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Psychological Evaluation

Screening version of Bender test to the assessment of school performance

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Abstract

This investigation's objective was to search for evidence of criterion validity for the screening version of Bender's Graded Punctuation System test through school performance. The subjects of the research were 333 children, aged between 6 and 10 ($M = 8.39$; $SD = 1.37$), enrolled between the first and fifth grade. Through Anova, it was verified that the three figures in this version were able to differentiate the group of children with low school performance, indicating that they committed more distortion errors when reproducing the figures. The Pearson coefficient showed significant correlations between the screening version and the Portuguese and mathematics classes, which indicated that well-developed percept motor maturity tends to be a facilitator to consolidate the contents proposed in Elementary School I. In conclusion, it is suggested that the screening version is a measure with the potential to assess possible learning difficulties.

Keywords: perceptual-motor skills; scholar psychology; psychological evaluation; child assessment; cognitive evaluation.

VERSÃO DE RASTREIO DO TESTE DE BENDER PARA AVALIAR O DESEMPENHO ESCOLAR

Resumo

O objetivo deste estudo foi buscar evidências de validade de critério para a versão de rastreo do teste de Bender – Sistema de Pontuação Gradual por meio do desempenho escolar. Participaram 333 crianças, com idades entre 6 e 10 anos ($M = 8,39$; $DP = 1,37$), matriculadas entre o primeiro e o quinto ano. Por meio da Anova, verificou-se que as três figuras dessa versão foram capazes de diferenciar apenas o grupo de crianças com baixo desempenho escolar, indicando que elas cometeram mais erros de distorções. O coeficiente de Pearson apresentou correlações significativas entre a versão de rastreo e as disciplinas de português e matemática, indicando que maturidade perceptomotora bem desenvolvida tende a ser facilitadora na consolidação dos conteúdos propostos nas disciplinas do ensino fundamental I. Destarte, sugere-se que a versão de rastreo é uma medida com potencial para avaliar de possíveis dificuldade de aprendizagem.

Palavras-chave: habilidade perceptomotora; psicologia escolar; avaliação psicológica; avaliação infantil; avaliação cognitiva.

VERSIÓN DE RASTREO DEL TEST BENDER PARA LA EVALUACIÓN DEL RENDIMIENTO ESCOLAR

Resumen

El estudio buscó por evidencias de validez de criterio para la versión de rastreo del Test de Bender – Sistema de Puntuación Gradual por medio del desempeño escolar. Participaron 333 niños, con edades entre 6 y 10 años ($M = 8,39$; $DP = 1,37$) matriculados entre el primer y el quinto año. La prueba de Anova verificó que las tres figuras de esta versión fueron capaces de diferenciar el grupo de niños con bajo desempeño escolar, sugiriendo que estos cometen mayores errores de distorsión. El coeficiente del Pearson mostró correlaciones significativas entre la versión de rastreo y las clases de portugués y matemática. Indicando que la madurez perceptiva bien desarrollada tiende a ser facilitadora en la consolidación de los contenidos propuestos en las clases del ensino fundamental I. Siendo así, se sugiere que la versión de rastreo es una medida con potencial para la evaluación de posibles dificultades de aprendizaje.

Palabras clave: habilidad perceptomotora; psicología escolar; evaluación psicológica; evaluación infantil; evaluación cognitiva.

1. Introduction

The various reasons to seek psychological evaluation include complaints of learning difficulties (Vagostello, Albuquerque, Queiroz, Lopes, & Silva, 2017). According to Vagostello et al. (2017), cognitive immaturity is one of the leading causes that make it difficult for children to present a good school performance. In this perspective, Pires and Simão (2017) point out the importance of understanding which cognitive functions are involved in the learning process and how they can influence the performance of children who are still at the beginning of school education. Knowing the cognitive factors that make learning deficient could contribute to the creation of intervention strategies that can minimize the impact of more severe impairments (Oliveira, Boruchovitch, & Santos, 2008; Silva, Oliveira, & Ciasca, 2017; Soto, 2014). Thus, in the psychological assessment process, the psychologist needs to resort to tests that permit the evaluation of cognitive aspects underlying the learning process, such as visual perception, language, motor coordination, logical reasoning, temporal and spatial organization capacity, attention, and memory (Batista & Gonçalves, 2016; Silva et al., 2017).

