

Mental Rotation And Its Relationship To Some Variables Among University Students

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Abstract

The aim of the current research is to identify: Mental rotation among university students, according to the variables of gender and specialization. In order to achieve the goal of the current research, it was necessary to have a tool to measure mental rotation, so a test (Mahdi, 2021) was adopted. To identify the mental rotation, and after verifying the psychometric properties of the research test and its paragraphs, it was applied to the basic research sample of (400) male and female students who were selected by the random stratified method with a proportional distribution, as The selection of the sample in this way makes it more representative of the original research community, it also gives the researcher the freedom to choose a number from each layer in a random manner commensurate with its size in the research community, and after analyzing the data statistically using the Statistical Package for Social Sciences (SPSS), the results yielded the following:

1. The university students have an average level of mental rotation.
2. There are no statistically significant differences in mental rotation according to the gender variable.
3. There are statistically significant differences in mental rotation according to the specialization variable (scientific - human) and in favor of the scientific specialization .

Research problem

The inability of students to use higher mental abilities, including the ability to mental rotation, which is based on the ability to perceive things, shapes and bodies and make changes to them, and then restore parts of that experience, which casts a shadow on the cognitive development of university students in general, but what we notice today is The students' lack of interest in these mental abilities, as their preoccupation became the degree they obtain without paying attention to the development of mental abilities, including the ability to mental rotation (Al-Shaqour and Al-Tal, 2015: 286-287), as the process of mental rotation needs practice and training until Students can benefit from them based on the time factor, because there are two-dimensional abilities that need a short time if they are trained, and other three-dimensional abilities, which are more difficult and need a long time, and all of this is not available at the present time for students because of their weak ability to use higher

mental abilities And those who desperately need it at the university level (Sternberg, 2006: 257).

Therefore, the inability to use mental rotation by university students reflects negatively on their performance in using a processing system, as the literature indicates that there are two systems: the verbal system, which processes verbal information, and the visual system, which processes visual information, and that any deficiency in the use of one of these two systems is reflected in a way Negative effect on students' performance represented in their inability to think and mentally rotate with the help of visual images (Paivio, 1986: 373). In addition, the literature confirms that there are areas in the parts of the human brain that are responsible for the perception of objects and shapes and the formation of mental images that consist of the remains of visible sensations. In advance, any deficiency in the mental ability to use these feelings leads to the formation of superficial perceptions and a distance from deep perceptions, and thus the loss

of the ability to conduct the mental rotation process in the brain (Kosslyn, 2006:69).

Through what has been presented, the problem of the current research is manifested in answering the following question:

Do university students have the mental abilities that enable them to rotate mental representations of two- or three-dimensional shapes for the purpose of comparing them? Meaning, do university students have the ability to mentally rotate? Is the degree of mental rotation ability of university students higher compared to university students? Is this what the ?current research will try to answer

The importance of the research environment :

The process of mental rotation is of great importance in the process of learning and education , especially in the various age stages , and many studies dealt with this area, especially among students in terms of being a higher mental process that leads students in general and university students in particular to use the frontal part of the brain responsible for the complex higher mental abilities during their learning process (cubicles, 2019: 164).

As a result of this, interest has increased in recent years in studying the mental activities and functions performed by the human brain, especially the interest in mental abilities based on the process of mental rotation, because the human brain is the most complex device on the face of the universe, whether in its structure, work or functions, so the importance of rotation The mentality of university students has its scientific implications in the learning process through the formation of new experiences in the brain regions that help in their cognitive development and develop with it a variety of mental abilities (Al-Tikriti, 2004: 238).

This was confirmed by many studies in this field, including the study of Gohan (Gohan, 1996), that there are certain areas in the human brain that are capable of using mental images through the use of magnetic resonance technology, which showed the tasks of mental rotation in the brain that the participants in the study performed (Gohan, 1996). :154.(

the study of Amorim (Amorim, 2006) indicated that the concept of mental image is responsible for the ability to mentally manage visual forms in the brain, as well as that the rotation of the body in any axis is not important, but the degree of mental rotation is the most important in affecting the response time, so The mental rotation process requires a high level in the depth of the recycling process (Amorim, 2006: 101-102).

In addition, the ability to mentally rotate among students according to their ability to rotate and compare stimuli and the extent to which they possess spatial abilities and skills is through visual coding. The process of comparing the stimulus that was rotated with the original stimulus, leading to the decision-making and judgment regarding the stimulus that was rotated and its conformity with the original stimulus (Gokson & et all, 2013: 230-231).

Research Objectives: The current research aims to identify:

Rotation mental I have students the University and accordingly for my change sex and specialization

H - search worms - w :

The current research is determined by the students of the University of Baghdad For disciplines (scientific and humanitarian) and of both sexes , for .the academic year (202 1 - 202 2)

Define terms:

mental rotation

He was known by:

Shepard And the Metzler 1971) Shepard & Metzler,) : capacity the individual on me rotate representations Mentality for shapes self after or three dimensions and comparison between them then Submit Response Around being identical Mother no The individuals they take refuge to me rotate shapes mentally when difference the situation with a goal Comparison and version provisions (**Shepard & Metzler, 1971: 771) .**

Richardson 1977) Richardson, : A spatial mental ability that clearly includes rotation as imaginations that can be visualized from all directions and from all angles (Richardson, 1977: 431).

Theoretical definition : The researchers adopted Shepard's definition And the Metzler in 1971, due to the adoption of his test and expressed by (Mahdi, 2021) in the current research.

Procedural definition : It is the total score obtained by the respondent through his answer to all paragraphs of the mental rotation test.

University students: "They are students accepted into Iraqi universities after passing ministerial exams in middle school at rates that qualify them for admission to the faculties of those universities" (Iraqi Ministry of Higher Education and Scientific Research, 1990).

