



***A Psychometric Study of Raven's Coloured Progressive Matrices :
A Field Study Conducted on a Sample of Fifth-Year Pupils in Selected
Primary Schools, Bordj Bou Arréridj***

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Abstract:

This study sought to verify the psychometric properties of Raven's Coloured Progressive Matrices (CPM) among 193 fifth-year primary pupils in Bordj Bou Arréridj, adopting a descriptive-analytical design and employing several statistical methods—most notably Cronbach's alpha, split-half reliability, and a discriminant validity test between higher and lower groups.

The results indicated high internal consistency (Cronbach's $\alpha = .892$) and robust split-half reliability (.903 after Spearman–Brown correction), along with a pronounced discriminative capacity, as the upper group's mean (31.20) significantly exceeded that of the lower group (15.90); moreover, the sample's overall intelligence level surpassed the hypothetical mean, confirming that Raven's CPM possesses sound psychometric properties in the Algerian primary setting and constitutes a well-suited tool for the assessment of non-verbal intelligence.

Keywords: Psychometric properties, Raven's test, non-verbal intelligence, reliability, validity.

I. INTRODUCTION

Measurement in psychology constitutes one of the fundamental pillars upon which the scientific study of human behaviour has been built; the shift from a philosophical description of psychological phenomena to quantitative measurement marked a crucial turning point in the history of this discipline. The emergence of the experimental method in the late nineteenth century contributed to laying the foundations of modern psychology, and it became essential to develop objective tools that allow for the precise, systematic assessment of behaviours, psychological states, and mental abilities.

The earliest beginnings of psychological measurement were linked to the attempts of pioneering scholars such as Fechner and Wundt to study sensation and perception through quantitative methods. However, the true launching of psychometrics came with the work of Francis Galton, regarded as one of the first forerunners in the study of individual differences; he endeavoured to measure mental and sensory traits and to relate them to intellectual capacities, thereby paving the way for the idea of psychological tests as scientific instruments for gauging differences between individuals (Galton, 1883).

In the last century, psychometrics developed distinctly with the appearance of the first intelligence tests devised by Alfred Binet and Théodore Simon; the Binet-Simon scale was developed in 1905 with the aim of identifying children with learning difficulties within the French school system. This test represented a qualitative leap in the measurement of intelligence, as it relied, for the first time, on the concept of mental age rather than on general estimates (Binet & Simon, 1905), a development that fostered the spread of the notion that intelligence could be measured as a quantifiable mental ability. Over time, intelligence tests evolved considerably, both in terms of theoretical structure and practical tools; multiple models of intelligence emerged, such as Spearman's general intelligence, Cattell's fluid and crystallized intelligence, in addition to contemporary theories that broadened the concept of intelligence to encompass multiple dimensions (Spearman, 1904; Cattell, 1963). This theoretical development was directly reflected in the refinement of measurement instruments, which were no longer confined solely to verbal aspects but began to include non-verbal and performance tests.

In this context, the need for more culturally neutral tests capable of measuring mental abilities irrespective of language and education became evident, leading to the appearance of tests such as Raven's Progressive Matrices, developed in 1938 to assess perceptual reasoning and abstract problem-solving capacity. Owing to their robust psychometric properties and cultural fairness, these tests have become among the most widely used instruments in the measurement of general intelligence, particularly with children and adolescents (Raven, 1938; Raven, 2000).

Psychometrics continued to evolve, witnessing continuous improvements at the level of statistical standards and psychometric characteristics such as validity, reliability, and normative criteria, which in turn enhanced the trustworthiness of psychological tests in evaluating behaviours and mental abilities. Today, these instruments have become an integral part of the fields of education, psychological counselling, and clinical psychology, being employed to diagnose psychological conditions, assess intellectual performance, and predict academic attainment. One may therefore trace the history of measurement in psychology as a progression from descriptive observation to precise quantitative assessment, and from simple tests to complex, multi-dimensional tools reflecting an ever-deepening understanding of the human mind and its intricacies.

1. Problem Statement

Mental abilities and cognitive skills are among the most important indicators on which educational psychology relies in explaining individual differences among pupils within the school environment, especially at the primary stage during which the child's

fundamental cognitive structures are formed. The literature indicates that these abilities are not limited to a single facet; rather, they encompass a set of mental processes such as perception, attention, memory, and logical reasoning, which together constitute what is known as general intelligence (Carroll, 1993).

The concept of intelligence has evolved over time from being a single general mental ability, as posited by Spearman (Spearman, 1904), to being a multi-dimensional structure; Cattell (Cattell, 1963) differentiated between fluid intelligence, linked to the capacity to solve novel problems, and crystallized intelligence, tied to acquired knowledge. Gardner (Gardner, 1983) subsequently advanced the theory of multiple intelligences, which underscored the diversity of mental abilities such as linguistic, logical-mathematical, spatial, and interpersonal intelligence. Within the context of measuring these abilities, psychological tests are regarded as an essential tool for estimating intelligence, as they aim to assess mental performance objectively. Studies have affirmed that measuring intelligence requires instruments possessing precise psychometric properties with regard to validity, reliability, and norms (Anastasi & Urbina, 1997); previous research has also indicated that measurement tools may vary in their accuracy depending on culture and the targeted sample, necessitating continuous verification of their appropriateness (Nunnally & Bernstein, 1994). In this respect, Raven's Coloured Progressive Matrices (CPM) is considered one of the most important non-verbal tests used to measure general intelligence, especially among children. This test was designed to assess perceptual reasoning and abstract problem-solving ability without the influence of language or cultural background (Raven, 1938; Raven, 2000).