In this context, being associated with possible learning difficulties, one of the instruments widely used in Brazil is the Bender Visual Motor Gestalt test, cor-

rected using the Gradual Score System – B-SPG (Rueda, Sousa, Santos, & Noronha, 2006; Sisto, Noronha, & Santos, 2006; Suehiro, Santos, & Rueda, 2015). According to Bender (1955), the precursor of this instrument, difficulties in accurately reproducing the drawing of the figures could derive from perceptual-motor immaturity or intellectual commitment. Thus, B-SPG has been used to evaluate the perceptual-motor maturity, understood as the ability to visually perceive external stimuli and to express them as a motor action (Bender, 1955).

Composed of nine figures that follow the principles of proximity, similarity, and closure, Bender (1955), Kacero (2005), and Sisto et al. (2006) suggest that, when copying the drawings from the test, the child is free to perceive and integrate features and shapes of the images. Thus, one can consider that these principles are primitive forms of experience that biologically tend to present a sensory-motor pattern of action and an evolutionary character. Hence, the perceptual-motor maturity assessed by the Bender test is considered a constant factor that accompanies the child's evolutionary development and is integrated with the neurological system. Bender (1955), Kacero (2005), and Koppitz (1989) state further that it is the observation of these copies that allows the psychologist to understand how children are oriented within a given frame of reference, and how they manage to deal with spatial relationships. In this context, Kacero (2005) considers that the reproduction process of the Bender test figures occurs as a scheme, in which the sensorial input refers to integration, elaboration, and planning, generating the motor output and joining visual perception with motor action. According to Soto (2014), this sensorial scheme tends to influence the learning process of children at the beginning of the school years. Koppitz (1989), on the other hand, suggests that the task of copying gestalt figures is a complex activity, as seeing, perceiving, and copying figures is an integration process that demands a range of cognitive abilities, such as visual perception, spatial concepts, organization, planning, attention, memory, and motor coordination.

In this perspective, Sousa and Salgado (2015) consider that how the stimuli are perceived exerts a significant influence in the execution of the actions, keeping in mind that the evocation of information tends to be transmitted according to the visual perception, and consequently reproduced in the same way. Therefore, Sousa and Rueda (2017) suggest that the attentive capacity is one of the most important and fundamental factors for visual perception because it is the attention

that will enable the selection of the most relevant stimuli to be fixed. Alves and Brito (2007), in turn, argue that memory is as important as attention because, when selecting a stimulus, storing it is essential, since evoking this information will contribute to the development of a concrete image. Thus, the way the child develops visual perception will depend on the various underlying abilities. Several authors suggest that well-developed perceptual-motor maturity is a facilitating ability in the learning process, considering that when well consolidated, it becomes an essential aspect for a good school performance (Batista & Gonçalves, 2016; Silva et al., 2017) and is linked to the neurological development of the child (Bender, 1955; Sisto et al., 2006).

Studies using the B-SPG indicated significant correlations when associated with instruments that evaluate school skills (Batista & Gonçalves, 2016; Carvalho, Noronha, Pinto, & Luca, 2012; Noronha, Santos, & Rueda, 2013; Suehiro & Santos, 2005; Suehiro et al., 2015). Suehiro and Santos (2005) aimed to compare the performance of 287 children, aged between 7 and 10 years, on the B-SPG and the Assessment of Learning Difficulties in Writing (ADAPE). The authors verified that children with no signs of difficulties in writing and the final stage of the literacy process were the group that performed best on the B-SPG, differing from the children with mild and medium levels of difficulty. These results show that children who present significant difficulties concerning writing tend to present perceptual-motor difficulties.