Theoretical background mental rotation: preamble:

- Prepare Ability on me Rotation mental one Highlight Processes that got attention Researchers, as This concept is related by many From Processes Cognitive that reflect nature complex and interconnected for the mind human, and when for them From Importance big in life the individual daily and educational and the academy, So strive Researchers in various fields in attempt The nature of individual differences in the ability to mental rotation (Blak, 1981: 60.
- has Back Concept Rotation Rotation Mental _ for several From Research and studies that I care studying nature the mind human General and pictures Images mental in particular , can return Favor in Search area visualization mental Optical as one Topics Science self Cognitive to me Galton in 1880 , that go run many From Studies on me hundreds From people in attempt to study visualization mental for stimuli and extent clarity this is stimuli and similar with sexy the original , And by appearing direction behavioral on me hand Watson say _ interest studying Processes Cognitive and visualization mental, What led to me Appearance of gap big in this field Cognitive for tens the years, not it's a quickly What is back Activity to me research

visualization mental hand Number From researchers Might Most notable Anderson , Kosslyn and Shepherd _and Metzler (Metzler & Shepard) , has Lesson All who are they visualization mental From destination consideration Unique (Sulso (2000 : 276-277 .(

- can a description Rotation mental that moving the brain for things From Yes Help in Understanding What she and where belong, and done study Rotation mental to try Discovery how to discrimination the mind for things existing in his environment and he is called Researchers Generally this is The things by alarms , that recycling mental he is Function cognitive per person To find out what the thing that It was completed Change it (Khaled, 2015: 100).
- is linked Concept Rotation mental by many From Processes Cognitive as imagine interstitial, and realization shapes and bodies . represents aside substantially and illusion in Ability stereoisomers and intelligence spatial, has eat Researchers in Science self Cognitive Ability on me Rotation mental in attempt To provide identification or Determine to her, it varied Tariffs according to for the field Cognitive that eat this is Ability (Bertho, 1998: 380).
- see Shepard Metzler , 1993 & Shepard) that Rotation mental "capacity the individual on me rotate representations Mentality for shapes self after or three dimensions, and comparison between them and then Submit Response Around being identical Mother no , The individuals they resort to me rotate shapes mentally when difference modes with a goal Comparison and version Judgments on it" (Metzler, 1993 & Shepard) , as Confirms Desi and Wolford (Wolford & Delisi, 2002) , on the other hand Rotation mental represent capacity the individual on me The performance imagine My mind sexy couple or tripartite Dimensions It was completed rotate it angle certain and present judgment the appropriate matching or non Congruence (Wolford & Delisi, 2002:156 (

- Mental rotation reflects ability represented by in Issuance Rule congruently sexy specified or being make up picture a mirror that can be seen mentally, and differ time Issuance judgment different Degree Rotation between hotties the first And the second (Wohlschlager, 1996: 265).
- and back Favor in a statement Concept Rotation mental to me Shepard and Metzler _ & Shepard) who kana first From touched to me this concept in study pay it 1971 , _ Around nature Rotation mental sexy Optical in memory using Hints Visual (Cues Visual) at Collection From examined, From During Show Pairs From stimuli and familiarize All Thrilling From ten cubes conjoined with Some of them and situations and angles different, ranged Degree mental rotation In which From zero to (180) degrees, and comparison between them From Yes Submit Response Around What if she was identical Mother no, was time back he is variable subordinate, mean with it amount time necessary to issue judgment Around What if she was stimuli identical Mother no , or Universe one stimuli may be Represent picture Reflexivity (mirror) of the stimulus The other (Anderson, 1990: 127.(
- and differ Ability on me Rotation mental between individuals different their ability on me rotate and compare stimuli and extent owning them for capabilities and skills spatial, and done Rotation mental From During several Phase basic, start From encoding sexy Optical and his representation mentally, then rotate sexy mentally, followed by Procedure proces comparison sexy rounded exciting the original , all the way to to me Issuance Rule while Regard exciting that It was completed rotate it and extent match it sexy The original (366 : Shipley, 2013).
- and affected efficiency proces Rotation mental naturally sexy and after it and degree rotate it, The stimuli Triple Dimensions require From Examined time went back Larger From stimuli faculty Dimensions . as such increase Number mistakes when exposure for stimuli Triple Dimensions comparison with stimuli bi

dimensions, has varied stimuli that use it Researchers in Ability on me Rotation mental, as pictures the animals and numbers and characters, can say that stimuli Mini and familiar per person easy recycle it mentally, and need to me time went back less From stimuli complex and the least Olfa (Murray, 2009: 215).

- . represents training and experience one most important Elements associated rotate mental, she is capacity met him for growth From During training continuous and exposure for experiences mental different, And who From like that constribte in a plus Speed and accuracy Rotation mental and lower time back Required to judge on me stimuli . Although that, Stay this is Ability doomed naturally the growth Cognitive per person, she is Different different Phase Development Cognitive (Bell & Roberts, 2008: 234).

Measurement of mental rotation:

Mental rotation goes through several cognitive stages during the measurement process, including:

1. Get up create picture mentality for something What From all directions (Imagine where Lasts in the form of straight Opposite turns).
2. Get up rotate object mentally until Can Procedure comparison (directive motivation to me Character other).
3. Get up conducting comparison.
4. Decide What if she was Objects she itself Mother No_ .
5. Inform About decision (done registration time to reply verb when Withdrawal the level or the pressure on me button).

The evaluation process is carried out in a test mental rotation that Comparing poster between two beings tripartite Dimensions (or characters) , Complete rotate them mostly in some axles , explain What if kana same Image or What if kana pictures inverted (shapes similar) , and usually What is included the test on me Pairs From Pictures Complete rotate All Of which by number a certain From grades , on me way example : (0) Degree or (60) Degree or (120) Degree or (180) degrees, and done to divide Number specific From couples distance that Complete rotate same Image , while Complete

Reverse some of them some , and asked the participant examiner accurately And the quickly Discrimination between couples inverted and change The reverse (Khaled, 2002: 177).

Theories that explain mental rotation:

Functional . I Equivalence Theory :

The pioneer of this theory is " Shepard ", and this theory is concerned with studying how cognitive abilities are activated during the process of mental transformations and how these abilities interact to complete the transformation process, and Anderson (1987) sees Hinton, 1979) and Kosslyn ,1980) (Kossly that the good results reached by Shepard (1973) , about the mental rotation process , helped all modern theories and models of mental perception , 1983: 53-52) (Pinker & Kosslyn.

That there is a great deal of interest in the field of mental visualization due to the clarification of the process of ability to mental rotation, which is the process presented by et al.1971) (Shepard) , where they studied the mental rotation of the visual stimulus in memory using visual cues , and the results indicate that the time required to respond to was a linear function of the degree of rotation, that is, it The higher the degree of rotation Small was judged faster, and the subject's internal representation of the images takes about one second for every 50 degrees of rotation. (Solso, 2001: 450.)

