



Research Article

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Reasoning Disorders Tests and School Success: A Study of the Correlation Between Tests, Reasoning Disorders and Success Rates in Affected Children in Morocco

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Abstract

Early detection of reasoning disorders has become a national priority; however, despite concerted efforts, certain children still receive late diagnoses. Notably, this study found that children of Moroccan origin were more susceptible to delayed diagnoses. The primary objective of this research was to identify specific tests relevant to various types of reasoning disorders and to establish the correlation between diagnostic assessments for reasoning disorders and academic performance, using quantitative methods. The study employed a non-experimental, correlational research design. Furthermore, the following variables were taken into account: gender, disorders, and success rates. The sample consisted of 621 students from three schools (colleges) under the jurisdiction of the Bouskoura provincial government. Data collection was carried out by completing a questionnaire developed by speech therapists from GEPALM (Study Group on the Psychopathology of Logical-Mathematical Activities) and Cogi'Act (a research group dedicated to promoting speech therapy research). The collected data were analyzed using IBM SPSS Statistics 21 software. The results revealed a significant correlation ($p\text{-value} = 0.013$) between tests identifying different types of reasoning disorders and the percentage of academic success. The correlation was found to be of high intensity, accounting for 81.6% of all correlations. Additionally, various types of reasoning disorders exhibited significant correlations with the success rate, indicating a strong negative intensity ($r = -0.816$). The strength of the correlation varied depending on the specific relationship and the type of reasoning disorder. In conclusion, this study emphasizes the need for further research to fully comprehend the impact of reasoning disorders on academic success. Additionally, it highlights the necessity of effective and tailored educational interventions for each type of reasoning disorder.

Keywords: tests; diagnosis; correlation; reasoning disorders; academic achievement

1. Introduction

In the process of teaching and learning, children with ADHD, who belong to the group of reasoning disorders, have a lower academic achievement rate compared to their non-ADHD peers of the same age. Reasoning disorders include a variety of cognitive difficulties that impact an individual's thinking, information processing and decision-making abilities. These disorders can manifest in various forms, including attention deficit/hyperactivity disorder (ADHD), working memory deficits, long-term memory loss, theory of mind deficits, visuospatial relational deficits, difficulties in understanding and applying analogies, effects of brain injuries on decision-making, and disruptions in moral reasoning.

To diagnose and understand these reasoning disorders, healthcare professionals rely on specific diagnostic tests tailored to each pathology. In this article, we will explore the diagnostic tests used for each of these reasoning disorders.

ADHD (Attention Deficit Hyperactivity Disorder)

1. Conners' Rating Scale for ADHD (CAARS): A comprehensive tool for assessing the severity of ADHD symptoms in individuals of varying age groups, including children, adolescents and adults. It evaluates key aspects of ADHD such as inattention, hyperactivity and impulsivity, aiding in diagnosis and intervention monitoring [1].
2. Brown's ADHD Rating Scale (BAARS): Specifically designed for adults, it focuses on executive function deficits associated with ADHD, encompassing issues such as working memory, time management, and organisational challenges, providing insights into how ADHD impacts daily functionality [2].

1.1 Working Memory Impairments

Tower of London Test: A neuropsychological tool assessing planning, problem-solving, and executive functioning skills. Participants rearrange coloured balls to match a target configuration, evaluating their ability to execute steps efficiently. This is often used for frontal lobe dysfunction assessment. [3].

Corsi Block-Tapping Test evaluates visuospatial working memory and short-term memory. Participants reproduce sequences of blocks tapped by the examiner, assessing their capacity to temporarily store and manipulate visuospatial information. Valuable for studying working memory and spatial memory deficits [4].

1.2 Long-Term Memory Loss

Wechsler Memory Scale: Assesses verbal memory and recall abilities through short stories or passages, evaluating an individual's capacity to encode, store and retrieve verbal information from memory, offering insights into their verbal memory function (Wechsler, 1945) [5].

Key Auditory Verbal Learning Test. Evaluates verbal memory and learning abilities through word recall tasks, measuring an individual's capacity to learn and retain verbal information, along with their susceptibility to interference and retrieval cues [6].

1.3 Theory of Mind Deficits

Sally-Anne False Belief Task: Evaluates an individual's theory of mind, testing their understanding of false beliefs through a story involving characters, assessing their ability to comprehend that someone can hold a false belief about an object's location due to absence during its relocation. A correct response demonstrates an understanding of false beliefs, a crucial component of theory of mind. [7]

Happé's Faux Pas Task assesses an individual's capability to identify and comprehend social faux pas or socially inappropriate remarks and behaviours within interpersonal scenarios. Participants

analyse stories for instances of social blunders, explaining why these actions are socially unacceptable. This task measures theory of mind and social cognition, requiring recognition of breaches in social norms and comprehension of the emotional and social implications of such conduct. [8]

1.4 *Visuospatial Relational Deficits*

Rey-Osterrieth Complex Figure Test: Assesses visuospatial and constructive abilities along with immediate and delayed recall of visual information. Participants copy and reproduce a complex geometric figure, providing insights into cognitive functions such as visuospatial perception, memory, and executive functioning. [9]

Kohs Block Design Test: Evaluates visuospatial and constructional abilities through tasks involving arrangement of cubes to match a given pattern. The test measures an individual's capacity for spatial perception, mental manipulation of objects, and organisational skills. It is commonly used in neuropsychological assessments to evaluate cognitive functioning and visual problem-solving. [10]

