

## Comparison of the effect of a taekwondo and gymnastics training course on the mental rotation of girls and boys aged 9 to 10 years

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### Abstract

The aim of this study was to compare the effect of a taekwondo and gymnastics training course on the mental rotation performance of girls and boys aged 9 to 10 years. This study was an experimental study and the research design included pre-test and post-test with the control group. The statistical population included all male and female students of the fourth grade of primary school in the first district of Mashhad. The samples of this study included 60 people (30 girls and 30 boys) who were purposefully selected and randomly divided into six groups: girl taekwondo, boy taekwondo, girl gymnastics, boy gymnastics, girl control and boy control (each group 10 people) were located. The ability of mental rotation with a reliability coefficient of 0.88 was obtained from six groups of pen-paper test groups. The experimental group then performed their 40-minute training protocol for eight consecutive weeks for eight weeks. At the end of the training sessions, post-test was taken again from all six groups. For data analysis, SPSS 19 software and mixed variance statistical method were used. The results showed that both types of exercises led to a significant increase in mental rotation ( $P < 0.05$ ) but there was no significant difference between the two types of exercise and also between girls and boys ( $P > 0.05$ ). The results of the present study show that taekwondo or gymnastics training program has an effect on the ability to rotate the mind, but this effect is not gender-dependent.

Keywords: Mental Rotation, Taekwondo, Gymnastics, Gender, Students

### 1. Introduction

Spatial ability is a mental ability that originates from the structure of human intelligence (1). Carol describes human intelligence as a general factor that includes a set of mental abilities that fall into three categories: verbal, perceptual, and visual rotation (1). Spatial abilities play a large role in our ability to move around, prepare for motion, and interact with objects in the universe. These abilities play a key role in the early stages of learning perceptual activity and their effective use is very important. Mental rotation is the best component of visual ability, which in many important situations in sports, requires athletes to respond appropriately and specifically to some visual stimuli. From a cognitive point of view, research shows that the practice of spatial skills is an important factor in the development of these skills and problem-solving abilities (2, 3, 4). Curiosity and play are two important characteristics of children and adolescents' behavior that play a role in the process of cognitive and spatial development (5). Kiel and Park (1990) concluded that when children are given opportunities to practice, they respond more quickly to mental rotation tasks (6).

There is disagreement among researchers about the age of onset of mental retardation and gender differences. Some researchers believe that children can develop their mental rotation abilities in 2D images from the age of 5. Although children are very slow at this age, from the age of 8 onwards, the speed of mental rotation improves and children They can use 3D images for this function (7, 8). Proponents of Piaget's theory, on the other hand, believe that mental rotation does not take place before the age of 11, when one is not yet in the stage of abstract thinking. Hoyek et al (2012) used a Vanderberg and Chius test to evaluate the performance of mental rotation in children aged 7 to 12 years. The results showed that children aged 7 to 8 years had difficulty in solving this test. Gender was from the age of 10 (9). As a result, the age of onset of mental retardation has not yet been properly determined. On the other hand, some studies on children and adolescents indicate that gender differences in the ability to rotate the mind are seen at the age of four and before puberty (2, 3). Other studies on the existence of these differences have not been shown before puberty (10). For this reason, it is necessary to examine the age of onset of these abilities. In relation to gender differences in the practice of mental rotation, gender has been considered as an effective factor and gender differences have been found in tasks that require mental rotation (11).

In Western cultures, people consider spatial abilities as a prominent feature of men and encourage boys more than girls to participate in activities that enhance the development of their spatial skills ( Such as computer games, math and science). Therefore, it seems necessary to study the effect of gender on this ability in children. Mental rotation in addition to age and gender can be influenced by environmental factors such as nutrition and socioeconomic levels and possibly exercise. Exercise in the cognitive and physical domains is one of the factors that can affect mental rotation. Johnson and Peach (2010) study between the effect of a period of cognitive and physical activity showed that physical

activity had a greater effect on improving mental rotation function (12). In addition, Johnson et al. (2013) in another study examined the effect of a creative physical training course on the mental rotation function of children aged 7 to 9 years, the results showed that physical exercise improves mental rotation function in children and improves Cognitive, social and emotional skills (13). Johnson et al (2012) state that physical exercises which they need to understand be aware of the body and the body axis and need high coordination, can affect mental rotation (14).

The effectiveness of such activities has been less studied and researched. At the same time, gymnastics is now mandatory as a basic sport in primary schools. In addition, Taekwondo is one of the medal-winning disciplines whose effects should be examined from an early age. Considering the importance of mental rotation as one of the components of intelligence, the aim of this study was to compare the effect of a taekwondo and gymnastics training period on the mental rotation of girls and boys aged 9 to 10 years.

## 2. Methodology

This research is an experimental type and the research design includes six groups with a control group with pre-test and post-test. In this study, the researcher compared the effect of a gymnastics training period on mental rotation performance between 9 to 10 year old boys and girls in Mashhad.