It is mentioned (Solso: 2001: 451) that several researchers formulated other hypotheses about mental rotation, and they generally included - two issues:

Using mental rotation experiments as a means of solving the problem of whether visual information is stored as holistic images or as hypotheses.

Technical issues related to the specific physical properties of exciting objects.

In (1981) Shepard presented integrated information about mental transformations and knew the apparent shape and movement, and used all of these in formulating some initial assumptions about the structure of mental and the processes involved in imagined transformations, and Shepard tried to prove these assumptions in the light of the theory Al-Istiqaa Shepard revealed the following results:

Comparing the shapes of two Tow Three-Dimensional objects. Individuals are asked to mentally rotate an

object to the other direction. The comparison has been made for significant numbers. In addition, the linear degree and rotation rate are exactly the same for the rotations in the front plane and the rotations in the depth.

When two three-dimensional objects differ in orientation that exist alternately with respect to the individual, this exchange will be perceived by the individual as a rockxing motion of a single rigid body . Rotation of a single rigid body, the greater the angle difference between the viewer, the greater the minimum interval, which allows the realization of the rigid rotation of the Rigid Rotation .

When examining two-dimensional line drawings, which individuals involuntarily perceive as a solid three-dimensional object, it is characterized by the following:

Symmetry and simplicity

A two-dimensional point will show minimal superficial changes when the object is rotated a tiny amount in depth.

As for the movement of the models, they remain solid during movement.

Shepard interpreted the aforementioned results as follows that mental rotations are continuous because the intermediate points in the spherical space may be a barrier when the activity spreads from one point to another, and the maximum rate of rotation is limited by the extent of the spread of neural activity through the spatial medium and is potentially linear because the standard distance in the space It is homogeneous and there is a clear movement through the angular path , which is the result of two consecutive active points in the active space of the shortest linear path connecting them within this space and that the change of the three-dimensional shape may be very sensitive to the results of possible rotations of the supposed shape because it is this shape The hypothesis is formed by activating a point in space and the points represent small transformations of this shape that are also active. The individual's perceptual systems give more weight to interpretations of moving points as rotating three-dimensional solid bodies because the distances (strength of correlations) between those points representing conservative solid transformations are shorter than Those that are

representative of non-conservative hard transfers (Ibrahim, 2010: 465-467).

Evidence from these and other experiences is central to Shepard's assumption that mental images (whether retrieved or internally generated) are functionally equivalent to true perceptual images. Sheppard (1977) believes that the relationship between the mental image and the external image of an object is similar to the relationship between a lock and a key. The lock and the key are physically different, however, on the functional level, the lock and its key have a one-to-one relationship, the appropriate key – only opens a particular lock – and accordingly the neural processes that constitute a mental image may not be the same as the external thing that it represents, the thing (as a key in a lock Its function is to activate this nervous process. Moreover, other keys, if similar in basic properties, can unlock a lock, and more than one stimulus range may lead to equivalent perceptual responses (Pinker & Kosslyn, 1983: 58-61).

Buffeau's Dual Coding Theorem .2: Dual Coding Theory

This theory is one of the cognitive theories, which postulates the existence of an orthogonal relationship between two independent but (interrelated and complex) systems . Written and familiar units of coherent features that rely on ,the use of linguistic symbols such as words, letters punctuation, numbers, letters or familiar written phrases.The second system is the "Imaginary encoding" system, which is responsible for ,transmitting visual, spatial and spatial information and the encoding or visual visual encoding is a pattern that is not Verbal expresses similar and similar boundaries, and depends on the use of visual and visual forms (images), meaning that both systems are characterized by organized .qualities (Zaoul, 2003: 199)

Bavio's theory was based on a set of theoretical :premises, namely

- 1- There is a distinction between the shape of the figure that is represented by the image of the body and the processes that occur in that image, and between its place of existence, which is represented by the spatial memory of the

location of the material or body and the processes that represent movement.

- 2- The encoding of spatial shapes includes location and movement in working memory, sight, sensation, and touch.
- 3- The imaginative design of shapes needs to :know the following characteristics
 - ❖ photo vehicles
 - ❖ The nature of a simple image, and the ability to manufacture a composite or metamorphic image through successive imaging of the parts .of that simple image
 - ❖ There is a relationship between image size and clarity
 - ❖ There is a relationship between imagination .and perception
- 4- Emphasis on the effect of the phenomenon of .muscle sensitivity in this process
- 5- The importance of the image, which means the ,operations of installation, clarification approximation, or operations that enter the image without action, whether it is destruction or demolition on it or on its original characteristics, and between destructive ,operations such as deletion, reverse cancellation, enlargement, reduction or rotation, which greatly affect the image. Part or all of the image, and there are processes related ,to the movement of the figure or the body because the high speed of rotation leads to a pattern of change that affects the properties of .the original image
- 6- There is the possibility of mental synthesis of one image from two separate images, as this process is essential to the rotation as it allows the opportunity to imagine the overlap between the first image of the visible shape and what it .can transform into later(Millal, 1975:333) .

Research Methodology and Procedures

First, the research methodology

The research method that was used in the current research is the descriptive correlative method, being the appropriate method in describing the phenomenon, identifying it and clarifying its characteristics and the degree of its connection with other phenomena.(Adas and others, 2016: 221) , it

seeks to determine the amount and direction of the correlation relationship and to reach generalizations that contribute to understanding and developing reality. It is a form of analysis that depicts the phenomenon, then interprets it and subjects it to study in a scientific and accurate manner (Franekle & Wellen, 1993: 370).

Second, the research community

research community consisted of students from the faculties of the University of Baghdad , their number is (53928) (*) by (16) colleges of scientific specialization And (8) from the humanities colleges, as the number of males in the scientific colleges reached (14642), which constitutes (44%) of the research community, and females (18342), which constitutes (56%) of the research community. As for the humanities colleges, the number of males (7405), which constitutes (35%) of the research community, and .females (65%) of the research community (13539)

Third - a sample : Search

After the size of the community has been determined, the next step is to determine the

research sample from this community, as the researcher 's selection of the sample is one of the important steps for the research and to think about it since he begins to define the research problem and its objectives (Obaidat, 2001: 92) , as it is known that The part that is representative of the society on which the study is being conducted, and includes that part that can be used to judge the whole . (Albayati and Athanasius, 1977: 235) The sample is taken from the community on which the research will be conducted, in order to generalize the findings of the sample study to the members of the community from which it was taken. Therefore, the sample must be chosen carefully, so that it comes as representative of its community as possible (Adas, 1999: 245). That's why it was followed The stratified random method in selecting the research sample, as a percentage of (0.74%) was withdrawn from the original population in a stratified random manner . This sample is considered representative of the community, as the sample amounted to (400) male and female students By (162) males and (238) females, as shown in Table (1) .