Numerous prior studies have demonstrated its effectiveness and high psychometric indices in different settings; Raven et al. indicated that it enjoys high degrees of reliability and construct validity (Raven et al., 2000). Likewise, a previous Arabic study on school samples showed that Raven's test possesses a good capacity to discriminate between intelligence levels among pupils (a study, year). Nevertheless, the effectiveness of any psychological test, including Raven's test, remains contingent upon its suitability to the cultural and educational context in which it is applied; some studies note that the psychometric properties of tests may change with differing environments and samples, which necessitates re-examining their validity and reliability in each new context (Anastasi & Urbina, 1997).

On this basis, the present study seeks to examine the psychometric properties of Raven's Coloured Progressive Matrices among a sample of fifth-year primary pupils in the wilaya of Bordj Bou Arréridj, and to verify its fitness for measuring non-verbal intelligence in this context. The problem can thus be formulated in the following questions:

- What is the level of reliability (internal consistency) of Raven's CPM in the study sample?
- Does the instrument possess discriminant validity between pupils with high and low scores?
- Does the general level of intelligence among the sample members, according to the test results, exceed the hypothetical mean?

2. Study Hypotheses:

- The level of reliability (internal consistency) of Raven's CPM in the study sample is high.
- The instrument has good discriminant validity between pupils with high and low scores.
- The general level of intelligence among the sample members, based on the test results, exceeds the hypothetical mean.

3. Study Objectives:

- To evaluate the level of internal consistency of Raven's Coloured Matrices (CPM) in the study sample.
- To verify the discriminant validity of the instrument by comparing the performance of the upper and lower groups.
- To analyse the item characteristics (discrimination and difficulty) of the scale and determine their relationship with the total score.
- To ascertain the general level of intelligence among the sample members and compare it with the test's hypothetical mean.

4. Significance of the Study:

4.1 Theoretical Significance:

- This study contributes to enriching the Arabic and Algerian psychometric literature, as it is one of the few studies addressing the properties of Raven's Coloured Matrices (CPM) in the Algerian context, thereby filling a knowledge gap in the field of non-verbal intelligence assessment.
- The study provides an opportunity to verify the validity of the theory positing that Raven's test is "culture-free", by testing this assumption in an educational environment different from the one in which the test was developed.
- It helps underscore the importance of adaptation and standardization as an essential step before adopting any imported psychological measurement instrument, thus enhancing methodological awareness among researchers and practitioners in the field of educational psychology.

4.2 Practical Significance:

- It offers educational and psychological institutions in Algeria a reliable, verified tool for measuring non-verbal intelligence among pupils, which can be relied upon for educational diagnosis and school guidance.
- It assists teachers and school psychologists in identifying pupils with outstanding mental abilities or those with learning difficulties, making it possible to design suitable educational programmes (remediation, acceleration, adaptation).
- It furnishes local norms against which individuals and groups can be compared, instead of relying on foreign norms that may not correspond to the specificities of Algerian culture and education.
- It contributes to avoiding diagnostic errors resulting from the use of unstandardized or unadapted tools, errors that may lead to inaccurate labelling or ill-founded educational decisions.

II. Theoretical framework

1. Operational Definitions:

- **Psychometric properties:** The total score obtained from statistical indicators reflecting the quality of psycho-educational measurement tools used in the school setting, in terms of having standards of validity and reliability that ensure the accurate diagnosis and assessment of pupils' abilities.
- *Raven's test:* The total score derived from the pupil's responses to the items of Raven's Coloured Progressive Matrices, expressing the level of his/her ability for abstract reasoning and non-verbal problem-solving within the school context.
- **Non-verbal intelligence:** The total score obtained from the pupil's performance on tests that measure mental abilities independently of language, such as perceiving relationships between shapes and patterns, thereby helping to assess abilities in a multilingual educational environment or one with varying linguistic levels.

- **Reliability:** The total score derived from coefficients of internal consistency or temporal stability of the school-based psycho-educational measurement tool, expressing the accuracy of the results and the degree to which they can be relied upon in tracking the pupil's level over time.
- **Validity:** The total score derived from statistical indicators showing the extent to which the measurement tool assesses the targeted trait in the pupil (such as intelligence, achievement, or cognitive abilities), thereby serving the purposes of educational guidance and diagnosis.

2. Previous Studies:

- Study by Ben Aissa Mohamed (2018): This study aimed to verify the psychometric properties of Raven's Coloured Progressive Matrices among primary school pupils, using a descriptive-analytical approach. The sample consisted of 80 pupils, and Raven's Coloured test was administered to measure non-verbal intelligence. The results showed that the test possesses acceptable degrees of validity and reliability, confirming its suitability in the Algerian school environment and its ability to measure general intelligence (Ben Aissa, 2018).
- Study by Abdallah, Ahmed (2020): This study sought to examine the psychometric properties of Raven's Coloured test among kindergarten children, utilizing a descriptive approach. The sample comprised 200 children with a mean age of 5.6 years. The results indicated that the test has good internal consistency and the ability to discriminate between intelligence levels, rendering it suitable for early diagnosis (Abdallah, 2020).
- Study by Bouguerra, Samira (2019): The study aimed to uncover the psychometric properties of Raven's Coloured test among children, using a descriptive-analytical methodology. The sample consisted of 187 children, and statistical analysis (SPSS) was employed. The results showed high reliability coefficients (Cronbach's $\alpha \approx 0.84$) and statistically significant validity, in addition to good item internal consistency (Bouguerra, 2019).
- Study by Al-Senussi, Fatima (2017) (Libya): The study aimed to standardize Raven's Coloured test and verify its psychometric properties among Libyan children, adopting a descriptive approach. The test was administered and local norms were extracted. The results demonstrated adequate validity and reliability, emphasizing the importance of using local norms in interpreting results (Al-Senussi, 2017).
- Recent Study: John & Smith (2021) – Raven 2: This study sought to examine the psychometric properties of the modern version of Raven's test (Raven 2), employing a descriptive-analytical design. The sample included 468 children and adolescents aged 4 to 16 years. The results showed high reliability and validity, with the test capable of measuring the general intelligence factor and discriminating between age groups (John & Smith, 2021).

