p-ISSN: 2184-2205 e-ISSN: 2184-3414 ISBN: 978-989-35106-6-7 © 2024

THE COMPUTERIZATION OF THE ABSTRACT AND SPATIAL REASONING TEST (ASRT)

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Abstract

The study aimed to adapt the Abstract and Spatial Reasoning Test (ASRT) for computerized administration while maintaining its original psychometric characteristics. Two samples were utilized: one to assess the latent structure in 540 eighth and ninth-grade students and another to evaluate the factorial structure and item parameters equivalence between the computerized and paper-and-pencil versions in 318 eighth and ninth-grade students. ASRT was computerized using Java, and Structural Equation Modeling indicated a unifactorial model's adequacy for the computerized version. Results partially confirmed the original instrument's bifactorial structure. Multigroup Confirmatory Factor Analysis demonstrated model invariance across different groups. In conclusion, the computerized ASRT showed evidence of satisfactory internal structure validity and equivalence to the theoretical model, with invariant item parameters between computerized and paper-and-pencil versions.

Keywords: *Intelligence, computerized testing, abstract reasoning, space reasoning.*

1. Introduction

Research in Psychology has, for decades, addressed the complexity of intelligence, with different perspectives on reasoning (Carroll, 1993; McGrew & Flanagan, 1998; McGrew & Wendling, 2010; van der Maas et al., 2006). Psychometric models have been widely used to understand intelligence, based on factor analyzes and correlations between subtests of assessment instruments (Carroll, 1993). These models seek to identify how many and which dimensions would be necessary to understand specific intellectual abilities, from the theories of Spearman and Thurstone to the Cattell-Horn-Carroll (CHC) model, which postulates a general dimension capable of aggregating several specific cognitive abilities (McGrew , 2005; Primi, 2003).

Despite the development of several instruments for assessing intelligence, the availability of computerized versions is still limited. However, the advantages of digital versions, such as greater participant sincerity and reduced costs, have driven their adoption (Olea & Hontangas, 1999; Kingsbury & Houser, 1999). Given this scenario, this dissertation aims to adapt the Abstract and Spatial Reasoning Test (TRAE) to a digital platform and evaluate the stability of the parameters between its versions (ITC, 2005).

2. Abstract and Spatial Reasoning Test

Valentini (2013) developed the Abstract and Spatial Reasoning Test (TRAE) to quickly assess specific intelligence skills. Divided into two subtests, the TRAE aims to assess Abstract Reasoning (AR), related to solving intellectual problems, and Spatial Reasoning (RE), which assesses visuospatial skills and orientation in 3D space.

The AR subtest contains 12 multiple-choice questions, where participants need to discover principles of transformation between figures and apply them. On the other hand, the RE subtest seeks to assess visuospatial and orientation skills in 3D space. Although the two versions of the TRAE are only available in traditional paper and pencil format, Valentini (2013) highlights the need for research to evaluate a possible computerized version of the test, which could significantly contribute to the area of psychological assessment in Brazil.

3. Study 1: Latent structure of the computerized version of ASRT

The study aimed to evaluate the latent structure of the computerized version of the Abstract and Spatial Reasoning Test (TRAE), investigating whether its best structure is one-dimensional, two-factor or two-factor. The sample consisted of 540 eighth and ninth year students from public and private institutions in Rio de Janeiro, aged between 13 and 18 years old. TRAE, divided into Abstract Reasoning (RA) and Spatial Reasoning (RE), was applied in a computerized way, adapted for clearer instructions and time control. The procedures included test administration in computer laboratories, followed by structural analysis using Structural Equation Modeling.

The results indicated that the single-factor model presented the best fit, showing a dominant general dimension, with significant factor loadings. Despite the limitations of the regional sample, the study contributes to psychometrics by providing an efficient and paper-free assessment tool, reducing application errors and saving time. Considerations for future research include validating the instrument in different contexts.

4. Study 2: Invariance of item parameters

This study investigated the equivalence between the computerized and traditional paper versions of the Test of Abstract and Spatial Reasoning (TRAE), using a repeated measures design. The sample consisted of 318 students in the eighth and ninth years of basic education in São Gonçalo, RJ, aged between 12 and 21 years old (mean = 14.69; SD = 1.27), 55% of whom were female. Both versions of TRAE were applied one week apart, in public and private schools. The procedures involved analysis using Structural Equation Modeling, with the data adjusted to a long format to allow analysis of invariance between applications.

The results indicated invariance in item parameters between versions, allowing the use of the computerized version without group bias. The more restricted analysis, with factor loadings and fixed thresholds between versions, showed the best fit to the data, confirming the study hypotheses. However, it is important to consider that the long format of the database may violate the independence of observations, suggesting a reanalysis of the data with invariance models at the item level.

5. Conclusions

This study's main objective was to adapt an intelligence scale for a computerized application, maintaining its original psychometric characteristics. Two studies were conducted to achieve this objective: the first evaluated the latent structure of the computerized version of the Test of Abstract and Spatial Reasoning (TRAE), while the second investigated the equivalence between the factor structure and item parameters in the computerized and paper versions. from TRAE.

The initial study sought to develop a computerized version of the TRAE to assess fluid intelligence quickly and collectively. The results showed that the tested models, with the exception of the bifactor model, presented a general dimension, indicating similarity in fit indices. Furthermore, balance was observed in the distribution of item difficulty parameters, confirming evidence of satisfactory internal structure validity.

The second study demonstrated the invariance between item parameters in the different versions of the TRAE (computerized and paper-based), supporting the equivalence of the two forms of the instrument. This finding is relevant in the context of the increasing computerization of psychological and educational assessment, providing an efficient tool to measure Abstract and Spatial Reasoning, without the need for paper, saving time and reducing measurement errors.

However, it is important to consider that this research has limitations, such as the sample restricted to a Brazilian region and the need for future studies to validate the instrument in different contexts and compare it with other already established tools. These additional efforts can enrich our understanding of intelligence and learning processes, especially in the school context.

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