Table (1) Research sample according to faculties and gender

T	the college	male	female	total summation
1	algorithm engineering	49	47	96
2	Sciences	58	90	148
3	Literature	29	55	84
4	Languages	26	46	72
total summation		162	238	400

Fourth: the search tool

mental rotation test

The two researchers adopted the mental rotation test prepared by (Mahdi, 2021). The test consists of (34) test items, and each paragraph has four

alternatives, three of which are wrong and one of which is correct. Accordingly, the respondent receives the correct answer for his choice (1) and (zero) for his non-response. correctly.

Statistical analysis of paragraphs:

The researcher obtained this data from the (*) planning and follow-up departments from the ,presidencies of the University of Baghdad according to books facilitating the task to all

.faculties of the University of Baghdad . According to book No. 4899 on 10/19/20/21 Issued by the College of Education / Ibn _ .Rushd

The logical analysis of the scales paragraphs , especially at the beginning of their preparation, is an important step . y y Ebel indicates that _ The test is honest if its paragraphs measure what they were designed to measure, and this depends on the arbitrator of the test items, as he was accurate in his judgment to be an indication of the apparent validity of the scale (Ebel , 1972:555) . It is made up of (25) airtight And a specialist in educational and psychological sciences, measurement and evaluation appendix (2) and asked them to express their opinion on the validity of the test paragraphs in terms of their suitability for the sample students and whether their formulation is good or does it need to be modified, as well as their approval of the approved alternatives for each paragraph . Chi-square test to determine the validity of the paragraphs , and all the test items obtained the approval of the arbitrators, as the calculated values of Ka2 reached (25), which is greater than the tabular value of Ka2 of (3.84) at the degree of freedom (1) and the level of significance (0.05), and therefore No item was deleted from the mental rotation test .

– **Experimental experiment (experiencing clarity of instructions and paragraphs**

An exploratory study was conducted on a sample of (40) male and female students , (20 males). and (20 females), and the purpose of this application was to know the extent of the clarity of the instructions, the clarity of the paragraphs of the mental rotation test in terms of meaning, and the time it takes for students to respond to the test paragraphs in order to overcome those difficulties before applying the test to university students (the research sample) And after observing the responses, it was found that the response instructions, paragraphs and alternatives are clear, and it was found that the time it takes for students to respond to the test is (18) min .

– **Statistical analysis of test items**

The process of statistical analysis of the test items is one of the basic steps, and the adoption of items that have good psychometric properties makes the test more honest and stable (Anastasi, 1988, 192) . Two indicators of the accuracy of the

paragraphs and their measurement of what they were prepared to measure (Al-Kubaisi, 2001, 32), Therefore, the statistical analysis of the paragraphs is more important than the logical analysis, because it verifies the content of the paragraph in measuring what it was prepared to measure, by verifying some of the standard indicators of the paragraph, such as its ability to distinguish between respondents, and its validity coefficient (Al Kubaisi, 1995: 5) because the analysis The logical of the paragraphs may sometimes not reveal their validity or accuracy accurately, while the statistical analysis of the experimental scores reveals the accuracy of the paragraphs in measuring what they were designed to measure. (Ebel, 1972:406). Therefore, the researcher conducted the statistical analysis according to the following:

First: - A sample of the statistical analysis of the :paragraphs

Most of the psychometric literature indicates that the appropriate sample size in the process of statistical analysis of items is preferable not to Less than (400) or (500) individuals are carefully selected from the original community (Henrysoon, 1963: 214) , because this size, when the two extreme groups are selected in the total degree of it and at a rate of (27%) for each group, achieves an appropriate size in each group. and a good contrast between them (Ghiselli, etal, 1981:434) . This size is also appropriate in Nanll 's opinion 1978 also, which suggests that the size of the item analysis sample should be between (5-10) individuals for each item of the scale, in order to reduce the impact of chance. Nunnally, 1978:262) Anastasia 1988 believes that the best sample size for paragraph analysis is to have in each of the two extreme groups in the total score (100) individuals if 27% of the sample size is adopted in each of the two extreme groups. (Anastasia, 1988:23(

Therefore , the researcher considered that The sample of the statistical analysis of the paragraphs should be (400) male and female students. This sample was chosen by the stratified random method . For the purpose of analyzing the paragraphs of the mental rotation test, the researcher followed the following:

A - Difficulty level of paragraphs:

The coefficient of difficulty means "the ratio of students who did not answer the paragraph to the total number of students participating in the test" (Sulaiman and Raja', 2010 : 313).

In order to calculate the difficulty of the test items, the following steps were taken:

- 1- The grades obtained by the students are arranged from the highest grade to the lowest grade.
- 2- The upper and lower 27% of the scores were chosen to represent the two extreme groups (216) male and female students, so that each group included (108) male and female students.
- 3- Extract the number of students who answered wrongly in each of the upper and lower groups for each of the test items.