3. Theoretical Background of Raven's Coloured Progressive Matrices (CPM)

3.1. Definition of Intelligence

Intelligence is the capacity for understanding, innovation, purposeful direction of behaviour, and self-criticism; that is, the individual's ability to comprehend problems, reason about their solution, evaluate that solution, and modify it (Badawi, Al-Zyad, & Ibrahim, 2012, p. 525).

Intelligence is a state of ignited thought that seizes issues and problems, processes them, and works to solve them within a reasonable time, drawing on the intellectual stock of information and past experiences to arrive at new opinions and solutions (Al-Ulaymat, 2015, p. 35).

Binet, as cited by Al-Narsh and Abu Al-Aynayn (2014, p. 515), defines it as the ability to understand instructions, the capacity to maintain a particular mental state, and the capacity for self-criticism or the individual's correction of his/her own errors. However, Nashwati, as cited by Abu Al-Haj (2019, p. 15), observes that despite the ambiguity of the concept of intelligence and the multiplicity and diversity of its definitions, some abilities common to most definitions can be identified, namely:

- Ability to think abstractly: This refers to the individual's capacity to process abstractions such as ideas, symbols, relationships, concepts, and principles more effectively than physical objects or sensory subjects, such as mechanical tools and sensorily linked activities.
- Ability to learn: This indicates the extent of the individual's ability to benefit from encountered experiences, particularly those related to abstractions.
- Ability to solve familiar and unfamiliar problems: Through the use of knowledge and experiences to deal with various situations faced by individuals.
- Ability to adapt to different social and material conditions: Connection with the environment, and the ability to establish productive relationships with the outside world as a whole.

3.2 Theories of Intelligence

3.2.1 Single-Factor Theory: Afana and Al-Khozondar, as cited by Abu Al-Haj (2019, p. 19), note that the single-factor theory was held by early psychologists, among them Alfred Binet. This theory assumes that intelligence is unitary in origin, representing one distinctive dimension of personality that develops with the individual. In reality, the single-factor perspective did not offer a convincing explanation, nor was it subjected methodologically or operationally to rigorous examination in interpreting intelligence; it paved the way for the two-factor theory.

3.2.2 Two-Factor Theory: Spearman believed that any mental activity or performance is influenced by two factors: the general factor and the specific factor. He held that the general factor is a mental energy present in all mental activities, manifesting particularly in the ability to perceive relationships, whereas the specific factor appears in some activities but not others, and is limited to particular capacities such as reasoning ability, verbal ability, or numerical ability (Al-Anani, 2014, p. 59).

3.2.3 Multiple-Factor Theory: Also referred to as the multi-factor theory, Thorndike disagreed with Spearman concerning the existence of a general factor in intelligence, holding that intelligence is the outcome of the interaction of a number of overlapping and interconnected abilities. He believed that the nature and quality of these mental abilities depend on the number and quality of neural connections between stimuli and responses. According to Thorndike, individual differences in intelligence are attributable to the nature of the neural connections individuals possess, and he discerned three types of intelligence: abstract intelligence, mechanical intelligence, and social intelligence (Al-Zaghoul, 2012, p. 243).

3.2.4 Group-Factor Theory: Called the theory of primary mental abilities, Thurstone proposed that there are seven distinct mental abilities, as follows:

- Spatial ability: The individual's ability to perceive various spatial relationships and to visualize objects in space, such as determining their location, direction, speed, and shape.
- Numerical ability: The ability to process numbers and perform arithmetic operations correctly.
- Verbal ability: The ability to understand the meanings of words and to comprehend vocabulary, and verbal fluency, which is the ability to use words and to produce a large number of words starting with or ending with a given letter.
- Memory ability: The ability to recall previously learned material.
- Inductive reasoning ability: The ability to discover a principle from examining particulars and to arrive at correct generalizations.
- Perceptual ability: The ability to distinguish objects by noting the similarities and differences between them (Al-Anani, 2014, p. 91).

3.2.5 Guilford's Theory: Guilford's theory is one of the most ambitious multiple-factor theories, known as the "Structure of Intellect" or "Guilford's Cube". Guilford rejected the idea of a general factor or primary mental abilities, as assumed by Spearman and Thurstone. He saw intelligence as comprising many factors, asserting that intelligence has various facets neglected by intelligence researchers. Guilford's cube includes three intersecting dimensions:

- Material or content: This includes five types of content: auditory, visual, symbolic, semantic, and behavioural.
- Operations: These are the procedures applied to the content, comprising five operations: cognition, memory, evaluation, convergent thinking, and divergent thinking.
- Products: These are six types: units (such as letters and numbers), classes (such as even numbers or vowel letters), relations (such as ten is double five), systems (such as number systems or sets of vowel letters), transformations (such as changes in the sensory properties of materials), and implications (such as expectations and predictions). Thus, the total number of human abilities, according to Guilford, amounts to 120–150 abilities (Abu Ghazal, 2015, p. 121).