1.5 *Difficulties in Understanding and Applying Analogies*

Wechsler Similarities Test: Assesses abstract verbal reasoning and conceptualisation in the Wechsler Intelligence Scales, where individuals describe similarities between word pairs. It measures verbal comprehension, abstract thinking, and the ability to identify and explain conceptual commonalities. [11]

1.6 *Effects of Brain Lesions on Decision-Making*

Iowa Gambling Task: Assesses decision-making and risk-taking abilities by evaluating choices made from different card sets to maximise gains. It measures the ability to learn from feedback and make advantageous choices, particularly in conditions involving frontal lobe lesions and addiction. [12]

Wisconsin Card Sorting Test: Evaluates cognitive flexibility, problem-solving, and executive functioning through card sorting based on changing rules. It assesses the capacity to adapt strategies and maintain mental flexibility, particularly relevant in conditions like frontal lobe dysfunction and ADHD. [13]

1.7 *Disruptions in Moral Reasoning*

Lawrence Kohlberg's Moral Reasoning Test: Assesses moral development and reasoning through the presentation of ethical dilemmas, based on Kohlberg's theory of moral development. Participants' responses are analysed to determine their stage of moral development, reflecting increasing complexity from simple obedience to reasoned understanding of universal moral principles. [14]

Given the scarcity of studies aimed at specifying the various diagnostic tests for the eight reasoning disorders precisely and the most suitable screening tool for each of these different types of disorders.

Our objective is to determine the different diagnostic tests for reasoning disorders and associate each test most suitably with each type of reasoning disorder mentioned in the previous article [15].

Additionally, in this study, we aim to identify the potential correlations between reasoning disorders, tests, and academic achievement among Moroccan children.

2. Materials and Methods

2.1 Participants

A research study was conducted on a sample of 621 students. This was made possible through a foundation under the jurisdiction of the Nouaceur regional authority (Nouaceur regional instruction: an administrative region, independent but linked to the Casablanca-Settat Academy). Among these students from three middle schools, 48.9% were boys, and 51.1% were girls. The sample comprises children with an average age ranging from 11.90 years to 15.70 years, with participants having a socio-economic status that is moderately low in the province of Nouaceur, within the community of Bouskoura. They were surveyed using a random sample, and the teachers were contacted prior to data collection to assess their level of agreement with the study's objectives. Table 1 below presents the characteristics of the study participants. The sample comprises children with an average age ranging from 11.90 years to 15.70 years, with participants having a socio-economic status that is moderately low in the province of Nouaceur, within the community of Bouskoura.

Table 1. Percentage of students by gender and by disorder.

Trouble	Gender					
	Female		Male		Total	
	Age		Age		Age	
	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation
ADHD	13.80 years	1.49	14.50 years	1.56	14.15	1.52
Working Memory Disruptions	15.51 years	1.40	15.89 years	1.43	15.70	1.41
Long-Term Memory Loss	14.71 years	1.12	15.20 years	1.14	14.95	1.13
Theory of Mind Deficits	12.63 years	0.46	12.75 years	0.58	12.69	0.52
Déficits Relationnel visuospatial	12.20 years	0.78	12.60 years	0.81	12.40	0.79
Challenges in Understanding and Applying Analogies	13.25 years	1.29	13.42 years	1.35	13.33	1.32
The Effects of Brain Damage on Decision Making	11.82 years	1.15	11.98 years	1.27	11.90	1.21
Disruptions of moral reasoning	14.53 years	0.98	14.78 years	1.21	14.65	1.09
Total	13.55	1.08	13.89	1.16	13.72	1.12

The average age of our study sample is 13.72 years. In the case of boys in secondary school, the average is around 13.89 years, while the average for girls is around 13.55 years. (Table 2)

Table 2. Average age by gender and disorder.

Trouble	Gender					
	Female		Male		Total	
	Workforce	N% Table	Workforce	N% Table	Workforce	N% Table
ADHD	56	9%	76	12.2%	132	21.2%
Working Memory Disruptions	49	7.9%	50	8%	99	15.9%
Long-Term Memory Loss	48	7.7%	54	8.7%	102	16.4%
Theory of Mind Deficits	42	6.8%	24	3.9%	66	10.7%
Visuospatial Relational Deficits	50	8.1%	34	5.5%	84	13.6%

Trouble	Gender					
	Female		Male		Total	
	Workforce	N% Table	Workforce	N% Table	Workforce	N% Table
Challenges in Understanding and Applying Analogies	29	4.7%	28	4.5%	57	9.2%
The Effects of Brain Damage on Decision Making	26	4.2%	22	3.5%	48	7.7%
Disruptions of moral reasoning	17	2.7%	16	2.6%	33	5.3%
Total	317	51.1%	304	48.9%	621	100%

2.2 Measurement Instruments

The Gepalm and Cogi'Act questionnaire for speech therapists is a survey aimed at gathering feedback and responses from speech therapists who use these two specific tools in their work. The questionnaire aimed to collect information about their demographic data, experience with Gepalm and Cogi'Act, their level of satisfaction, the difficulties encountered, and their suggestions for improvement. The data collected from this questionnaire helps the developers of Gepalm and Cogi'Act to improve their products and services to better meet the needs of speech therapists and their clients.