Carvalho et al. (2012), in turn, verified the relationship between perceptual-motor maturity and the Word Recognition Test. The study was carried out with 297 children, with an average age of 9.04. The statistically significant correlation ($r = -0.29$, $p < 0.001$) between the instruments indicated that, as the B-SPG score decreased, the reading and writing comprehension improved. In a similar study, Suehiro et al. (2015) analyzed protocols of 199 children aged between 7 and 10. The significant correlation of moderate magnitude ($r = -0.56$, $p < 0.001$) between B-SPG and the Writing Assessment Scale (EAVE) allowed the authors to infer that well-developed perceptual-motor maturity tends to facilitate the learning process. Silva et al. (2017) compared the performance on the B-SPG between children with and without complaints of learning difficulties. Twenty-six children aged between 7 and 9 participated. According to the authors, the non-compliant group performed much better than students with learning complaints, indicating that chil-

dren without intellectual impairment tend to make fewer distortion errors in the reproduction of Bender figures.

Based on the above, we can observe that the nine B-SPG figures can predict possible learning difficulties, as children who can easily reproduce the images tend to perform better on the instruments that evaluate cognitive skills intrinsic to the learning process (Carvalho et al., 2012; Silva et al., 2017; Suehiro et al., 2015). Recently, Rueda et al. (2016) took an interest in verifying, with a smaller set of figures, whether it would be possible to obtain a measure of perceptual-motor maturity consonant with the original proposal of the B-SPG. The authors applied the nine test figures to 787 children aged between 6 and 10 and, employing factorial analysis, they observed that Figures 3, 4, 7a and 7b explained 80% of the variance in the total B-SPG score. They also verified that this version is capable of distinguishing the performance of the children by age because performance improved with increasing age. Given these results, the authors state that these four figures are capable of measuring the perceptual-motor maturity, and can evaluate possible learning difficulties.

In this context, by empirically confirming the potential of this screening version to measure school performance, It is also important that, to provide reliable results, it is essential that all psychological instruments have psychometric properties that assure better assessments of the variables to be measured (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 2014). Therefore, this study aims to find evidence of criterion validity for the screening version of the Bender – Gradual Scoring System (B-SPG) through the school performance of students in Elementary School (Primary Education I).

2. Method

2.1 Participants

In total, 333 children (53.8% girls), aged between 6 and 10 ($M = 8.39$; $SD = 1.37$) participated in this study, all of them were public school students enrolled between the 1st and 5th year of Primary Education I. Table 2.1.1 indicates the distribution of participants considering the age and school year:

Table 2.1.1. Distribution of participants per age and school year.

Age	1 st year	2 nd year	3 rd year	4 th year	5 th year	Total
6	30	3	–	–	–	33
7	25	47	1	–	–	73
8	2	11	42	4	–	59
9	–	–	26	35	7	68
10	–	–	–	32	68	100
Total	57	61	69	71	75	333

2.2 Instruments

Bender's Visual Motor Gestalt Test: Gradual Scoring System (B-SPG) (Rueda et al., 2016): The screening version of the Bender B-SPG (Rueda et al., 2016) evaluates the perceptual-motor maturity through shape distortion errors, which refer to the drawing's structural aspects. The instrument is composed of three figures (Figures 3, 4 and 7), consisting of continuous lines or points, hairpin bends or angles, in which scores range from 0 to 2 points. Considering that Figure 7 can be corrected twice (7a and 7b), the maximum score is eight points. It should be noted that errors are scored; therefore, the higher the score, the worse the performance on the test. Besides the advantage of using only a blank sheet and a writing pen, the instrument can be applied individually or collectively.

2.3 Procedures

After the approval of the Research Ethics Committee at the São Francisco University (CAAE n. 73102617.1.0000.5514), the students received the Free and Informed Consent Form (TCLE) to collect their parents' signature. Before administrating the instruments, information concerning the research's purpose and the non-mandatory participation was given to the children. The teacher and one psychologist accompanied the data collection. Initially, a group relationship was established with the children, so that they felt motivated to take the test in the best possible way. The students were directed to a classroom with a data show projector to display the Bender figures. They all received a black writing pencil and a blank sheet of paper, on which they were asked to write their name, age, and school year. The test was administered collectively

on a single occasion, taking about 30 minutes, and the classrooms contained 20 children on average.