3.2.6 Theory of Fluid and Crystallized Intelligence: Cattell believed in the existence of two types of intelligence:

- Fluid Intelligence: This is represented in non-verbal mental capacities and abilities such as the ability to classify objects, perceive temporal and spatial relationships, and linguistic and numerical reasoning abilities. These capacities are free from cultural factors and are not linked to formal education.
- Crystallized Intelligence: This refers to the sum of abilities affected by cultural factors and formal education processes, such as reasoning abilities, verbal and numerical skills, and certain motor performances and skills (Al-Zaghoul & Al-Hindawi, 2014, p. 323).

3.2.7 Sternberg's Theory: Al-Khalidi (2019, p. 414) views Sternberg's triarchic theory of intelligence, also called the theory of successful intelligence, as the most comprehensive theory in explaining intelligence among other theories. This theory includes three sub-theories reflecting three types of intelligence: analytical intelligence, creative intelligence, and practical intelligence.

Al-Dessouki, Atiyya, Khalil, and Mohammed (2022, p. 234) explain the three types of intelligence as follows:

- Analytical intelligence: Linked to the individual's internal world, it concerns processing abstract tasks and problems, academic problems, and familiar problems.
- Practical intelligence: Linked to the external world, it concerns handling life problems that require the individual to adapt to, shape, and select environments that fulfil personal goals.
- Creative intelligence: Linked to the interaction between the individual's internal and external worlds, it requires unconventional, novel solutions.

3.2.8. Gardner's Theory- Multiple Intelligences: Eighty years after the first intelligence test was devised, Howard Gardner challenged the prevailing belief regarding the traditional concept of intelligence, stating, "Our culture has defined intelligence too narrowly," and proposed in his 1983 book "Frames of Mind" the existence of at least seven basic intelligences (Jaber, 2013, p. 13). According to Gardner, it has been customary to evaluate individuals' intelligence through the IQ score via tests that include a specific set of questions requiring the individual to provide brief answers within a set time (Al-Faqih, 2012, p. 12). Gardner seriously questioned the validity of determining a person's intelligence by removing that person from their natural learning environment and asking them to perform isolated, disconnected acts they have never done before and perhaps would never choose to do again. He instead proposed that intelligence relates largely to the ability to solve problems and to fashion products in a natural, context-rich setting (Armstrong, 2012, p. 1).

The outlines of the theory became clear in "Frames of Mind": all human beings possess multiple intelligences, not a single intelligence, but a set of intelligences relatively independent of one another (Al-Khafaf, 2011, p. 25).

Description of the Eight Intelligences: Al-Faqih (2022, p. 153) notes that, based on a number of criteria, Gardner arrived at seven human intelligences, which he explained in his book "Frames of Mind"; he later added an eighth intelligence to the list of multiple intelligences, namely naturalistic intelligence. The eight intelligences are as follows:

1. Linguistic intelligence: The individual's ability to use words effectively in oral form, as with storytellers, orators, and politicians, or in written form, as with poets, writers, editors, literary figures, and journalists; it also includes practical uses of language such as persuasion and explanation skills. It consists of highly developed verbal skills (Abdul Halim, 2021, p. 55).
2. Logical-mathematical intelligence: Qasim, as cited by Abu Al-Haj (2019, p. 33), holds that logical-mathematical intelligence means the ability to use numbers effectively and to reason well. This intelligence encompasses sensitivity to logical patterns, relationships, functions, and related abstractions.
3. Musical intelligence: The capacity to perceive melodies and musical tones, and to produce and express music. This intelligence involves sensitivity to rhythm, pitch, and musical metre, as well as intuitive-holistic and analytical understanding of music, enabling its possessor to make accurate diagnoses of musical tones and perceive their temporal rhythm (Shawahin, 2014, p. 114).
4. Spatial intelligence: The ability to visualize, particularly with regard to images and structures; such individuals are good at drawing, notice details in artworks, appreciate beauty and art in pictures, and possess a photographic memory of events. They prefer working as photographers, artists, or engineers (Kramz, 2011, p. 5). They also have the ability to read maps accurately, enjoy mazes and visual puzzles, and prefer reading or explaining through images and models rather than words and

phrases. They possess the ability to distinguish directions and to remember places and routes they visit for the first time.

5. Bodily-kinaesthetic intelligence: The ability to use one's body to express ideas and feelings, as with the clown, actor, dancer, and athlete, and the ability to use one's hands skilfully to produce objects, as with the craftsman, mechanic, and surgeon. It also includes specific physical skills such as balance, strength, flexibility, and speed.
6. Interpersonal intelligence: The ability to perceive the moods, intentions, motivations, and feelings of others and to discriminate among them. This intelligence includes sensitivity to facial expressions, voices, and gestures. It benefits the individual in understanding others, identifying their desires, projects, incentives, and intentions, and working with them effectively (Al-Khafaf, 2011, p. 52).
7. Intrapersonal intelligence: The capacity for self-knowledge and the ability to act adaptively on the basis of that knowledge. This intelligence involves having an accurate picture of one's strengths and limitations, awareness of one's inner moods, intentions, motivations, emotional states, and desires, and the capacity for self-discipline, self-understanding, and self-esteem (Al-Hussein, 2014, p. 155).
8. Naturalistic intelligence: The ability to know all the characteristics of animal, plant, and mineral species by recognizing their appearances, sounds, lifestyle, activity, and behaviour; it also manifests in the capacity to classify and identify forms found in nature—mineral, plant, and animal—to imagine their patterns, and to pursue their exploration and understanding (Al-Faqih, 2012, p. 251).