Test Validation: the validation process of the diagnostic questionnaire draws from Gepalm and Cogi'Act, utilised for identifying reasoning disorder issues in Moroccan students, went through a careful series of moves towards ensuring their reliability and validity. At first, an exhaustive writing survey was conducted to lay out a hypothetical structure and identify relevant ideas. Following this, questions were created to cover a range of cognitive abilities and ways of behaving relevant to the target population. These questions were then evaluated by a panel of experts in psychology, education, and assessment to ensure clarity, relevance, and fairness. Pilot testing with a little gathering of understudies considered refinement of the polls before full-scale approval. Information assortment from a bigger example empowered investigations of dependability and legitimacy, enveloping measures, for example, inward consistency, test-retest unwavering quality, content legitimacy, develop legitimacy, and model legitimacy. Cross-approval with a free example guaranteed the generalizability of the outcomes. Regulating information was additionally collected to lay out reference values for understanding. Eventually, in view of the results of this thorough cycle, the surveys were completed to identify thinking problems in Moroccan students effectively.

Learning outcomes: The success rate of students facing these issues is presented on the "MASSAR" platform.

The "MASSAR" platform is a school management system accredited by the Moroccan Ministry of National Education. It represents the prevalence rate of 8 types of reasoning disorders.

2.3 Design.

We employed quantitative methods, incorporating both experimental and correlational approaches, to investigate diagnostic tests for reasoning disorders, the disorders themselves, and their association with academic achievement. We simultaneously conducted tests for students of different ages and levels. We note that the results could lead to a new direction in pedagogical thinking.

2.4 Data Analysis

Pearson correlation analyses were carried out to investigate the connections between eight reasoning disorders and fourteen diagnostic tests. The findings are shown in the form of correlation matrices containing details such as the number of observations (N), the p-value (indicating the correlation's

significance), the Pearson correlation coefficient (r), and the square of this coefficient (r^2). Partial correlations were utilised to evaluate these connections whilst taking control variables into account, including age, gender and disorder. The set significance threshold was $p=0.05$, with the analysis performed utilising IBM SPSS Statistics 21 software.

3. Results

3.1 Relationship between reasoning disorders and educational achievement.

There is a correlation between the eight reasoning disorders included in the Gepalm and Cogi'Act questionnaire and each diagnostic test for reasoning disorders, controlled by three variables: gender, disorder, and success rate. The eight reasoning disorders have highly significant correlations with the diagnostic tests for these disorders, of strong intensity ($r=1.000$).

Table 3 presents the 14 diagnostic tests for reasoning disorders with the 8 types of reasoning disorders according to the Gepalm and Cogi'Act questionnaire. We found that out of the 288 calculated correlations, 152 relationships were positive, which are highly significant ($p = 0.01$ to 0.996), accounting for 52.7% of all relationships. We note that diagnostic tests and reasoning disorders have highly significant correlations ($p = 0.000$). These correlations are explained by the control effect on the correlations of reasoning disorders, which include gender, disorder, and success rate.

Table 3. Correlations between diagnostic tests of reasoning disorders controlled by gender, disorder, and success rate in school

Reasoning Disorder Tests	Control Effect on Reasoning Disorders			
	Gender		Disorder	Success Rate
	M	F		
Conners' Rating Scale for ADHD (CAARS) and Brown's ADHD Rating Scale (BAARS) [16,17].	77.5 %	22.5 %	ADHD	68%
Tower of London Test and Corsi Block-Tapping Test [18,19]	53.4%	46.6%	Working Memory Impairments	40%
Wechsler Memory Scale and Rey Auditory Verbal Learning Test [20,21]	43%	57%	Long-Term Memory Loss	33%
Sally-Anne False Belief Task and Happé's Faux Pas Task [22,23]	61 %	39 %	Theory of Mind Deficits	30%
Rey-Osterrieth Complex Figure Test and Kohs Block Design Test [24,25]	53.4 %	46.6 %	Visuospatial Relational Deficits	66%
Wechsler Similarities Test [26]	-----	-----	Challenges in Understanding and Applying Analogies	50 %
Iowa Gambling Task and Wisconsin Card Sorting Test [27,28]	88.4%	11.9%	The Effects of Brain Damage on Decision Making	45,2%
Lawrence Kohlberg's Moral Reasoning Test [29]	74%	26%	Disruptions of moral reasoning	30%

3.2 Kolmogorov-Smirnov and Shapiro-Wilk Normality Test.

In order to analyse our data using Pearson's correlation for our variables, we must test for normality. If the data does not follow a normal distribution, which corresponds to a Gaussian curve, we cannot use the tests referred to as parametric tests. In this regard, we should use equivalent non-parametric tests. A non-parametric test is one that is based on the study of the ranks of observations and does not make any specific assumptions about the shape of the original distribution. However, it is true that some tests are robust to the non-normality of the data.

To test the normality of the distributions and determine which test to perform accordingly, there are several methods. The simplest method is to examine the skewness coefficients (Skewness) and kurtosis coefficients (Kurtosis) in the SPSS software. Skewness and kurtosis values between -1.96 and +1.96 are considered acceptable to demonstrate a univariate normal distribution.

The most common method for testing the normality of the distribution involves using one of these two common tests. The first one is the Shapiro-Wilk test, and the other is the Kolmogorov-Smirnov test (KS test).

Table 4. Normality tests

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistique	ddl	Signification	Statistique	ddl	Signification
Reasoning impairment tests	,105	8	,200*	,975	8	,933
Gender	,513	8	,000	,418	8	,000
Percentage of gender male	,205	8	,200*	,907	8	,331
Percentage of gender female	,162	8	,200*	,959	8	,799
Disorder	,105	8	,200*	,975	8	,933
Success rate	,166	8	,200*	,879	8	,182
*. This is a lower bound of the actual significance						
a. Lilliefors significance correction						

Typically, for a test to be significant, the P-value should be less than 0.05. In the cases of the Shapiro-Wilk and KS tests, normality is established when the significance of the P-value is greater than 0.05. Otherwise, it indicates that the data does not follow a normal distribution. See Table 4.