Collecting the wrong answers for the two groups and dividing them by the total number of the two groups by evaluating the difficulty of the paragraphs for the objective questions , as you found them, they ranged between (0, 41) - 0,64), as the test items are considered acceptable if their difficulty rate is between (0.20- 0.80) (Al-Faki, 2014: 198), and this means that all test items are acceptable and valid for application, and the table (4) shows this

B - The discriminatory powers of the vertebrae:

The discriminatory power of the paragraphs means the ability of the paragraph to distinguish between the upper and lower groups, that is, the ability of the paragraph to distinguish individual differences between students who possess the trait or know the answer and those who do not have the measured trait or do not know the correct answer for each of . the test items (Al-Dulaimi and Adnan, 2005: 66)

The current research followed the method of the two extreme groups in extracting the coefficient of discrimination through the difference between the number of those who answered correctly in the two groups (higher and lower) divided by the number of one of the two groups, as the coefficient of distinction is related to the validity of the construction and its purpose is to find differences between students who are able to answer On the ,question and the students who are unable to do so as the distinctive question is what leads to the distinction between these students through the students who answered correctly in the upper and lower groups, as its value is limited between (+1) and (-1) If the difference is positive, the discriminatory power is positive, and if the ,opposite is negative, the discrimination is negative and if the two groups are equal, the discrimination is (zero), and the paragraph with high positive discrimination is preferred . Or its ease is the .weakness of its discernment (Awdah, 19 98 : 129)

Table (2) table of the paragraphs is divided according to the distinction as follows:

Discrimination coefficient	Paragraph Calendar
or more - 0.40	very good paragraph
0.30– 0.39	Good paragraphs, but may be subject to revision
0.20– 0.29	Paragraphs that usually need revision and improvement
0.19- or less	Weak paragraphs, deleted or improved

(Eble, 1972: 392)

The researcher relied on the previously mentioned Ebel criterion as a guide for determining the coefficient of discrimination, as he relied on the items whose discriminatory power exceeds (0.30),

and after calculating the discriminatory power for each paragraph of the mental rotation test , it was found that its value ranges between (0,31 - 0, 72) Thus, the test items are good and their coefficient of distinction is acceptable. Table (3) illustrates this.

Table (3) Difficulty and discriminatory power coefficients for the items of the mental rotation test

parag raph numb er	Correct answers for the upper group	The correct answers are for the lower group	The number of correct answers for the two groups	The number of wrong answers for the two groups	Ease coefficien t	Difficulty factor	discrimin atory power
1	90	27	117	99	0.54	46 .0	_ 0.58
2	95	32	127	89	59 .0	41 .0	_ 0.58
3	88	22	110	106	51 .0	49 .0	60 .0
4	90	23	113	103	52 .0	48 .0	62 .0
5	80	22	102	114	47 .0	_ 0.53	_ 0.54
6	92	24	116	100	_ 0.54	46 .0	63 .0
7	81	14	95	121	44 .0	_ 0.56	62 .0
8	70	20	90	126	42 .0	_ 0.58	46 .0
9	100	32	132	84	61 .0	39 .0	63 .0
10	79	19	98	118	45 .0	_ 0.55	_ 0.56
11	90	19	109	107	50 .0	50 .0	66 .0
12	77	17	94	122	44 .0	_ 0.56	_ 0.55
13	68	14	82	134	38 .0	0.62	0.5
14	96	25	121	95	_ 0.56	44 .0	66 .0
15th	93	20	113	103	52 .0	48 .0	68 .0
16	94	16	110	106	51 .0	49 .0	72 .0
17	94	20	114	102	_ 0.53	47 .0	69 .0
18	66	23	89	127	41 .0	59 .0	40 .0
19	89	19	108	108	0 0.5	5 0.5	65 .0
20	68	13	81	135	38 .0	63 .0	51 .0
21	93	19	112	104	52 .0	48 .0	69 .0
22	90	23	113	103	52 .0	48 .0	62 .0
23	68	14	82	134	38 .0	62 .0	8 0.5
24	80	14	94	122	44 .0	_ 0.56	61 .0
25	77	19	96	120	44 .0	_ 0.56	_ 0.54
26	68	19	87	129	40 .0	60 .0	45 .0
27	59	26	85	131	38 .0	61 .0	31 .0
28	62	16	78	138	36 .0	64 .0	43 .0
29	66	16	82	134	38 .0	62 .0	46 .0
30	87	28	115	101	_ 0.53	47 .0	_ 0.55
31	90	30	120	96	_ 0.56	44 .0	_ 0.56
32	89	31	120	96	_ 0.56	44 .0	_ 0.54
33	87	26	113	103	52 .0	48 .0	_ 0.56
34	75	26	101	115	47 .0	_ 0.53	45 .0

C - Effectiveness of the wrong alternatives:

The wrong alternative is considered valid and effective if the alternative is able to attract a

proportion of the students of the lower group greater than the proportion of the students of the upper group. The alternative is considered effective, and

it is also considered effective when its value is negative (Al-Dulaimi and Adnan, 2005: 94).

When the wrong alternative in a particular paragraph of the test was not able to attract students to it, this alternative is weak and useless and a waste of students' time without measuring the required attribute (Allam, 2000: 291).

The researcher conducted a statistical analysis of the data amounting to (400) students to identify the effectiveness of the wrong alternatives using the equation of the effectiveness of the wrong alternatives, and found that its value ranged between (- 0.09 , -0 , 28) and it was clear from this that all the alternatives of the mental rotation test items are effective and thus all of them are suitable.

Internal consistency validity (the relationship of the paragraph score with the total score of the mental rotation test):

This method is considered one of the most accurate known means of calculating the internal consistency of the paragraphs in measuring the concept, and it means that each of the paragraphs runs in the same path as the test as a whole (Esawy, 1985: 51), then the equation (Point Basiral) was used, the authentic binary correlation Point-BiserialCorrelation Coefficient Formula to calculate the correlation between the total score of the test (connected) for the scores of (400) male and female students, and the binary score (Discrete) for each paragraph , it became clear that all the correlation coefficients are statistically significant when balanced with the critical value of (0.098) at a significance level (0.05) and a degree of freedom (398) .

Psychometric properties of mental rotation test

One of the most important standard characteristics of the scale confirmed by specialists in psychometrics is honesty and reliability, as the accuracy of the data or the scores you obtain from psychological and educational tests and measures It .depend on it. (Abd al-Rahman, 1998: 159-227) has been verified as follows

Or not. Test validity:

It means the ability of the test to achieve the purpose for which it was prepared (Awda, 1998: 333-335),

and those concerned refer to the multiplicity of methods of calculating and estimating the validity, so in some cases we obtain a quantitative coefficient of validity and in other cases we obtain a qualitative estimate for it. (Faraj, 1980: 360), and the classification of the American Psychological Association defines honesty in three types: (content validity, test validity, and construct validity) (APA, 1985:9). Here comes an explanation of how to get each indicator from them:

A - Apparent honesty:

It was achieved in this study when the test in its initial form was presented to a group of specialized experts to judge the validity of the paragraphs in . measuring mental rotation

B - The validity of the construction:

Structured honesty is described as the most representative type of honesty for the concept of honesty, which is sometimes called concept fidelity or hypothetical formation validity. (Rabee, 1994: 98), and construction honesty means the degree to which the scale measures a theoretical construct or a specific feature. (Anstasi, 1976: 151).