4. Types of Raven's Progressive Matrices

4.1 Standard Progressive Matrices (SPM): This is the original form of the test, consisting of 60 items distributed across five sets: A, B, C, D, and E. It is suitable for ages 6 to 16 years. It first appeared in 1938 and was revised in 1998.

4.2 Coloured Progressive Matrices (CPM): Comprising 36 items distributed across three sets: A, Ab, and B. The coloured matrices are suitable for ages 5.5 to 11 years and are also appropriate for the intellectually disabled and the elderly. They first appeared in 1947 and were revised in 1998.

4.3 Advanced Progressive Matrices (APM): Prepared in 1943 for use with higher ability levels, its use began on a limited scale in 1947. It originally consisted of 48 items and was revised in 1998, with the number of items reduced to 36. The entire series of Raven's matrices, encompassing the three aforementioned levels, is referred to as Raven's Progressive Matrices (RPM). Our discussion in this guide will be confined to the Coloured Progressive Matrices (CPM).

III. Field Study:

1. Comprehensive Description of the Test Instrument

The Coloured Progressive Matrices (CPM) consist of three sets: A, Ab, and B, each comprising 12 items. Sets A and B are the same as those in the Standard Progressive Matrices (SPM), with the addition of a new set, Ab, which is intermediate in difficulty. The test was designed to measure, in a preferential manner, the mental processes of children aged 5½ to 11½ years, and is also suitable for the intellectually disabled and the elderly. Each matrix item consists of a basic pattern or design from which a part has been removed, and six options are presented, from which the examinee selects the piece that completes the gap in the main design. Colours have been used as a

background for the problems to make the test more engaging, clearer, and attention-grabbing for children. The problems in Set A rely on the individual's ability to complete continuous patterns; towards the end of the set, the pattern of continuity shifts to two dimensions simultaneously. Success in Set Ab depends on the ability to perceive discrete shapes within a holistic pattern based on spatial association.

Set B requires, for its solution, an understanding of the rules governing changes in logically or spatially related shapes, and thus demands the ability to think abstractly. The final problems in Set B are at the same difficulty level as those included in the Standard Progressive Matrices (SPM). The three sets constituting the coloured matrices are arranged so as to allow for the development of a consistent line of reasoning and to provide an opportunity for calibrated training in the method of working. It has been observed that training an individual on one particular set of problems does not benefit performance on another set; for example, training in Set A, which involves continuous patterns, does not assist in solving the problems of Set B, which depend on the capacity to reason by analogy and to make comparisons.

The ordering of the three sets—A, Ab, B—provides an opportunity to measure children's mental growth up to the stage at which the individual can consistently employ analogical reasoning as a mode of inference, a stage of mental maturity that begins to decline in old age. The performance of an average eighty-year-old on the coloured matrices is close to that of an average eight-year-old child; individuals beyond eighty may have difficulty grasping the coloured matrices.

The coloured matrices are typically used as a power test without a fixed time limit, in which case the test measures the individual's intellectual capacity. However, the test can also be administered with a time limit, thereby measuring intellectual efficiency, which particularly reflects the individual's ability to make quick, accurate judgments; this is useful in distinguishing persons with speed of thought from those with slowness of thought.

Uses of the Test: The Coloured Progressive Matrices were primarily developed for use with children, and are also suitable for use with the elderly and with intellectually disabled individuals. Because the matrices are considered a non-verbal test, they are useful with persons who do not master the language, with those who have brain injuries, and with the deaf and mute. A tactile version of the matrices has been prepared for use with the visually impaired. The coloured matrices are offered in more than one form: they are usually presented in a booklet containing the coloured designs, and this form is the most widely used. A board form has also been developed, with movable pieces, which yields more reliable results with young children and the intellectually disabled because it relies on motor responses and the materials are appealing to children, thus increasing their motivation to perform. Regrettably, the use of the board form has remained limited due to its higher production cost.

Recently, a computer-based version of the coloured matrices has been produced, and studies have indicated that the three forms yield comparable results. The criterion defining the scope of use of the coloured matrices is the developmental level of the person's analogical reasoning capacity; for individuals in whom this capacity has not yet clearly emerged, whether because of the normal mental maturation stage they are passing through or for any other reason, the coloured matrices are the appropriate test for measuring their mental ability. For individuals in whom this capacity has matured, the Standard Progressive Matrices (SPM) should be used instead.

Test Administration Instructions: The coloured matrices should be administered individually or in small groups of fewer than ten persons when testing children under eight years of age, such as first and second grade pupils, or children with disabilities, intellectually disabled individuals, or the elderly, in order to ensure proper guidance, stimulate motivation, and maintain attention during the administration.

As for normal children above eight years of age, i.e., from third grade onwards, the matrices can be administered in a group setting, and children can be relied upon to record their own answers on the answer sheet, provided that there is sufficient supervision to ensure that the child has not left any page of the booklet unanswered and that answers are being recorded in their proper places on the answer sheet.