The following table presents the results of the Kolmogorov-Smirnov and Shapiro-Wilk normality tests. In the Kolmogorov-Smirnov normality test, the p-value=0.2 > 0.05 is not significant for all variables except for the 'Gender' variable, where p-value=0.000 < 0.05 is significant. In other words, we accept Ho, according to which the variables "Reasoning impairment tests," "Percentage of gender male", "Percentage of gender female," "Disorder," and "Success rate" follow a normal distribution. On the contrary, the 'Gender' variable follows an abnormal distribution.

However, in the Shapiro-Wilk normality test, the p-value ranging from 0.1-0.9 is >5% for all variables except for the "Gender" variable, where the p-value is 0.000 <5%. This leads us to accept Ho, according to which all the variables are normally distributed, except for the "Gender" variable, which has an abnormal distribution. Therefore, the data of the study sample are normally distributed except for the gender data.

3.3 Correlation between reasoning disorders, reasoning impairment tests, and success rate.

Table 5. Pearson Correlations between Disorder, Reasoning Disorder Tests, and Success Rate

		Disorder	Success rate	Reasoning impairment tests
Disorder	Pearson Correlation	1	-,816*	1,000**
	Sig. (two-tailed)		,013	,000
	N	105	105	105
Success rate	Pearson Correlation	-,816*	1	-,816*
	Sig. (two-tailed)	,013		,013
	N	105	105	105
Reasoning impairment tests	Pearson Correlation	1,000**	-,816*	1
	Sig. (two-tailed)	,000	,013	
	N	105	105	105

*. The correlation is significant at the 0.05 level (two-tailed).

** The correlation is significant at the 0.01 level (two-tailed).

3.3.1 Correlation between reasoning disorders and reasoning impairment tests.

We aimed to establish a connection between the disorders of children at the start of the study and the impairment tests for reasoning. Because both variables are on a continuous scale and we have

already confirmed their normal distribution and linear relationship, we used the Pearson's correlation R. When correlating a variable with itself, for example, disorder with disorder, it will have a perfectly positive correlation. Similarly, when correlating reasoning impairment tests with other reasoning impairment tests, they will be perfectly positively correlated as evident from the diagonal. These correlation coefficients range from -1 to 1, where +1 signifies a perfect positive correlation, indicating that they lie exactly on a straight line.

The first value is our actual correlation coefficient, indicating the strength of the linear relationship between our variables, which is 1. In a table, such a value denotes a strong positive correlation. The second value to examine is the significance value, with a p-value of 0.000. Comparing this to the significance threshold of 0.05, being below it indicates that the correlation is statistically significant. This suggests there is enough evidence to suggest that the observed correlation indeed exists within the population.

3.3.2 Correlation between reasoning impairment tests and success rate

We investigated the relationship between the reasoning impairment tests and the success rate. Having ensured the normality of the distribution of these two variables and their linear relationship, we employed Pearson's correlation.

The correlation coefficient between the reasoning impairment tests and the success rate is -0.816, indicating a strong negative linear correlation between these two quantitative variables. The significance value, with a p-value of 0.013 < 0.05, indicates that this correlation is statistically significant. This confirms the existence of a relationship between the reasoning impairment tests and the success rate in the population. It implies that reasoning impairment tests impact the success rate negatively, as an increase in the number of reasoning impairment tests corresponds to a decrease in the success rate.

3.3.3 Correlation between reasoning disorders and success rate

We examined the relationship between reasoning disorders and the success rate. Ensuring the normality of the distribution of these two variables and their linear relationship, we utilised Pearson's correlation.

The correlation coefficient between reasoning disorders and the success rate was -0.816, denoting a strong negative linear correlation between these two quantitative variables. The significance value is a p-value of 0.013 < 0.05, indicating that this correlation is statistically significant. This validates the existence of such an association between reasoning disorders and the success rate in the population. It suggests that reasoning disorders negatively affect the success rate. (See Table 5)

3.4 Correlation between reasoning disorders, gender, and success rate

Table 6. Pearson Correlations between Gender, Reasoning Disorder Tests, and Success Rate

		Success rate	Reasoning impairment tests	Gender
Success rate	Pearson Correlation	1	-.816*	.404
	Sig. (two-tailed)		.013	.321
	N	105	105	105
Reasoning impairment tests	Pearson Correlation	-.816*	1	.247
	Sig. (two-tailed)	.013		.555
	N	105	105	105
Gender	Pearson Correlation	.404	.247	1
	Sig. (two-tailed)	.321	.555	
	N	105	105	105

*. The correlation is significant at the 0.05 level (two-tailed).
Correlation between reasoning impairment tests and gender

We aimed to examine the relationship between reasoning impairment tests and gender. To achieve this, we conducted Pearson's correlation after observing the normality of the reasoning impairment tests and the non-normality of gender. However, the non-normality of the data is not necessary at all when establishing this correlation.

The correlation coefficient between reasoning impairment tests and gender was 0.247, indicating a weak positive linear correlation between these two quantitative variables. The significance value, with a p-value of $0.555 > 0.05$, reveals that this correlation is statistically insignificant. This confirms the absence of a relationship between the reasoning impairment tests and gender in the population, suggesting that gender does not influence the results of reasoning impairment tests.