This kind of honesty has been achieved as follows:

- By finding the discriminatory power and the difficulty coefficient of the test items by the method of the upper and lower groups, where it was found that all test items are within the acceptable range of difficulty and . discrimination
- This honesty was also achieved by finding the relationship between the score of each of the test items and the total score of the test by using the (Point Pacerial) correlation .coefficient

Second: The stability of the test:

Stability is one of the indicators of verifying the accuracy of the test and the consistency of its clauses in measuring what must be measured (Crocker & Algine, 1986: 125), and the purpose of calculating the reliability is to estimate the scale errors and suggest ways to reduce these errors (Murphy, 1988: 63).

The stability was calculated by Kewder Richardson 20 method as follows:

Kewder - Richardson equation 20 :

The researcher relied on the method of internal consistency in finding the stability of the test, which is a method that depends on the correlation between the test items with each other within the test , and one of the most frequently used equations to find the internal consistency of the test is the Couder-Richardson equation 20 (Abdul Rahman, 2008: 184).

In order to extract stability in this way , Kewder Richardson equation 20 was applied to the scores of the sample members of (400) male and female students . It is regulated and is considered good, as its stability coefficient is (0.67) and above” (Odeh and Al-Khalili, 1988: 146) .

Statistical indicators of mental rotation test:

The scientific literature has clarified that one of the statistical indicators that should characterize any test is to identify the nature of the equilibrium distribution , which can be identified by two main indicators: the arithmetic mean and the standard deviation (Al-Bayati and Athanasius, 1977, 217) And the arithmetic mean, even if it is defined as the sum of the values of the scores divided by the number of those values, the standard deviation is expressed as the amount of the degree of deviation or distance of the values of the variable from the arithmetic mean, and that whenever the degree of

standard deviation decreases and approaches zero, this indicates the existence of a kind of homogeneity or Convergence of the values of the degrees of the distribution.

Also, Skewness and kurtosis (Kurtosis) and if they are two characteristics of the frequency distributions, where the skew coefficient refers to the degree of concentration of frequencies at different values of the distribution, and the kurtosis coefficient refers to the extent to which the frequencies are concentrated in a region of the equilibrium distribution (Awda and Al Khalili, 1988: 79-81), it is possible to distinguish Between distributions by degree and type of skewness and kurtosis, where he usually uses statistical indicators to express them, as whenever the skew coefficient and the kurtosis coefficient are close to zero, whether it is positive or negative, this indicates that the shape of the recurring distribution of degrees is close to the shape of the normal distribution (Back, 1998 : 247).

The frequency distribution is symmetric when the values of the mean, median, and mode match, and the frequency distribution is skewed, negative or positive, when the values of these three measures do not apply to each other (Ferrickson, 1991: 78)

has This required the researcher to use the Statistical Package for Social Science (SPSS) to extract those statistical indicators, as shown in Table (6).

Table (6) The values of the statistical indicators of the mental rotation test

Statistical indicators	the value
Arithmetic mean	16,527
Mediator	16,00
mode	15th
standard deviation	7,584
variance	57,518
skewness	0,200
kurtosis	-0,452
lower degree	1
highest score	34

Term	33
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mental rotation test When observing the values of the aforementioned statistical indicators for the It appears from the above table that the degrees of mental rotation approximate the shape of their recurring distribution to the equilibrium distribution, because the degrees of the mean, median, and mode are convergent Also, the coefficients of skewness and kurtosis approach zero, as whenever the skew coefficient and kurtosis . coefficient are close to zero, whether it is positive or negative, this indicates that The form of the frequency distribution of scores is close to the form of the average distribution, and accordingly, the test is accurate in measuring the psychological concept, and the sample is representative of the community, which allows .generalizing the results of the application of this test . (Awda, 1998: 86). Figure (1) shows this

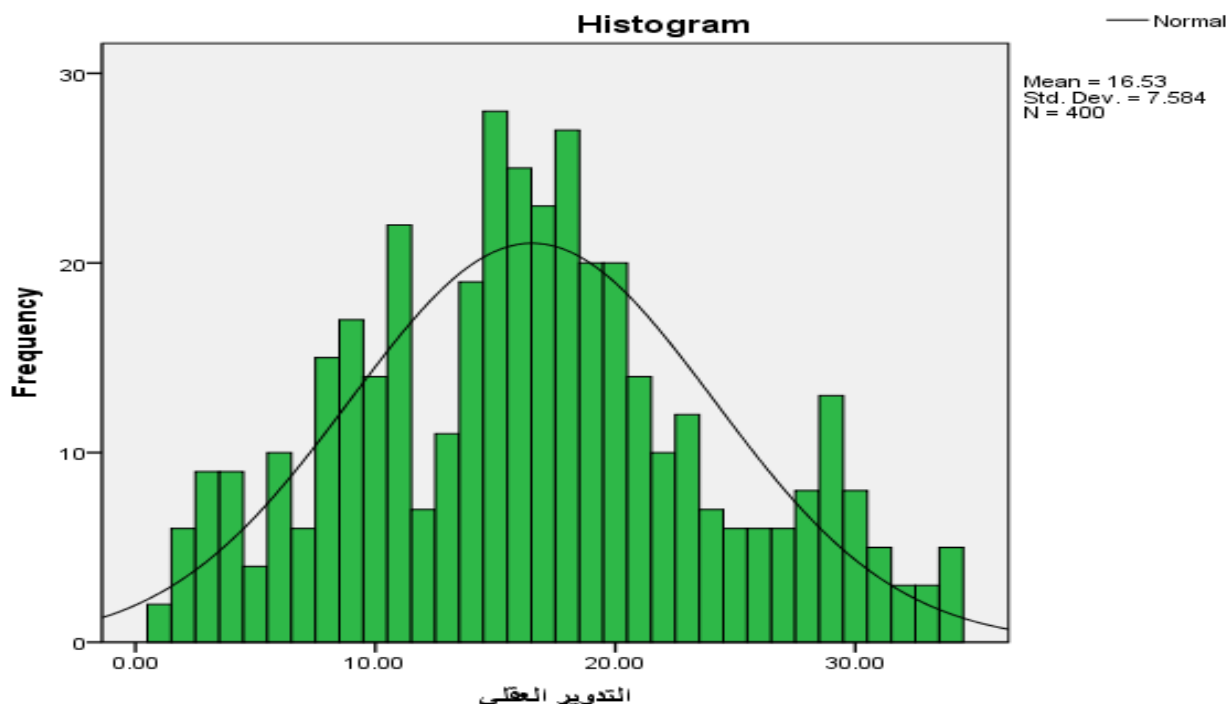


Figure (1) = Final application sample graph (n mental rotation (400

Third : Calculating the psychometric properties of the vertebrae:

The process of paragraph analysis is defined as a study to evaluate its effectiveness through the students' response to each paragraph separately (Adas, 1993: 111).