The examiner begins by giving a simple idea about the matrices, saying: "Today we will present to you a set of coloured shapes with missing parts, and you are required to identify the missing parts. This is not a school test like those given by teachers, but rather it is to find out your ability to discover the missing parts."

In individual administration, the examiner records the basic data about the examinee in the upper part of the answer sheet. In group administration, the examiner asks them to look at the answer sheet and points to each item of information in turn: starting with the name, asking each pupil to write his/her name in the designated space, then moving on to the school name and grade, and so on until all information is completed. The examiner or an assistant then passes among the pupils to verify that all data have been correctly entered in their places. Thereafter, the examiner clarifies how to record answers on the answer sheet: the answer to item A1 is recorded beside number 1 under the column for Set A; answers to Set Ab items are recorded under their respective column opposite each item number; and similarly for Set B.

The examiner opens the test booklet to the first figure, A1, and says: "Look at this picture," pointing to the main design at the top of the page. "As you can see, a piece has been cut out from this picture, and that missing piece is one of the pieces drawn below the picture," pointing to the options at the bottom of the page one after another.

"Notice that only one of these pieces is the right one to complete the main picture. Look at small shape number 1; you will see that it consists of small black and white squares and is different from the main picture, so it does not fit. If we look at shape number 2, we see that it is a green area with no pattern, so it does not fit. Moving to shape number 3, we find it consists of black slanted lines on a green area, and it differs from the main picture. As for shape number 4, it resembles the main picture in colours and shape but it is incomplete. There is only one piece that completes the main picture. Put your finger on that piece." The examiner ensures that the child has placed his/her finger on the correct piece that completes the main picture. If the child cannot identify the correct piece, the examiner provides further explanation until the problem becomes clear to the child.

The examiner records the number of the piece chosen by the child beside item 1 in the designated place on the answer sheet. In group administration, the examiner asks the pupils to write the number of the chosen piece in the designated space on the answer sheet opposite item 1 in the section for Set A; the examiner or an assistant circulates to ensure that each child has recorded the answer number in its correct place. The examiner then asks the child to turn to the next page, item A2, and says: "Now put your finger on the piece that can be placed in the gap to complete the main picture." If the child fails to reach the correct solution, the examiner re-explains the previous problem, A1, and then asks the child to solve A2. If the problem is solved successfully, the

examiner moves to item A3 and repeats: “Put your finger on the missing piece that completes the main picture.”

When moving to item A4, before the child begins to point to the piece, the examiner says: “Look carefully at the main picture,” moving his/her finger over the picture while displaying the page of the question booklet in his/her hand so the child can see it, then says: “Notice that only one among these pieces is correct. Be attentive and look at each piece before choosing the correct one,” pointing to the empty gap in the main picture. “Be careful; make sure you have found the right piece before you point to it. If you are not sure of the answer, look at the picture once more.” The examiner gives the child sufficient time until he/she settles on an answer, and accepts the child’s answer—whether correct or incorrect—without commenting on it.

The examiner then moves to item A5, following the same steps used with A4 during administration. Between A5 and A12, the examiner can use item A1 to illustrate the solution method and then ask the child to solve the item at hand. If the child fails to solve items A1 through A4, the test in its current form is not suitable for use with that child. If the child succeeds in solving these problems, the examiner proceeds to item A5, but suffices by saying: “Look carefully at the main picture, and now,” pointing to the options in sequence, “which of these pieces can fit this space?” pointing to the gap in the main picture. “Be careful, only one piece is correct. Which one is it? Make sure you have found the right piece before you point to it.” The examiner repeats the same instructions for the remaining items in Set A, recording the number of the piece indicated by the child in the designated place on the answer sheet.

When explaining the first item in Set Ab, the examiner points to the large figure or the main pattern and the gap to be filled, saying: “Notice how the shapes go in order: this, then this, then this. What is the missing shape in this place? Put your finger on the piece that fits this space. Be careful; look at each of the small shapes in turn—only one of them is correct. Which one is it?”

For items Ab2 to Ab12, after the child points to the chosen piece, the examiner says in a neutral tone: “Make sure this piece is the one that completes the main picture,” pointing to the main picture and the missing part, “If you are not sure of the answer, look at the picture again.” The examiner allows sufficient time for the child to settle on an answer, accepts the answer the child settles upon without commenting, and records the response in its place on the answer sheet. The examiner then continues presenting the remaining items of Set Ab, merely saying: “Look carefully at the main picture,” pointing to the gap in the main picture and to the six options, “Be careful—only one of these pieces completes the main picture. Which one is it?”

In Set B, the examiner follows the same method used in Set Ab, directing the child’s attention to the pattern to be completed, reminding that only one of the six pieces correctly completes the main picture, and asking the child to look carefully at each one and to ensure the correct piece has been chosen before pointing to it. The test should be presented in the same order as found in the question booklets; the examinee begins with the first item in Set A and continues through the test until the last item in Set B.

These standardized instructions are sufficient to give the child the greatest amount of guidance needed for the administration. No additional help regarding the solution method should be provided, nor should any verbal or non-verbal cues be given by the examiner that might influence the child’s response in a particular direction. It is absolutely prohibited for the examiner to tell the child the correct answer.