After applying the test, the supervisor responsible for Primary Education I at the school allowed the researcher to have access to the school grades of children on subjects such as Portuguese, Mathematics, Geography, History, Science, Arts, and Physical Education referring to the semester when the test was applied. Thus, the teachers provided the grades of all the students. At the school, the students were scored as follows: 3 = student with excellent performance who until that moment had reached all the proposed objectives; 2 = student presented a good performance, but still lacked consolidation of some proposed objectives; and 1 = student presented poor performance, indicating learning difficulties.

2.4 Data analysis

The analyses of this study were carried out by using the Statistical Package for Social Sciences 21 (SPSS). After verifying the accuracy among the evaluators, using Pearson's correlation, the participants' means descriptive and inferential statistics were calculated. Then, Pearson's correlation was used to verify the relationship between the performance on the B-SPG screening version and the school performance levels. Finally, new correlations were made between the performance on the screening version of the B-SPG and the disciplines in the Primary Education I curriculum.

3. Results

To enhance the reliability of the research results, 20% ($n = 66$) of the protocols were blinded. The precision coefficient between the two evaluators indicated a statistically significant, positive, and strong correlation ($r = 0.90$, $p < 0.001$). This result suggests that the correction of the protocols is unbiased and that the presented results tend to be reliable. To meet the research objectives, first, we found that the overall mean score on the B-SPG screening version was 4.07 ($SD = 2.04$). Only 2.3% of the children did not present any distortion error when reproducing the figures. Concerning the level of school performance informed by the teachers and obtained by the addition of the general notes of the children, we found that 44.7% ($n = 150$) of the students did not present learning difficulties. Students who presented good performance but still lacked consolidation of some of the proposed

objectives in the subjects were classified as medium (31.2%, $n = 104$); finally, 24.1% ($n = 80$) presented poor performance, indicating learning difficulties.

Next, we tried to verify if the screening version would be able to distinguish children with high, medium, and low school performance. The results of the analysis of variance (Anova) indicated statistically significant differences in the reproduction of the figures of the B-SPG screening version among and inside the groups [$F(131, 1308) = 65.53$; $p < 0.001$]. As shown in Table 3.1, however, Tukey's post-hoc test indicated that only two groups differed mutually:

Table 3.1. Difference of means in the screening version due to the school performance level.

School performance level	N	Subgroup	For alpha = 0.005
		1	2
High	150	2.86	
Medium	103	4.32	
Low	80		5.25
<i>p</i>		0.055	1.00

According to Table 3.1, the group of children with high and medium performance differed significantly from those with more significant learning difficulties. The first group found it easier to reproduce the Bender figures, and children with poor school performance reproduced the greatest distortion errors. The performance on the screening version was also correlated with the subjects on the Elementary Education I curriculum. The results are presented in Table 3.2:

Table 3.2. Correlation between subjects in Elementary Education I and B-SPG screening.

Measures		Portuguese	Mathematics	Sciences	Geography	History	Arts
Screening	<i>r</i>	-0.50	-0.49	-0.27	-0.27	-0.28	-0.20
B-SPG	<i>p</i>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

All correlations were statistically significant, negative, and weak to moderate (Cohen, 1988). In the Bender test, the distortion errors are scored, so the high-

er the score, the smaller the perceptual-motor maturity. The distribution of school grades indicates that the higher the score, the better the student's performance. Thus, the results suggest that as the errors of distortion in the reproduction of the Bender figures decrease, the children's school performance tends to be better, which justifies the negative correlation coefficient. In general, the correlation between the subjects of Portuguese ($r = -0.50$) and Mathematics ($r = -0.49$) were the strongest. Finally, we looked at whether the magnitude of the correlations between the screening version of the B-SPG and the subjects' performance in the subjects would be maintained when considering age. The results can be observed in Table 3.3:

Table 3.3. Correlation between subjects in Primary Education I and B-SPG screening per age.