3.4.1 Correlation between reasoning impairment tests and success rate

Having confirmed the normality of the distribution of these two variables and their linear relationship, we established Pearson's correlation to test the presence of a relationship between the reasoning impairment tests and the success rate.

The correlation coefficient between the reasoning impairment tests and the success rate is -0.816, indicating a strong negative correlation between these two quantitative variables. The significance value is a p-value of $0.013 < 0.05$, demonstrating that this correlation is statistically significant. This validates the presence of a link between the reasoning impairment tests and the success rate in the population. It means that as the number of reasoning impairment tests increases, the success rate decreases.

3.4.2 Correlation between gender and success rate

After confirming the normal distribution of these two variables and concluding that they have a linear relationship, we established Pearson's correlation. We aimed to test the presence of a relationship between gender and the success rate.

The correlation coefficient between gender and the success rate is 0.404, indicating a moderate positive correlation between these two quantitative variables. The significance value is a p-value of $0.321 > 0.05$, signifying that this correlation is statistically insignificant. This confirms the absence of a link between the gender and the success rate in the population. It means that the gender variable does not affect the success rate. (See Table 6)

3.5 Correlation between the percentage of male gender, the percentage of female gender, and the success rate.

Table 7. Pearson Correlations between Male Gender Percentage, Female Gender Percentage, and Success Rate

		Success rate	Percentage of gender male	Percentage of gender female
Success rate	Pearson Correlation	1	-,167	-,496
	Sig. (two-tailed)		,694	,212
	N	105	105	105
Percentage of gender male	Pearson Correlation	-,167	1	,106
	Sig. (two-tailed)	,694		,802
	N	105	105	105

Percentage of gender female	Pearson Correlation	-,496	,106	1
	Sig. (two-tailed)	,212	,802	
	N	105	105	105

3.5.1 Correlation between the percentage of male gender and the percentage of female gender.

We conducted Pearson's correlation after confirming the normal distribution of these two variables and observing their linear relationship. We sought to determine the presence of a relationship between the percentage of males and the percentage of females.

The percentage of male gender and the percentage of female gender exhibit a weak positive correlation, with a correlation coefficient of 0.106. However, the significance value (p-value) is 0.802, which exceeds 5%. Thus, this correlation is not statistically significant, confirming the absence of a correlation between the percentage of male gender and the percentage of female gender in the population. This suggests that the percentage of male gender no longer influences the percentage of female gender.

3.5.2 Correlation between the percentage of male gender and the success rate.

After verifying the normal distribution of both variables, which showed a linear relationship, we established Pearson's correlation. We wanted to examine whether there is a relationship between the percentage of male gender and the success rate.

The relationship between the percentage of male gender and the success rate is weakly negative, with a correlation coefficient of -0.167. The p-value is greater than 5%, reaching a value of 0.694. Therefore, this correlation is not significant, indicating that there is no correlation between the percentage of male gender and the success rate. This implies that the percentage of male gender does not have an impact on the success rate.

3.5.3 Correlation between the percentage of female gender and the success rate.

We established a Pearson correlation after confirming the normal distribution of both variables and their linear relationship. We wanted to determine whether there is a relationship between the percentage of females and the success rate.

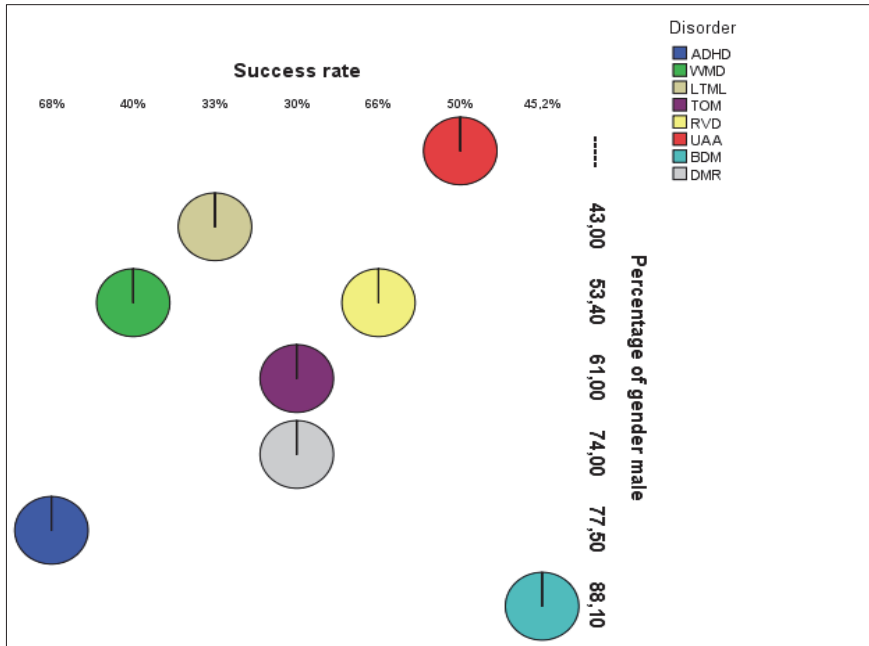
The correlation between the percentage of females and the success rate is moderately negative, with a correlation coefficient of -0.496. The p-value is greater than 5%, with a value of 0.212. This relationship is not significant, indicating that there is no correlation between the percentage of female gender and the success rate. This suggests that the percentage of female gender does not have an effect on the success rate. (See Table 7)