The process of extracting the psychometric properties of these paragraphs aims to calculate their discriminatory power, their level of difficulty, and their validity coefficients. My agencies:

Sixth: Description of the final exam:

The mental rotation test in its final form consists of (34) items. The item is corrected by giving a grade of (1) for the correct answer and a score of (zero) for the wrong answer , so the highest score that the

respondent can get in the test is (34) and the lowest score is (zero). While the hypothetical mean of the test is (17) and the appendix (1) includes the test in its final form.

Presentation and interpretation of results

first goal : (to identify the mental rotation The of university students according to the sample as a whole and the variables of gender and (specialization

To achieve this goal, the researcher By applying the mental rotation test consisting of (34) items on the research sample consisting of (400) male and female students . The results of the research showed that the arithmetic mean of the scores of this sample on the test reached (16,527) degrees , with a standard deviation of (7,584) degrees . And it was found that the difference is not statistically significant at the significance level (0.05). The calculated t-value amounted to (1,246) and is

smaller than the tabular t-value of (1,9 6), and with a degree of freedom (399), and this means that the degree of mental rotation is average for university

students , and the table (7) and Figure (2) illustrate this .

Table (7) The mean , standard deviation, and T-value of the mental rotation test

variable	the number	SMA	standard deviation	hypothetical mean	t * value		indication (0.05)
					calculated	tabular	
mental rotation	400	16,527	7,584	17	1,246	6 1,9	insignificant --

mean of the mental rotation test

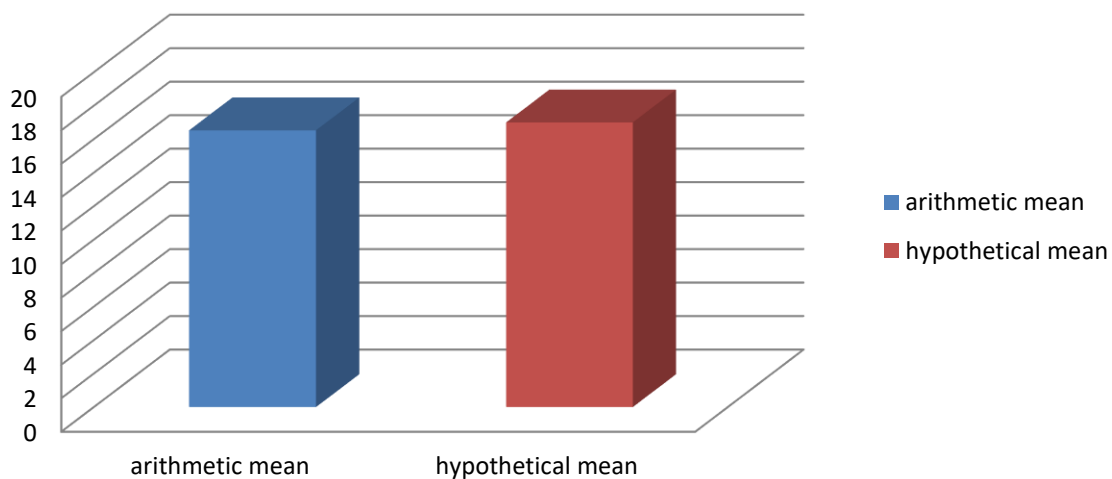


Figure (2) The arithmetic and hypothetical mean of the mental rotation test

From the table and figure above, it was found that university students have an average level of mental rotation, as the researcher attributes this result to the difference in the ability of mental rotation between individuals according to their ability to rotate and compare stimuli and the extent of their possession of spatial abilities and skills, and mental rotation is carried out through several basic stages, starting with From encoding the visual stimulus and mentally representing it, then mentally rotating the stimulus, followed by a process of comparing the rotated stimulus with the original stimulus, leading to a judgment regarding the stimulus that was rotated and its conformity with the original stimulus (366 : Shipley, 2013). the researcher then performed another procedure, which is to identify

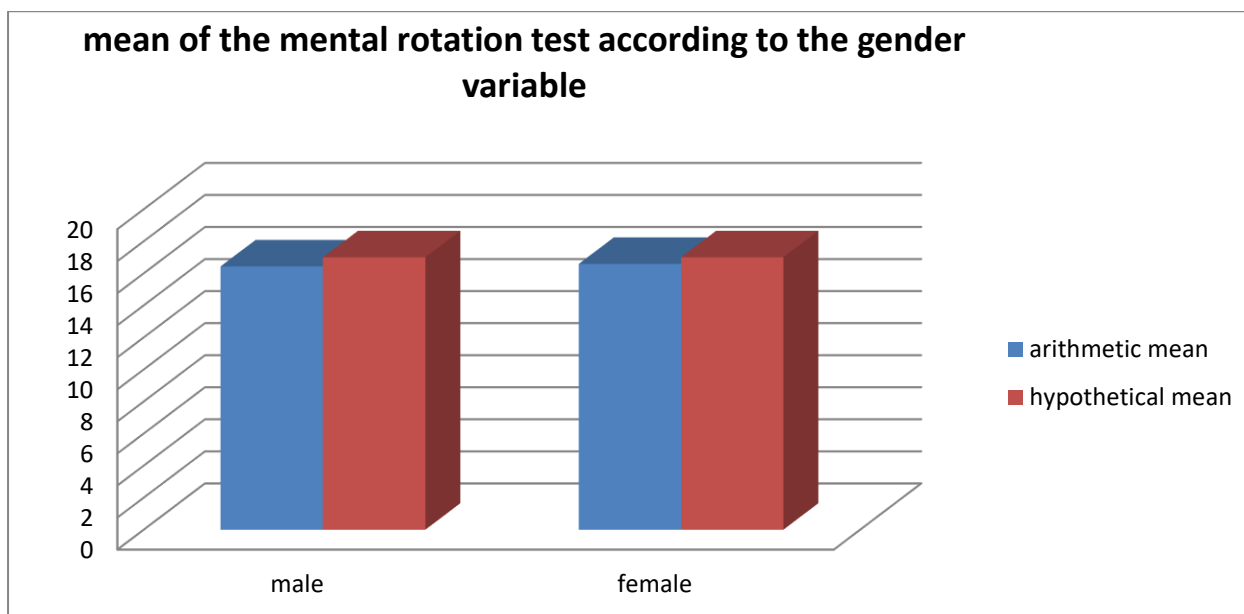
the mental rotation according to the variables of :gender and specialization, as follows