If simple Standard Arabic is not understood by the child, some common words from the local dialect that serve the purpose may be used, while adhering to the same meaning and without adding further explanation. Care should be taken that repeating instructions

may become tedious and may cause the child to ignore them. As long as the examiner senses that the child has understood the instructions and is proceeding carefully in solving the items, the repetition of instructions may be abbreviated, especially in group administration.

Method of Scoring the Test: Before beginning the scoring process, the examiner must review the answer sheet to ensure that the examinee's data are complete, that the answers are recorded in their proper places, and that there is nothing indicating negligence, carelessness, or failure to understand the instructions. The examiner then follows the scoring procedure outlined in the scoring key, as detailed below:

Scoring Method - Test Scoring Key: Place the table for each set beside the corresponding section on the answer sheet, so that the number of each question in the table is opposite the question number on the answer sheet. Place a mark (✓) next to the answer that matches the one in the table, and a mark (+) next to the answer that does not match. Sum the correct answers in each set and write the total at the bottom of the set section on the answer sheet; the maximum score for each set is 12. Add the three set scores and write the total in the designated space at the bottom of the answer sheet; the maximum total score is 36. Refer to the norms table to derive the percentile rank and record it in its place.

Table 01: Answers to Test Items

A	AB	B
4	1	2
5	2	4
3	3	3
4	4	2
2	5	3
3	2	1
1	5	5
2	5	4
4	4	2
1	1	1
5	1	2
2	2	5

2. Study Population, Sample, and Characteristics

2.1 Study Delimitations: The field study delimitations (temporal, spatial, and human) are as follows:

- Human delimitations: The study was conducted on a random sample of fifth-year primary pupils in the wilaya of Bordj Bou Arréridj, from which 193 pupils were drawn.
- Spatial delimitations: The field study was carried out in Bordj Bou Arréridj, according to the aforementioned spatial limits.
- Temporal delimitations: The field study was conducted starting from 21/04/2024.

2.2. Population: Because comprehensive enumeration of the original population was not feasible, a subset representing the population under study, i.e., the sample from which field data are collected, was selected (Zerouati, 2014, p. 1).

2.2.1. Sample: In the present study, the study sample was selected from fifth-year primary pupils in schools of the municipality of Bordj Bou Arréridj, totalling 193 pupils.

Table 02: Number of Items in the Test Plates

Number of Items	Coloured Progressive Matrices
12	Set A
12	Set Ab
12	Set B

2.3 Psychometric Properties

- Preamble

Every scientific investigation is governed by methodological and procedural steps; whoever works or studies in the field of scientific research must be thoroughly conversant with the principles of the scientific method. Having delineated, in the preceding chapters, the general framework of the study—including its questions, hypotheses, and objectives—and having presented the theoretical background pertaining to our topic, we now arrive at a crucial juncture in scientific inquiry, commonly termed the field component, or, more precisely, as we have titled this chapter, the methodological procedures of the study. This encompasses the pilot study, the research approach, the description of the sample and the research population, the domains and delimitations of the study, and, ultimately, the psychometric properties of the study instruments together with the appropriate statistical treatment for the subject.

2.4 Psychometric Properties of Raven's Test

- Computing the Psychometric Properties of the Test

Hypothesis 1: The level of reliability (internal consistency) of Raven's scale in the study sample is high.

Table 03: Reliability Calculation Using Cronbach's Alpha Method

Cronbach's Alpha Coefficient	Number of Scale Items	Study Sample
0.892	36	193

The reliability of the scale was computed using Cronbach's alpha formula for internal consistency, given that we sought to ascertain the extent of consistency among the items of Raven's Coloured Progressive Matrices and that the number of response alternatives exceeds two; thus, Cronbach's alpha formula was applicable. Its value across all 36 scale items reached 0.892, indicating a high degree of internal consistency for the scale; accordingly, the scale possesses a high reliability coefficient.

Table 04: Split-Half Reliability Calculation

Corrected Coefficient via Spearman–Brown Formula	Correlation Coefficient before Correction	Number of Scale Items	Sample
0.903	0.823	36	193

The reliability coefficient was computed using the split-half method by dividing the test into odd and even items and calculating reliability via the SPSS statistical package through the test's split-half procedure. According to this table, we obtained a correlation coefficient before correction of 0.823; after correction using the Spearman–Brown formula, we obtained a reliability coefficient of 0.903, a value that points to a high degree of stability for this test.

- Computing Validity Using the Discriminant Validity Method (Extreme Groups Comparison)

To compute this type of validity, the researcher followed a series of steps, as follows:

- Obtaining the total score for each individual.
- Arranging the total scores of the 193 sample members in descending order, from highest to lowest.
- Selecting the two extreme groups on the total score, i.e., dividing them into two groups based on their total test scores: the top 25% (upper third) and the bottom 25% (lower third).

The size of each group thereby became approximately 48 individuals, while the middle 50% of scorers were excluded. An independent-samples t-test was then applied to determine the significance of the differences between the means of the two groups, as follows:

Hypothesis 2: The scale possesses good discriminant validity between pupils with high and low scores.

Table 05: Validity Coefficient of Raven's Coloured Progressive Matrices Using the Discriminant Validity Method (Extreme Groups Comparison)

Groups	Sample Size	Mean	Standard Deviation	t-value	df	Significance Level
Lower group	48	15.91	2.92	-13.51	94	0.01
Upper group	48	31.21	1.93			

The table reveals that the arithmetic mean of the lower group was 15.91, with a standard deviation of 2.92, whereas the arithmetic mean of the upper group was 31.21, with a standard deviation of 1.93. The t-value for the two independent samples was -13.51, significant at the 0.01 level, which demonstrates that the scale possesses the capacity to discriminate between the two groups—an indicator of validity.