3.6 Analysis of graphs by groups of three variables

3.6.1 Comparison by gender

- a) Analysis by male gender: Male children, accounting for 88.10% of those affected by the effects of brain lesions on decision-making, achieve a moderate success rate of 45.2%. Boys, representing 77.50% of the population with ADHD, achieve a success rate of 68%. On the other hand, 74% of male learners with disruptions in moral reasoning achieve a success rate of 30%. Nonetheless, 61% of male pupils with theory of mind deficits attain a success rate of 30%. Despite this, 53.40% of male children experiencing difficulties in working memory and visuospatial relational deficits achieve success rates of 66% and 40% correspondingly. Nevertheless, 43% of male students with long-term memory impairment reach a success

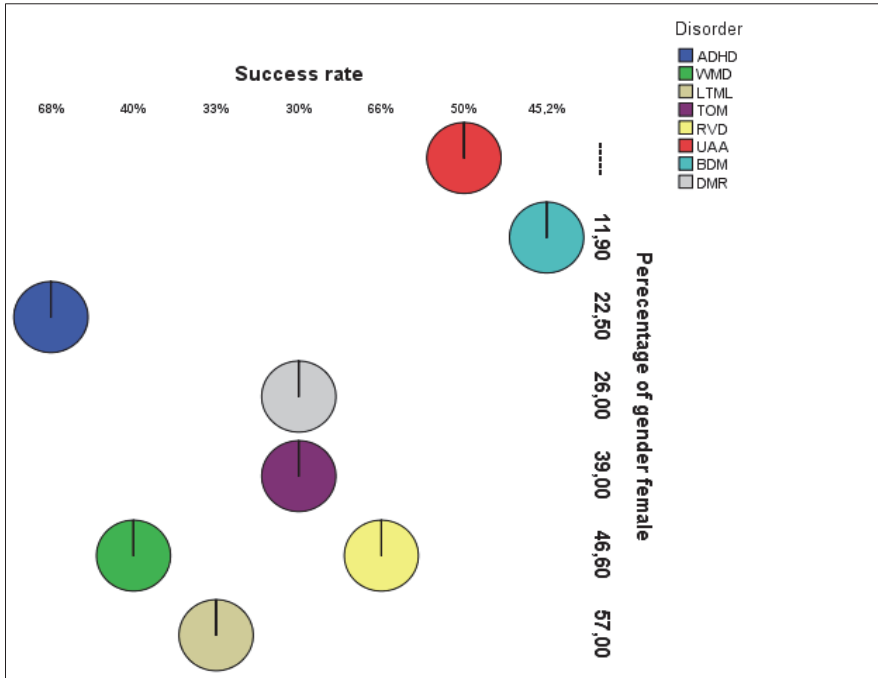
rate of 33%. Finally, an unidentified percentage of boys who face difficulties related to understanding and applying analogies achieve a moderate success rate of 50%. (See figure 1.)



GRAPH; /PIE=COUNT BY DR; /PANEL COLVAR=SR COLOP=CROSS ROWVAR=PGdrF ROWOP=CROSS.

Figure 1: Percentage of male gender based on disorder and success rate

- b) Analysis by female gender: The success rate for female students experiencing long-term memory loss is 33%, whereas girls facing both working memory disruptions and visuospatial relational deficits achieved success rates of 40% and 66%, respectively, with a total success rate of 57%. Only 39% and 26% of female learners exhibiting deficits in theory of mind and disruptions in moral reasoning achieved success rates of 30%, while a small proportion of 22.5% of females with ADHD achieved a high success rate of 68%. On the other hand, 11.9% of female students experiencing the effects of brain lesions on decision-making showed a moderate increase in the success rate, reaching 45.20%. Conversely, an unspecified percentage of a category of female students demonstrating difficulties in understanding and applying analogies achieved a success rate of 50%. (See Figure 2)



GRAPH; /PIE=COUNT BY DR; /PANEL COLVAR=SR COLOP=CROSS ROWVAR=Tests ROWOP=CROSS.

Figure 2: Percentage of female gender based on disorder and success rate.

