Trends in Psychiatry and Psychotherapy

Brief Communication

Intragroup differences and similarities in performance on rapid automatized naming tasks in children with ADHD symptoms, children with reading disabilities, and controls

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Abstract

Introduction: Rapid automatized naming (RAN) is the ability to name, as fast as possible, symbols such as letters, digits and figures. The present study aimed to investigate intragroup performance patterns on RAN tasks in children with attention deficit hyperactivity disorder (ADHD) symptoms alone, children with reading disability (RD) alone and controls with typical development.
Methods: A total of 216 Brazilian children between 8 to 11 years old were selected from public schools located in two Brazilian capitals, namely Porto Alegre and Belo Horizonte, to participate in the study. Mixed 3 (participant group: ADHD symptoms, RD or control group) × 3 (type of stimulus: letters, numbers or figures) ANOVAs were performed using response time and number of errors as dependent variables. Only intragroup comparisons are described in this paper.
Results: The groups with ADHD symptoms and RD showed similar performance results on naming speed. There were no differences between letters and numbers within each group, but we found slower responses in figure naming compared to the other tasks for both groups. Concerning accuracy, children with ADHD symptoms showed a similar number of errors in all three tasks. These patterns were distinct from the performance of the control group.
Conclusion: Results suggest a shared deficit in naming speed of alphanumeric stimuli in children with ADHD symptoms and those with RD, and impairments in naming digits correctly in children with ADHD symptoms.
Keywords: Attention deficit hyperactivity disorder, reading, language tests, children, neuropsychology.

Introduction

Rapid automatized naming (RAN) is the ability to name, as fast as possible, visually presented familiar symbols such as letters, digits, figures or colors.[1] Several studies have revealed RAN to be a strong longitudinal predictor of reading development, especially reading fluency.[1-3] Furthermore, deficits in this skill are common to different neurodevelopmental disorders, such as attention deficit hyperactivity disorder (ADHD)[3,4] and reading disability (RD).[5]

Performing RAN tasks requires several cognitive processes such as attentional and visual processes, integration of visual patterns and orthographic information (letters as stimuli) and recovery of phonological labels. These processes are often impaired in children with ADHD and/or RD, translating into an increased number of errors and decreased naming

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speed in these tasks.[4,6] Authors also claim the potential usefulness of RAN in the diagnosis of reading and attentional problems, particularly in children aged from 5 to 9.[6]

There is also evidence that the development of RAN color and object may diverge from RAN letter and digit, suggesting that different cognitive processes may be involved in these different subtasks.[7] Letters and digits engage largely automated decoding processes, whereas objects and colors do not, and as such, the latter would consume more resources relating to attention.[6] In this sense, children with ADHD tend to present lower performance rates specifically on tasks composed of figures and colors compared with controls.[4,6]

Within groups, adolescents and adults with ADHD have demonstrated significantly quicker naming of letters/digits compared with colors and objects; the RD group has shown significantly quicker naming of letters compared with digits, and both did not differ from object naming.[8] However, that study had some limitations: it considered only naming speed of each task as a RAN score and it did not include a control group to compare the performance of others to the pattern expected.[8]

Thus, it is important to investigate the differences and similarities in performance on RAN tasks according to type of stimulus between children with ADHD and those with RD, especially due to the high comorbidity of both disorders.[6] Establishing execution performance profiles for these groups has crucial clinical relevance for both assessment and intervention designs.[5] The current study sought to compare differences in performance (response time – RT and number of errors) between RAN of letters, numbers and figures in children with ADHD symptoms alone, in children with RD alone, and in controls with typical development.

Method

This was a quasi-experimental contrasting groups study[9] that evaluated 216 children (55.1% girls) attending public schools, aged between 8 and 11 years (mean ± standard deviation = 8.94±0.71), from the 3rd (n = 62) and 4th grades (n = 154) of elementary schools located in Porto Alegre, state of Rio Grande do Sul (n = 66), and Belo Horizonte, state of Minas Gerais (n = 150).

