Preschoolers Social-Emotional Assessment. *Psicologia: teoria e pesquisa, 30*, 373–383.

Marturano, E. M., & Elias, L. C. (2016). Família, dificuldades no aprendizado e problemas de comportamento em escolares. *Educar em Revista,* (59), 123-139.

Marturano, E. M., Toller, G. P., & Elias, L. C. (2005). Gênero, adversidade e problemas socioemocionais associados à queixa escolar. *Estudos de Psicologia, 22*(4). doi: 10.1590/S0103-166X2005000400005

Masten, A. S., Roisman, G. I., Long, J. D., Burt, K. B., Obradovic, J., Riley, J. R., … Tellegen, A. (2005). Developmental cascades: linking academic achievement and externalizing and internalizing symptoms over 20 years. *Developmental Psychology, 41*(5), 733–46. doi: 10.1037/0012-1649.41.5.733

Morgan, P. L., Farkas, G., Tufis, P. A., & Sperling, R. A. (2008). Are reading and behavior problems risk factors for each other? *Journal of Learning Disabilities, 41*(5), 417–36. doi: 10.1177/0022219408321123

Niclasen, J., Skovgaard, A. M., Andersen, A.-M. N., Sømhovd, M. J., & Obel, C. (2013). A confirmatory approach to examining the factor structure of the Strengths and Difficulties Questionnaire (SDQ): a large scale cohort study. *Journal of Abnormal Child Psychology, 41*(3), 355–65 doi: 10.1007/ s10802-012-9683-y

Petersen, I. T., Bates, J. E., D'Onofrio, B. M., Coyne, C. A., Lansford, J. E., Dodge, K. A., … Van Hulle, C. A. (2013). Language ability predicts the development of behavior problems in children. *Journal of Abnormal Psychology, 122*(2), 542–57. doi: 10.1037/ a0031963

Pinsonneault, M., Parent, S., Castellanos-Ryan, N., & Séguin, J. R. (2015). Low Intelligence and Poor Executive Function as Vulnerabilities to Externalizing Behavior. In T. P. Beauchaine & S. P.

Hinshaw (Eds.), *The Oxford Handbook of Externalizing Spectrum Disorders* (pp. 375–400). New York: Oxford University Press. doi: 10.1093/oxfordhb/9780199324675.013.14

Rueda, M. R., & Paz-Alonso, P. M. (2013). Função executive e Desenvolvimento emocional. In *Enciclopédia sobre Desenvolvimento na primeira infância*. Recuperado de http://www.enciclopedia-crianca.com/funcoes-executivas/segundo-especialistas/funcao-executiva-e-desenvolvimento-emocional

Santos, P. L. (2006). Problemas de saúde mental de crianças e adolescentes atendidos em um serviço público de psicologia infantil. *Psicologia Em Estudo, 11*(2), 315–321. doi: 10.1590/S1413-73722006000200010

Santos, P. L. dos, & Graminha, S. S. V. (2006). Problemas emocionais e comportamentais associados ao baixo rendimento acadêmico. *Estudos de Psicologia*, 11(1), 101–109. doi: 10.1590/S1413-294X2006000100012

Saur, A. M. & Loureiro, S. R. (2012). Qualidades psicométricas do Questionário de Capacidades e Dificuldades: revisão da literatura. *Estudos de Psicologia, 29*(4), 619-629. doi: 10.1590/S0103-166X2012000400016

Schoemaker, K., Mulder, H., Deković, M., & Matthys, W. (2013). Executive functions in preschool children with externalizing behavior problems: a meta-analysis. *Journal of Abnormal Child Psychology, 41*(3), 457–71. doi: 10.1007/s10802-012-9684-x

Seabra, A. G., & Capovilla, F. C. (2010). *Teste de Competência de Leitura de Palavras e Pseudopalavras - TCLPP*. São Paulo: Memnon.

Seabra, A. G., Dias, N. M., & Capovilla, F. C. (2013). *Avaliação Neuropsicológica Cognitiva: leitura, escrita e aritmética*. São Paulo: Memnon.

Seabra, A. G., Montiel, J. M., & Capovilla, F. C. (2013). Prova de Aritmética. In A. G. Seabra, N. M. Dias, & F. C. Capovilla (Eds.), *Avaliação Neuropsicológica Cognitiva: leitura, escrita e aritmética* (pp. 97–104). São Paulo: Memnon.

Seabra-Santos, M. J., & Gaspar, M. F. F. (2012). Pais, educadores e testes: estão de acordo na avaliação de aptidões de crianças pré-escolares? *Psicologia: Reflexão e Crítica, 25*(2), 203–211. doi: 10.1590/S0102-79722012000200001

Stevanato, I. S., Loureiro, S. R., Linhares, M. B. M., & Marturano, E. M. (2003). Autoconceito de crianças com dificuldades de aprendizagem e problemas de comportamento. *Psicologia em Estudo, 8*(1), 67–76. doi: 10.1590/S1413-73722003000100009

Stivanin, L., Scheuer, C. I., & Assumpção Jr, F. B. (2008). SDQ (Strengths and Difficulties Questionnaire): identificação de características comportamentais de crianças leitoras. Psicologia: *Teoria e Pesquisa, 24*(4), 407–413. doi: 10.1590/S0102-37722008000400003

Trevisan, B. T. (2010). *Atenção e controle inibitório em pré-escolares e correlação com indicadores de desatenção e hiperatividade* [Dissertação de Mestrado]. Universidade Presbiteriana Mackenzie.

About the authors:

Natália Martins Dias
Psychologist, PhD (postdoc) in Developmental Disorders. Professor of the Department of Psychology, Federal University of Santa Catarina – UFSC, Florianópolis, SC. Coordinator of the Laboratory of Cognitive and School Neuropsychology (LANCE) CNPq Productivity Scholarship.
ORCID: https://orcid.org/0000-0003-1144-5657
E-mail: natalia.m.dias@ufsc.br

Alessandra Gotuzo Seabra
Psychologist, PhD (postdoc) in Experimental Psychology. Professor of the Graduate Program in Developmental Disorders at Mackenzie Presbyterian University, Sao Paulo-SP. Coordinator of the Child Neuropsychology Group. CNPq Productivity Scholarship.
ORCID: https://orcid.org/0000-0002-8373-7897
E-mail: alessandragseabra@gmail.com

Contact:

Natália Martins Dias
Universidade Federal de Santa Catarina
CFH. Departamento de Psicologia
Cidade Universitária
Trindade
Florianópolis-SC, Brasil
CEP: 88040970