Age	B-SPG	Portuguese	Mathematics	Sciences	Geography	History	Arts
6	<i>r</i>	- 0.47	-0.49	-0.27	-0.25	-0.23	-0.05
	<i>p</i>	0.003	0.004	0.126	0.146	0.196	0.978
7	<i>r</i>	- 0.36	-0.36	-0.16	-0.15	-0.17	-0.19
	<i>p</i>	0.002	0.002	0.835	0.917	0.905	0.929
8	<i>r</i>	- 0.52	-0.50	-0.10	-0.10	-0.40	-0.03
	<i>p</i>	0.001	0.001	0.417	0.447	0.762	0.816
9	<i>r</i>	- 0.59	-0.60	-0.37	-0.34	-0.42	-0.35
	<i>p</i>	0.001	0.001	0.002	0.002	0.004	0.004
10	<i>r</i>	- 0.47	-0.49	-0.49	-0.44	-0.43	-0.31
	<i>p</i>	0.001	0.001	0.001	0.001	0.010	0.002

Based on Table 3.3, we can verify that, for the group of 6, 7, and 8-year-old children, the correlations were statistically significant and negative only for Portuguese and Mathematics. Concerning the 9 and 10-year-olds, all the disciplines indicated significant correlations. In general, the magnitude of the correlations was moderate to strong (Cohen, 1988), with coefficients varying from $r = -0.34$ to $r = -0.59$.

4. Discussion

This study aimed to verify if, as in the original version of the B-SPG (Sisto et al., 2006), the three figures that make up the screening version would be able

to differentiate children at different levels of learning. The results suggest that the B-SPG screening version can distinguish only the school performance of those children with the greatest learning difficulties. These findings allow us to infer that the teachers of the institution where the data were collected present greater clarity to differentiate the students with excellent school performance from those children with possible learning difficulties. Also, it was also observed that teachers tend to distinguish between students with an average level of performance and children with learning difficulties, as they were still able to learn some of the objectives proposed in the subjects on the Primary Education curriculum. In this perspective, it is considered that the screening version of the B-SPG does not present a limitation to differentiate levels of school performance, but rather that the way teachers evaluate their average performance may not be that objective.

In general, it was verified that, as the errors of distortions in the reproduction of the Bender figures increase, so does the children's difficulty to retain the proposed content in the classroom. According to the teachers of the school where the data were collected, children with poor school performance present learning difficulties, as they have not yet been able to consolidate the concepts taught in the subjects. These results corroborate the study by Silva et al. (2017), who found that children with learning difficulties tended to perform poorly on the Bender test. This is because the wide range of cognitive skills that are intrinsic to the perceptual-motor maturity can facilitate the learning process since they underlie the capacity to retain, integrate and process information that will enable the emission of a targeted response to something (Batista & Gonçalves, 2016).

When verifying the performance in the different subjects and their relation with the score on the screening version of the Bender, we observed that as the errors of distortion in the reproduction of the figures diminish, the students tend to do better in Portuguese, Mathematics, Science, Geography, History, and Arts. When thinking about learning as part of an acquisition and assimilation process of new ways of perceiving, understanding and acting, well-developed perceptual-motor maturity would serve as a facilitator for the evolution of the school abilities, being able to favor and enhance the integration and interpretation of the content learned (Batista & Gonçalves, 2016, Sousa & Rueda, 2017). Based on these considerations, we can state that the perceptual-motor maturity assessed by the B-SPG screening

version is entirely associated with school performance, as statistically significant correlations were found between the B-SPG screening version and the performance on academic subjects.