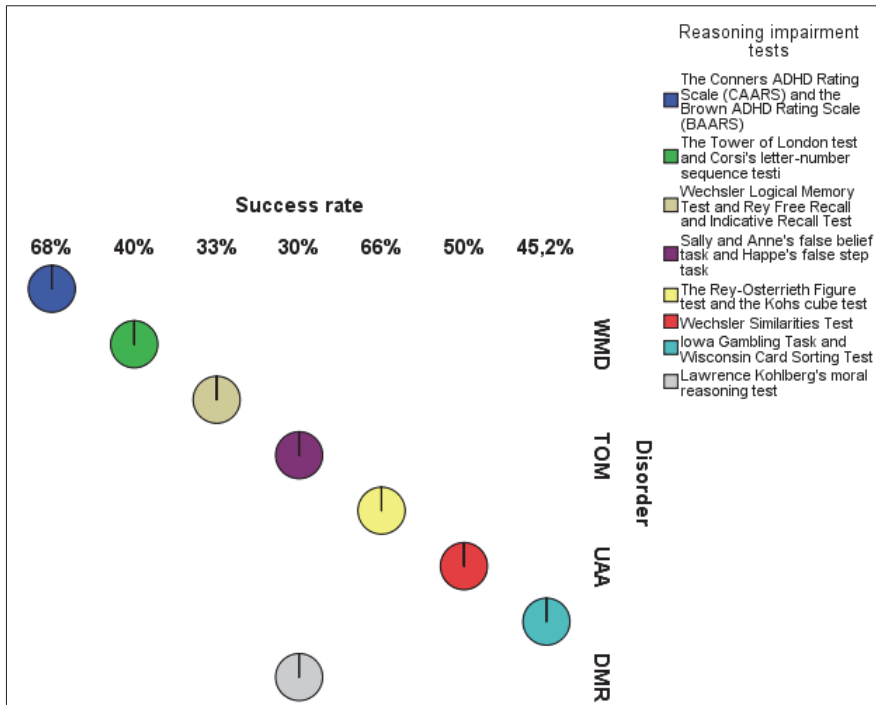
3.6.2 Analysis by disorder

The first category of children, with the highest success rate of 68%, reveal that they suffer from ADHD, diagnosed using the Conners' ADHD Rating Scale (CAARS) and Brown's ADHD Rating Scale (BAARS). They are followed by the category of children with a 66% success rate, showing visuospatial relational deficits, detected through the Rey-Osterrieth Figure Test and the Kohs Block Design Test. Meanwhile, half of the children, 50%, who have succeeded, experience difficulties related to understanding and applying analogies, identified through the Wechsler Similarities Test, placing them in the third category.

Children with a 45.2% success rate demonstrate the effects of brain lesions on decision-making after completing the Iowa Gambling Task and the Wisconsin Card Sorting Test, placing them in the fourth category of significantly affected children, reflecting their academic success rate.

Simultaneously, the fifth category of learners, achieving a 40% success rate, experience disruptions in working memory, identified through the Tower of London Test and the Corsi Block-Tapping Test. However, 33% of the academic success of students is associated with long-term memory loss, detected through the Wechsler Memory Scale and the Rey Auditory Verbal Learning Test, constituting the sixth category of students.

Although a low success rate of 30% is associated with deficits in theory of mind and the effects of brain lesions on decision-making, identified sequentially through Sally and Anne's False Belief Task, Happé's Faux Pas Task, the Iowa Gambling Task, and the Wisconsin Card Sorting Test, forming the last category in the classification of disorders according to their decreasing intensity on students' academic success. (See figure 3)



GRAPH; /PIE=COUNT BY DR; /PANEL COLVAR=SR COLOP=CROSS ROWVAR=Tests ROWOP=CROSS.

Figure 3: Disorder according to reasoning impairment diagnostic tests and success rate.

4. Discussion

First of all, let us recall that our research aims to identify the different reasoning impairment tests that are appropriately detected for each type of disorder, as well as to discern the correlation between reasoning impairment tests and different types of reasoning disorders affecting Moroccan children along with their academic success rate. It aims to identify the typology of disorders based on their degree of impact on student learning whilst explaining their influences on academic performance. We will discuss key findings based on the research objective: studying the correlation by choosing the age group most affected by reasoning disorders that disrupt the student's educational journey, reasoning impairment tests and the gender effect, along with their academic success rate.

Our initial results have demonstrated that all tests for reasoning disorders maintain strongly positive correlations amongst themselves, i.e. the more the diagnostic tests for reasoning disorders are positive, the more it reveals the presence of reasoning disorders which occurs also increases. These have a very significant negative direct impact on the academic success rate of the students. This means that children presenting these disorders, as indicated by the tests, have a detrimental effect on their lower success rate. In other words, students who will receive support according to their type of disorder will statistically be capable of improving their academic success rate.

These findings have been validated by Español-Martín et al. [30], who confirmed that ADHD is associated with numerous academic difficulties, including poor grades, low academic performance, special educational needs, repetition, and failure to complete secondary education, even after adjusting for intelligence, SES, and cognitive decline. It is worth noting that the present study

confirms, for the first time, the association between the diagnosis of ADHD and academic outcomes in Spain. It supports the previous analysis conducted by Pagerols et al. who found that learners with high attention problems were more likely to achieve poor results. This was regardless of other risk factors such as comorbid psychopathology, sociodemographic characteristics, stressful events, and lifestyle-related behaviours, all of which have a significant effect. As shown in the study conducted by Shi and Qu [31], which mentions the effects of cognitive ability and self-control on academic outcomes, all five cognitive abilities have a significant positive impact on overall academic performance, whilst Gathercole and Pickering [32] revealed that children with lower academic outcomes exhibited notable deficiencies in measures of central executive function, notably in visuospatial working memory. Additionally, according to de Wilde et al., other socio-relational factors can increase the rate of academic failure among children with these reasoning disorders, as lower working memory scores were associated with increased teacher-child conflicts and decreased teacher-child warmth one school year later, in addition to a decrease in peer empathy during the same school year [33].

These studies show consistency between the results obtained in this study and the existing literature which confirms the negative relationship that exists between reasoning difficulties and academic success rate.

The proposed hypotheses have been fully verified by the results. In the field of educational psychology, teachers need to enquire about the type of reasoning disorders the students they encounter have. The idea is to understand what sets them apart from others and to promote their active learning, taking into account their deficit in order to offer follow-up educational sessions within listening cells or to refer them to a speech therapist. All of these efforts aim at the learner's interest and have a significant influence on their academic success rate. Educational psychologists, including David Johnson, Roger Johnson [34], and Elizabeth Cohen [35], have emphasised the importance of making efforts at the level of peer learning. This includes taking into account socio-relational factors as this allows students to develop social and cognitive skills, and strengthen their self-confidence to improve their academic performance, especially amongst learners who experience reasoning disorders.

Peer learning has numerous practical implications for educational settings. First and foremost, it gives an amazing asset to working on how children might interpret course material. By clarifying ideas for one another, schoolchildren develop their comprehension and retention of data.