The exclusion criteria were: uncorrected auditory or visual impairments (reported by parents/guardians); non-verbal intelligence quotient (IQ) below the 15th percentile on the Raven Colored Progressive Matrices Test (CPM),[10,11] which measures non-verbal intelligence; and meeting the criteria for comorbidity between ADHD and RD symptoms (n = 6). The following criteria were used to define the groups:

a) Group with ADHD symptoms alone (n = 20, 50% male/female): children who scored at least 6 items as either "quite a bit" or "very much" in questions 1 to 9 (inattention symptoms) of the Multimodal Treatment Study for ADHD (MTA) version of the Swanson, Nolan, and Pelham, Version IV (MTA-SNAP-IV) scale,[12-14] and/or who scored at least 6 items as either "quite a bit" or "very much" in questions 10 to 18 (hyperactivity/impulsivity symptoms), and with performance above the 16th percentile on the Word and Pseudoword Reading Test (LPI).[15]
b) Group with RD alone (n = 37, 64.9% female): children who scored below the cut-off point described above on the MTA-SNAP-IV scale[13] and with performance below the 16th percentile on LPI.[15]
c) Control group (without ADHD symptoms or RD) (n = 159, 53.5% female): children who scored below the cut-off point described above on the MTA-SNAP-IV scale[13] and with performance above the 16th percentile on LPI.[15]

The Contingency Naming Speed Task (CNS)[16] consists of four RAN trials of letters (D, A, O, S), numbers (1, 2, 3, 4) and figures (square, circle, triangle and rhombus). Performance was measured based on RT (speed) and number of errors (accuracy) in each CNS task. The scores that assess inhibition and flexibility[16] were not analyzed in the present study (for more details about the task, see van der Sluis et al.[16]).

This study was approved by the research ethics committees of both Universidade Federal de Minas Gerais (UFMG; protocol 939.562) and Instituto de Psicologia, Universidade Federal do Rio Grande do Sul (UFRGS; protocol 1.023.371). Two evaluation sessions (a group session and an individual session with each child) were conducted with children whose parents had signed the informed consent term. The CPM[10] was administered in the group session; the CNS,[16] the LPI[15] and other neuropsychological tasks were administered individually. Here we report on CNS[16] and LPI[15] performance only. The parents/guardians completed the MTA-SNAP-IV scale.[13]

Mixed 3 (group: ADHD symptoms, RD, or control group) × 3 (type of stimulus: letters, digits or figures on CNS) analyses of variance (ANOVAs) were performed. We used the group as a between-subjects factor and the CNS task as a within-subjects factor. However, in this study, only intragroup comparisons are described (intergroup comparisons have already been published[17]).

Results

As shown in Table 1, ADHD symptoms and RD groups exhibited similar RT performance in CNS tasks with letters and numbers ($p > 0.05$) and slower RT performance in the CNS task with figures ($p < 0.05$). In contrast, the control group named letters significantly faster than numbers, and the latter faster than figures ($p < 0.05$, $F_{2,212} = 3.9$, $p < 0.022$, Wilk's $\Lambda = 0.037$, $\eta^2 = 0.03$).

Regarding accuracy, children with ADHD symptoms showed a similar number of errors in the three CNS tasks. In contrast, children with RD and controls made more errors when naming figures than letters and digits ($p < 0.05$). These two groups did not differ significantly from each other ($p > 0.05$, $F_{4,422} = 2.696$, $p < 0.03$, Wilk's $\Lambda = 0.951$, $\eta^2 = 0.02$; Table 1).

Table 1 - Mixed ANOVA intragroup comparisons between each CNS measure and each CNS task (n = 216)

	RAN Letters	RAN Digits	RAN Figures	*F*	Wilk's Λ	p
Response time (milliseconds)						
Controls (n = 159)	20813.23 ± 4355.49[a]	22721.39 ± 5666.98[b]	52920.13 ± 17813.67[c]	3.9	0.03	0.022*
ADHD symptoms (n = 20)	22655.00 ± 5079.37[a]	23860.00 ± 6089.46[a]	56022.56 ± 19935.232[b]	3.9	0.03	0.022*
RD (n = 37)	24781.03 ± 6626.67[a]	26059.73 ± 5833.22[a]	64448.92 ± 17717.10[b]	3.9	0.03	0.022*
Number of errors						
Controls (n = 159)	0.11 ± 0.4[a]	0.12 ± 0.52[a]	0.67 ± 1.69[b]	2.69	0.95	0.03*
ADHD symptoms (n = 20)	0.10 ± 0.44[a]	0.20 ± 0.41[a]	0.70 ± 1.12[a]	2.69	0.95	0.03*
RD (n = 37)	0.32 ± 0.62[a]	0.24 ± 0.68[a]	1.86 ± 2.64[b]	2.69	0.95	0.03*

Data presented as mean ± standard deviation.
ADHD = attention deficit hyperactivity disorder; RAN = rapid automatized naming; RD = reading disability.
* $p < 0.05$.
Different letters indicate differences among tasks.