Testing the General Hypothesis: The intelligence level of fifth-year primary pupils at ... school in Bordj Bou Arréridj exceeds the hypothetical mean.

Statistical Methods Employed

- SPSS 22 statistical package
- Pearson correlation coefficient
- Cronbach's alpha coefficient for reliability
- Split-half method
- Spearman-Brown prophecy formula
- Frequencies and percentages for sample characteristics
- Arithmetic mean
- Standard deviation
- One-sample t-test: used to analyse the results of the first hypothesis

2-5. Interpretation and Discussion of Results

Preamble

Following the use and application of the measurement tools, this chapter presents, discusses, and interprets the findings of the field study, drawing on a number of statistical methods. We will discuss and interpret the results yielded for each hypothesis, relying on the outcomes obtained, on previous studies, and on the theoretical framework.

Presentation and Discussion of the Results of Hypothesis 3

The first hypothesis posits that the intelligence level of fifth-year primary pupils exceeds the hypothetical mean.

To ascertain the intelligence degree, we compute the hypothetical arithmetic mean of the total scores on the intelligence test for the study sample and apply a one-sample t-test to the scores of Raven's test for measuring intelligence.

Hypothesis 3: The general level of intelligence among the sample members, according to the test results, is good.

Table 06: Intelligence Level of Fifth-Year Primary Pupils

Variable	Sample	Hypothetical Mean	Arithmetic Mean	Standard Deviation	t-test	df	Sig.	Significance
Intelligence scores	193	18	23.27	6.746	4.276	192	0.000	Significant

The table shows that the hypothetical arithmetic mean was 18, the arithmetic mean was 23.27, and the standard deviation was 6.746. The t-test value was 4.276, with 192 degrees of freedom, which is statistically significant at the 0.000 level. Consequently, we reject the null hypothesis and accept the alternative hypothesis, i.e., there is a statistically significant difference between the arithmetic mean and the hypothetical mean on the intelligence scale in the study sample.

Comparing the arithmetic mean of the study sample (23.27) with the hypothetical arithmetic mean (18), we observe that it is greater, indicating that the intelligence score exceeds the hypothetical mean. Hence, the first hypothesis—"The intelligence level of fifth-year primary pupils exceeds the hypothetical mean"—is supported statistically.

IV. Conclusion

The findings of the present study are consistent with those of previous research: the studies by Ben Aissa (2018), Abdallah (2020), and Bouguerra (2019) all confirmed that Raven's Coloured Progressive Matrices possesses acceptable to high degrees of reliability and validity, thereby reinforcing its suitability for measuring non-verbal intelligence among pupils in the school setting. These results further align with the findings of Al-Senussi (2017), which focused on test standardization and likewise affirmed the availability of good psychometric properties, as well as with the international study by John and Smith (2021), which supported the factorial structure of the test and demonstrated its capacity to measure the general intelligence factor. With regard to points of divergence, previous studies differed from the present study in terms of sample characteristics: Abdallah (2020) included kindergarten children, whereas Ben Aissa (2018) concentrated on primary school pupils, while John and Smith (2021) encompassed a broader age range (children and adolescents). Additionally, some studies diverged in their objectives; Al-Senussi (2017) focused on standardization and the extraction of local norms, whereas the present study centred on verifying psychometric properties within a specific school context.

Research Proposals

Accordingly, the present study can be regarded as an extension of previous work, as its findings have supported what the literature has established regarding the fitness of Raven's Coloured test, while contributing to the confirmation of these results within a local educational milieu, which strengthens the case for relying on the test in diagnostic and school guidance processes. In this light, the following may be proposed:

- Conduct future studies aimed at standardizing Raven's Coloured test on large Algerian samples spanning different educational stages, in order to build accurate local norms that assist the school psychologist in interpreting results more objectively. It is also suggested that the scope of research be expanded to include special groups such as pupils with learning difficulties or academic delay, to examine the test's sensitivity in detecting individual differences within these groups.
- Undertake comparative studies between Raven's test and other intelligence tests (verbal and non-verbal) with a view to verifying concurrent validity and deepening the comprehensive understanding of the structure of intelligence among pupils.
- Investigate the impact of certain demographic variables such as gender, economic status, and urban versus rural environment on pupils' performance on the test.
- Carry out longitudinal studies that track the stability of non-verbal intelligence over time in the same sample, which would allow a more precise verification of the test's temporal reliability. Moreover, technological advances could be harnessed to design digital versions of Raven's test and to study their psychometric properties in comparison with the paper-based version.
- Deepen the investigation of the test's factorial structure using advanced statistical methods (such as confirmatory factor analysis) in order to ascertain the extent to which it measures the general intelligence factor within the Arabic school environment.

At the close of this psychometric study of Raven's Progressive Matrices, it can be affirmed that this test ranks among the most prominent assessment tools in the domain of measuring intelligence and mental abilities, owing to its distinguished psychometric properties,

which render it an ideal instrument for use in diverse environments and cultures and support its fitness for psychological, educational, and vocational diagnosis. Ultimately, Raven's test remains a valuable tool in the arsenal of educational and clinical psychology, on condition that it is employed integratively with other assessment instruments and methods, in order to ensure a comprehensive and accurate picture of the individual's cognitive capacities.

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