Moreover, peer learning develops fundamental relational abilities by encouraging students to articulate their thoughts clearly, listen effectively to others, and provide useful feedback. This works on their scholarly execution, yet additionally sets them up to convey successfully in different individual and expert settings. Moreover, peer learning advances decisive reasoning as youngsters participate in conversations and collaborative critical thinking exercises. By challenging each other's viewpoints and exploring information together, students develop the ability to think critically and evaluate arguments. Likewise, peer learning enhances inspiration and commitment by creating a stable and intuitive learning environment. Youngsters feel more connected to the material and to one another, leading to increased support and enthusiasm for learning. Overall, the beneficial effects of peer learning go beyond academic achievement and include the development of essential skills for success in both intellectual and real-world contexts.

In this regard, it seems that teachers in teaching and learning situations form groups based on their psychological characteristics, which can promote the conjunction of this group and, ultimately, increase the collective and individual success of learners. However, results have emerged regarding the relationships between gender and the academic success rate, ranging from lower results with negative associations in children exhibiting ADHD inattention symptoms. While these studies have not reported any relationship between gender and success rate [36,37], another study suggests that differences between genders were not significant for children with deficient working memory, which has a negative effect on their academic success in various academic subjects [38].

The results indicate that the gender factor does not have a significant impact on the success

rate, despite the moderately high correlation coefficient between gender and the success rate. Statistically speaking, it is preferable to work in different contexts with a larger sample. In this way, we can broaden it to include primary and secondary school pupils in multiple institutions in various provincial directions.

5. Conclusions

The aim of our study was to correlate diagnostic tests for reasoning impairment and students' reasoning disorders with their academic success rate, to identify relevant and effective educational interventions. Thus, it was essential to begin by disseminating the Gepalm and Cogi'Act questionnaire aimed at speech therapists to identify the different screening tests for reasoning impairment used in Morocco.

This study provides well-supported and highly significant negative correlations between reasoning impairment tests and academic outcomes. The more the reasoning impairment test leads to a positive diagnosis of the disorder, the lower the chances of success for the suspected students because of their lower cognitive performances as a consequence of these disturbances. Subsequently, reasoning disorders have proven their detrimental impact on academic outcomes, leading to negative academic results. A multidimensional approach allows for an understanding of the complexity of the learner's cognitive behaviours.

It is undeniable that the efficacy of teacher intervention requires an increased investment. Indeed, the act of teaching is a complex process that depends on various factors to equip learners with essential skills. The results obtained represent a step towards a better understanding by all actors in the Moroccan educational system of the fundamental importance of the role of teachers beyond the mere transmission of knowledge. Psychological behaviour is a factor to be considered, and speech therapy intervention for these affected children can maintain effective and relevant educational intervention, as the student lives in an invigorating context that impacts their academic performance and allows them to open up to their environment. This should be the priority of the intervention of numerous officials in speech therapy centres, leading to the need for a third party mediator that adapts pedagogical methods to meet the specific needs of these learners in the practice of support and psycho-pedagogical assistance with the aim of facilitating the teaching practice of the teacher.

Using a longitudinal perspective involves observing individuals over an extended period, often spanning years or even decades, to detect changes and patterns. Applying this approach to assess the long-term impact of reasoning disorders on academic success allows researchers to gain a deeper understanding of how these disorders influence educational outcomes over time.

This method enables researchers to monitor the academic progress of individuals with reasoning disorders from childhood through adolescence and into adulthood. Through this process, they can identify trends, trajectories, and potential factors that contribute to both positive and negative outcomes.

Moreover, a longitudinal perspective allows researchers to investigate the persistence of these challenges over time. They can explore whether the effects of reasoning disorders on academic success remain stable, worsen, or improve as individuals move through different life stages. This analysis provides valuable insights into the developmental paths of individuals with reasoning disorders and informs the development of interventions and support strategies tailored to their specific needs at different points in their lives.

Overall, incorporating a longitudinal perspective into the study of the impact of reasoning disorders on academic success provides a comprehensive understanding of the complexities involved and facilitates the development of effective interventions to address these challenges over the long term.

6. Limitations

Although our review provides important insights into the prolonged effect of reasoning impairments on academic achievement, it is important to recognise some limitations. Firstly, the scope of our review was somewhat limited, which may restrict the generalisability of our findings to larger populations. Furthermore, there is a possibility of selection bias as participants were not chosen randomly, which could have biased the results towards specific socio-economic aspects. Additionally, the assessment tools used to measure reasoning deficits and academic achievement may have exhibited measurement error, influencing the validity of our results. Furthermore, the study's findings may not be entirely applicable, as they could be influenced by social or financial contexts that are unique to our study population. Lastly, dependence on self-disclosure for data collection could have led to biased responses.

Despite these limitations, our review provides an opportunity for future exploration to address these concerns and further elucidate the relationship between reasoning disorders and academic achievement.

7. Ethical Considerations

Within this study, explicit attention was given to ethical considerations. Prior to participation, informed consent was obtained from all participants or their legal guardians. Additionally, measures were taken to ensure the protection of participants' rights throughout the research process, including confidentiality of data, voluntary participation, and the right to withdraw from the study at any time without repercussion.

Given the absence of a formal ethics committee in the country or region concerned, suitable ethical protocols were established and rigorously followed to ensure the rights of participants were respected. These protocols included attaining informed consent, securing data confidentiality, and minimising potential risks to participants. Although the lack of formal ethical approval is unusual within a school psychology science research context, all necessary steps were taken to ensure compliance with fundamental ethical principles throughout the study.

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