When considering the evolutionary nature of perceptual-motor maturity and learning, we decided to compare separately the performance on the subjects and the screening version of the B-SPG for the sake of age. The results showed that children who are at the beginning of school education (6, 7, and 8 years old) presented significant correlations only in Portuguese and Mathematics. These results were as expected as, according to Oliveira et al. (2008), these disciplines (Portuguese and Mathematics) are fundamental for the acquisition of new contents. Also, the supervisor of the school where the data was collected informed that, although all subjects are charged based on the same criteria, more hours of Portuguese and Mathematics are taught in class, and that much of this content is playfully taught. Even if we consider that, because they are at the beginning of school education, children are in the process of literacy, and have not yet consolidated some concepts necessary to perform better on other subjects, such as planning, monitoring, and regulating ones' own learning process (Carvalho et al., 2012; Oliveira et al., 2008).

Another point that supports this supposition is the fact that, for the group of children aged 9 to 10 years, the relation between the screening version of the B-SPG was significant for all the subjects. Furthermore, the non-significant correlation of some disciplines with the group of children aged 6 to 8 years suggests that learning in Science, Geography, History, and Arts might be related to cultural values and experiences. Although the thematic axis of teaching-learning is the same, it should be kept in mind that the specificities of the place can influence the interaction with the object of knowledge.

For Soto (2014), age tends to influence the acquisition process of perceptual-motor maturity and non-verbal intelligence as it favors the greater development of visual construction skills, visual perception, and fine motor coordination. According to Pires and Simão (2017), learning is a slow, individual and structured process, in which the child gradually consolidates the symbolic concepts that involve reading, writing, and calculus that will provide a better school performance. Thus, well-developed perceptual-motor maturity allows the child to select and establish a hierarchical relationship between the different information of a stimu-

lus (Alves & Brito, 2007). In this sense, the different types of drawing of the Bender test figures allow us to understand how children integrate external information and how they deal with spatial and temporal orientations that also involve the writing process (Kacero, 2005).

Overall, it was verified that the strong correlations occurred between the performance on the screening version of the B-SPG and the subjects Portuguese and Mathematics. In recovering the concept that perceptual-motor maturity is the combination of the ability to integrate visual perception with motor movements, Suehiro and Santos (2005), Carvalho et al. (2012), and Suehiro et al. (2015) already pointed to the close relationship of this ability to reading and writing. The authors found that children with poor performance on B-SPG tend to face difficulty in understanding reading and writing. Concerning Mathematics, the integration of visual perception is also essential in the resolution of mathematical tasks, being a process that requires an analytical and synthetic understanding of the information received (Alves & Brito, 2007).

It is known that one of the main ways to evaluate learning is through educational tests, in which the objective is for the students to write what they understood of the contents the teachers taught. From this perspective, it can be considered that a distorted perception could lead to poor school performance. In addition to these considerations, Oliveira et al. (2008) indicate that only being able to read and write is not enough for a better school performance, it is also necessary to have a critical and reflective understanding that permits demonstrating what has been learned of the proposed content.

Given the results obtained in this study, we can confirm that evidence of criterion validity was found for the screening version of B-SPG based on the levels of school performance because, as the distortion errors decrease, the performance in the subjects taught in Primary Education I tends to improve. When verifying that children with problems to reproduce Bender figures also tend to present difficulties in learning the content taught in the subjects, we consider that the screening version may be useful in assessing possible learning difficulties. It is important to note that, for Rueda et al. (2016), the figures of the B-SPG screening version cover different types of drawing, permitting a better interpretation of the distortion errors each child commits. Therefore, when used in the psychological assessment process, it can contribute to the early diagnosis of learning difficulties, besides

permitting the creation of intervention strategies that minimize the impact of learning difficulties even at the beginning of school education.

Although the results were positive concerning the ability of the B-SPG screening version to assess school performance, this research has some limitations, one of which is the fact that only public school children from a single region of Brazil compose the sample. Also, other instruments related to school performance were not used to compare the performance of children in different tasks. Further studies can remedy these limitations and seek other validity evidence for the B-SPG screening version. One suggestion is to use instruments that evaluate related measures and that permit verifying how perceptual-motor maturity can serve as an increment to assess other cognitive skills.

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