Discussion

The present study investigated similarities and differences between performance in different RAN tasks in participants with ADHD symptoms, participants with RD, and control children with typical development. We discuss the results in order to provide possible explanations and directions for future investigations with RAN.

The ADHD symptoms and RD groups showed similar temporal performance in RAN tasks with letters and numbers, and lower performance with figures (when compared to letters and numbers). Children with typical development performed differently. They named letters significantly faster than numbers, and the latter faster than figures. Thus, there is probably a shared common difficulty in letter and digit (alphanumeric tasks) speeded naming in children with ADHD symptoms and those with RD, compared to control children.

The relationship between RAN and reading might be explained by the fact that both tasks require serial processing and retrieval of specific names[18]: good readers access word representations stored in the mental lexicon[19] faster and more efficiently. In this sense, rapid naming of digits and letters has a strong predictive relationship with early word recognition processes.[20] In addition, RAN interventions seem to enhance word reading speed and, consequently, improve reading fluency.[21]

In children with ADHD, a deficit in executive control or failure to automatize working memory maintenance processes underlies the speed naming deficits observed in RAN tasks. In order to name a list of symbols, the child must plan, control and monitor the visual processing time for each stimulus; inhibit distractors to retrieve the representation of the next symbol; and implement sequential processing efficiently. This is probably the reason why RAN performance is also related to executive functions, especially inhibitory control, working memory and shifting. Commonly, the executive function components mentioned above are impaired in children with ADHD.[22] It can also be argued that a more general underlying cognitive process, such as processing speed, is impaired in children with ADHD symptoms and also in those with RD. Thus, the lower performance observed in naming speed in RAN

tasks, especially with alphanumeric stimuli, might be explained by a common deficit in processing speed in children with RD and those with ADHD.[23,24]

Concerning accuracy (number of errors), children often have more difficulty in naming figures than letters or numbers, since the former task is less common in everyday life.[25] Therefore, we expected children with ADHD symptoms to make a significantly higher number of errors in figure naming when compared to the two other categories, as opposed to the control group. However, no significant differences were observed in performance between naming letters, digits or figures in children with ADHD symptoms. One possible explanation for this absence of statistically significant differences is that children with ADHD symptoms showed a larger mean number of errors in digit naming in a qualitative comparison with the number of errors made by the control group. This result indicates that the accuracy of digit naming can be impaired in children with ADHD symptoms, even in the absence of comorbid RD.

Finally, to corroborate the hypotheses discussed in this brief communication concerning RAN effects in children with ADHD symptoms and RD, we suggest that future studies include other RAN tasks, such as discrete naming (naming isolated stimuli – we only tested serial naming, in which all the stimuli are presented simultaneously). It would also be interesting to study samples with comorbid symptoms (i.e., children with both ADHD and RD), as well as to perform multivariate statistical analyses to include multiple dependent measures. In addition, it is important to emphasize that, in order to compare RAN performances across groups, stimulus type must be taken into consideration (i.e., letters, numbers, figures or colors), as each task demands different cognitive processes.

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Disclosure

No conflicts of interest declared concerning the publication of this article.