A according to gender (male - female)

The two researchers took the male and female responses to the mental rotation test separately, and for the purpose of identifying the differences between the arithmetic averages and the hypothetical mean, a single-sample t-test was used. And it was found that the difference is not statistically significant at the significance level (0.05). , as the t-values calculated for them were smaller than the tabular t-value of (1,9 6), and with a degree of freedom (161, 237) and this means that the degree of mental rotation is average for male and female university students , table (8) and Figure (3) Explains that.

Table (8). The arithmetic mean, standard deviation, and t-value are mental rotation according to gender

the sex	the number	SMA	standard deviation	hypothetical mean	t * value		indication (0.05)
					calculated	tabular	
male	162	16,432	7,554	17	0,957	6 1,9	insignificant
female	238	16,592	7,619	17	0.825	6 1,9	insignificant

**Figure (3)** Arithmetic and hypothetical mean of the mental rotation test Depending on the gender variable

From the table and figure above, it was found that there are no differences between males and females in the level of mental rotation, and the researcher attributes this result as Some researchers believe that despite the emergence of many points of view emphasizing the differences between the sexes in spatial abilities, these differences gradually decrease with the passage of time, due to the change in the role that males and females play in each of the societies according to the experiences provided by the teachers who train Students in the use of mental visualizations (Klieme, 1989: 256-257).

- B . Depending on the specialization (scientific humanitarian)

The two researchers took the responses of students with two specializations (scientific and human) on the mental rotation test separately, and for the

purpose of identifying the differences between the arithmetic averages and the hypothetical average, the T-test for one sample was used. And it was found that the difference was not statistically significant at the level of significance (0.05) for students of scientific specialization , as the calculated T -values were (0.146) Smaller than the tabular t-value of (1.9 6), with a degree of freedom (243) , and a statistical function for students of humanitarian specialization and in favor of the hypothetical average, as the calculated t -values were (2,129) greater than the T-table value of (1,9 6), and with a degree of freedom (155) This means that university students from the (scientific) specialization have average mental rotation, and students from the humanistic specialization have weak mental rotation. Table (9) and Figure (4) illustrate this .

Table (9) The arithmetic mean, standard deviation, and T-value of mental rotation depending on the discipline

the specialty	the number	SMA	standard deviation	hypothetical mean	t * value		indication (0.05)
					calculated	tabular	
scientific	244	17,070	7,443	17	0,146	6 1,9	insignificant
Humanitarian	156	15,679	7,747	17	2,129	6 1,9	function in favor of the hypothesis

mean of the mental rotation test according to the specialization variable

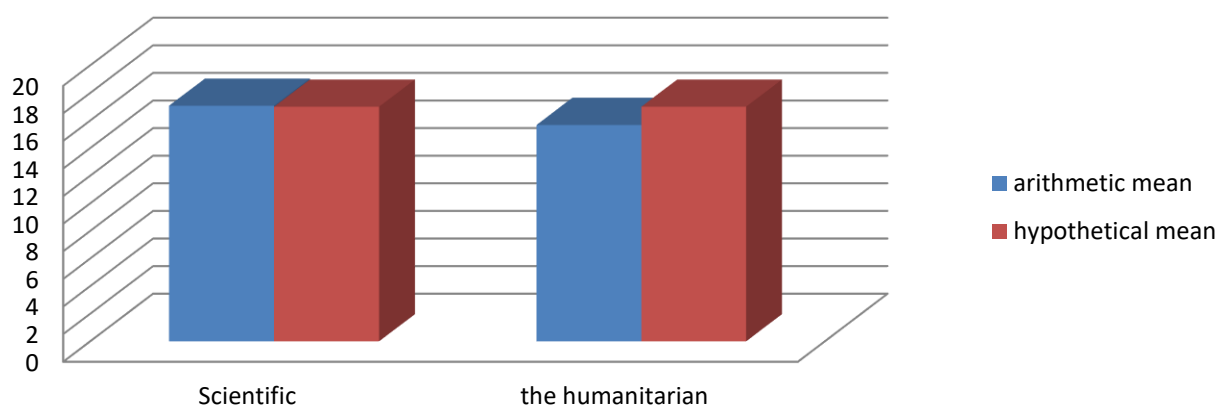


Figure (4) The arithmetic and hypothetical mean of the mental rotation test Depending on the variable of specialization

Through the above table and figure, it was found that there are differences in the scientific and humanitarian specialization and in favor of the scientific specialization, and the researcher attributes that this result is that students of scientific specializations need to perform mental rotation in the study laboratories and practical and applied lessons in order to be able to solve the scientific problems that hinder the progress of their learning process More than the humanities .

Conclusion

1. Mental rotation is an important mental ability that university students possess that helps them .perform important tasks and duties
2. ,Mental rotation has an important benefit which is to give university students an adequate opportunity to access the information they must learn and acquire by allowing them

to reflect and reflect as much as possible in .learning the material to be learned

Recommendations:

1. Preparing and providing educational programs for mental rotation in order to increase and develop the higher mental abilities of students.
2. Paying attention to developing the capabilities of university students by providing creative ways of thinking that help them to carry out the process of mental rotation and solve problems..

Suggestions

researcher suggests that:

Conducting a study under the title (Mental Recycling and its Relationship to Mental Imagination among University Students).

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