References

1. Georgiou GK, Torppa M, Manolitsis G, Lyytinen H, Parrila R. Longitudinal predictors of reading and spelling across languages varying in orthographic consistency. Read Writ. 2012;25:321-46.
2. Kirby JR, Parrila RK, Pfeiffer SL. Naming speed and phonological awareness as predictors of reading development. J Educ Psychol. 2003;95:453-64.
3. Wolf M, Bowers P. The "Double Deficit Hypothesis" for the developmental dyslexias. J Educ Psychol. 1999;91:1-24.
4. Semrud-Clikeman M, Guy K, Griffin J, Hynd G. Rapid naming deficits in children and adolescents with reading disabilities and attention deficit hyperactivity disorder. Brain Lang. 2000;74:70-83.
5. Siddaiah A, Padakannaya P. Rapid automatized naming and reading: a review. Psychol Stud (Mysore). 2015;60:70-6.
6. Areces D, García T, González-Castro P, Alvarez-García D, Rodríguez C. Naming speed as a predictive diagnostic measure in reading and attentional problems. Child Neuropsychol. 2018;24:1115-28.
7. Arnell K, Joanisse M, Klein R, Busseri M, Tannock R. Decomposing the relation between Rapid Automatized Naming (RAN) and reading ability. Can J Exp Psychol. 2009;63:173-84.
8. Whipple B, Nelson J. Naming speed of adolescents and young adults with attention deficit hyperactivity disorder: differences in alphanumeric versus color/object naming. Arch Clin Neuropsych. 2015;31:6-78.
9. Nachmias C, Nachmias D. Research methods in the social sciences. London: Arnold; 1996.
10. Angelini A, Alves I, Custódio E, Duarte W, Duarte J. Manual Matrizes Progressivas Coloridas de Raven: Escala especial. São Paulo: Centro Editor de Testes e Pesquisas em Psicologia; 1999.
11. Raven JC. Manual for the Coloured Progressive Matrices (revised). Windsor: NFER-Nelson; 1984.
12. Costa DS, de Paula JJ, Malloy-Diniz LF, Romano-Silva MA, Miranda DM. Parent SNAP-IV rating of attention-deficit/hyperactivity disorder: accuracy in a clinical sample of ADHD, validity, and reliability in a Brazilian sample. J Pediatr (Rio J). 2019;95:736-43.
13. Mattos P, Serra-Pinheiro MA, Rohde LA, Pinto D. Apresentação de uma versão em português para uso no Brasil do instrumento MTA-SNAP-IV de avaliação de sintomas de transtorno do déficit de atenção/hiperatividade e sintomas de transtorno desafiador e de oposição. Rev Psiquiatr Rio Gd Sul. 2009;28:290-7.
14. Swanson JM, Kraemer HC, Hinshaw SP, Arnold LE, Conners CK, Abikoff HB, et al. Clinical relevance of the primary findings of the MTA: success rates based on severity of ADHD and ODD symptoms at the end of treatment. J Am Acad Child Adolesc Psychiatry. 2001;40:168-79.
15. Salles JF, Piccolo LR, Miná CS. Manual do Instrumento de Avaliação de Leitura de Palavras e Pseudopalavras (LPI). São Paulo: Vetor; 2017.
16. van der Sluis S, de Jong PF, van der Leij A. Inhibition and shifting in children with learning deficits in arithmetic and reading. J Exp Child Psychol. 2004;87:239-66.
17. Koltermann G, Becker N, Lopes-Silva JB, Gomides, MRA, Paiva GM, Haase VG, et al. Are "cool" executive function impairments more salient in ADHD symptoms than in reading disability? Dement Neuropsychol. 2020;14:47-55.
18. Georgiou GK, Parrila R, Cui Y, Papadopoulos TC. Why is rapid automatized naming related to reading? J Exp Child Psychol. 2013;115:218-25.
19. Vellutino FR, Fletcher JM, Snowling MJ, Scanlon DM. Specific reading disability (dyslexia): what have we learned in the past four decades? J Child Psychol Psychiatry. 2004;45:2-40.
20. Wolf M. Naming speed and reading: The contribution of the cognitive neurosciences. Read Res Q. 1991;26:123-40.
21. Vander Stappen C, Reybroeck MV. Phonological awareness and rapid automatized naming are independent phonological competencies with specific impacts on word reading and spelling: an intervention study. Front Psychol. 2018;9:320.
22. Altani A, Protopapas A, Georgiou GK. The contribution of executive functions to naming digits, objects, and words. Read Writ. 2016;30:121-41.

23. McGrath L, Pennington B, Shanahan M, Santerre-Lemmon LE, Barnard HD, Willcutt EG, et al. A multiple deficit model of reading disability and attention-deficit/hyperactivity disorder: Searching for shared cognitive deficits. J Child Psychol Psychiatry. 2011;52:547-57.
24. Shanahan MA, Pennington BF, Yerys BE, Scott A, Boada R, Wilcutt EG, et al. Processing speed deficits in attention deficit/hyperactivity disorder and reading disability. J Abnorm Child Psychol. 2006;34:584-601.
25. Cummine J, Szepesvari E, Chouinard B, Hanif W, Georgiou GK. A functional investigation of RAN letters, digits, and objects: How similar are they? Behav Brain Res. 2014;275:157-65.

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