The statistical population of this study was male and female students of the fourth grade of primary school in the first district of Mashhad. The samples of this study included 60 people (30 girls and 30 boys) who were purposefully selected and randomly divided into six groups: girl taekwondo, boy taekwondo, girl gymnastics, boy gymnastics, girl control and boy control (each group 10 people) were located.

After obtaining the consent of school parents and students and identifying eligible individuals, pre-test data were collected using a pen-paper test of mental rotation ability to determine the function of mental rotation. The subjects in the experimental groups performed their 40-minute Taekwondo or gymnastics training protocol for 8 consecutive weeks for 8 weeks. The control group participated only in pre-test and post-test. At the end of the course, post-test was performed in all six groups.

The pen-paper test of mental rotation ability was used to measure the performance of mental rotation. The test consists of 14 items that use animated images known as stimuli. This test was prepared by 3D max software, which in each item has a target shape on the left and four sample shapes on the right. The two shapes on the right are correct, meaning they are exactly the same as the target shape, except that it rotates at different angles and on the x, y, z axes, while the other two shapes are incorrect, ie mirrors the shape. The reason for choosing the right two forms is to eliminate any chance and coincidence in choosing the options. Individuals must answer questions within a limited time of seven minutes. The subject must also test two items before beginning the test. Reliability in the present study was calculated to be 0.88 by Cronbach's alpha method.

The collected data were analyzed using descriptive and inferential statistical methods. In the descriptive statistics section, the data were described by means and standard deviation. In inferential statistics, mixed variance statistical method was used. SPSS19 software was used for data analysis and the significance level was considered  $P \leq 0.05$ .

## 3. Results

Taekwondo training and gymnastics training both increased mental rotation in these students ( $P = 0.001$ ) but there was no significant difference between the effect of two types of exercise on mental rotation ( $P > 0.05$ ). Also, no significant difference was observed between boys and girls ( $P > 0.05$ ).

## 4. Discussion

Based on the present findings, both types of exercise led to a significant increase in mental rotation, but there was no significant difference between the two types of exercise and also between girls and boys.

Gender probably cannot affect the effectiveness of exercise on mental rotation. Despite research in this area, researchers are still researching at different age groups throughout life to examine gender differences in mental rotation and spatial abilities. Researchers such as Subrahmanyam and Greenfield (1994) have also observed gender differences in mental rotation before the age of four (2). The results of this study were consistent with the results of Roberts and Bell (2000) and Jansen, Kellner and Reader (2012) (13, 15). But it was inconsistent with the results of the research of Shepard and Metzler (1994), Vandenberg and Kewes (1978), Pourmohseni (1384) and Rekabi (1392) (1, 16, 17, 18). In this research, it is stated that there is a significant difference between boys and girls, as well as men and women in spatial abilities and in particular mental rotation in favor of men, which is not the case between girls and boys in the present study. . A review of the research confirms the strong influence of the gender factor on spatial ability, but has created ambiguities in the field of gender research. In some studies of children and adolescents, the results indicate that gender differences in the ability to rotate the mind are seen even at the age of four and in the pre-pubertal age (2, 3). Other studies have not shown the existence of these differences before puberty (10). The role of

gender differences in the ability of mental rotation can be explained in the context of a biological perspective. According to the bio-evolutionary perspective (Annie, 1992) in childhood (8 to 15 years) the brain development and intelligence of girls is somewhat higher than boys, but this difference is not significant. Among many cultures, the pattern of gender role in spatial-visual ability is similar, and this finding supports the principles of evolutionary psychology. In the study of Pourmohseni et al. (2004) who studied the effect of Tetris computer game on mental rotation of boys and girls, they found that after a few sessions of play for both boys and girls, there was an increase in mental rotation. It is noteworthy that this increase in mental rotation was greater in girls than in boys, due to the greater flexibility of girls in training than boys. In other words, the findings of this study showed that although both groups of boys and girls became more capable of mental rotation due to exercise and play, but this increase was more for girls than boys, which shows that girls are more flexible in practicing and learning. They have more than boys. These results were inconsistent with the results of our research (1). Thus, it can be similar to what Pitch and Johnson (2012) pointed out, considering that girls score lower in the mental rotation test than men, but the size of the effect and benefits of training and education in women is higher than men (19). Given that girls are generally lower in spatial and mental rotation abilities than men, but due to the greater effects of motor training, they compensate for these deficiencies in mental rotation ability. The result does not make a significant difference between boys and girls. On the other hand, in most disparate studies, the scales are in favor of men. Possible reasons for the discrepancy between the present study and the mentioned research.

The research literature shows that women have less experience in playing computer games. Research also shows that men participate in new computer games at a higher level than women (1). Therefore, during the first or second task, men may automatically become automatic, and as a result, their only conflict and challenge is to solve the problem of mental rotation. In other words, women have not gained experience with computer games and perform the task of mental rotation along with the task of manipulating the computer. That is, women must both be aware of the task and take appropriate action to solve the problem (1). Of course, gender differences in the two-dimensional and three-dimensional tasks of mental rotation are different (1). That is, because of the similarity of 3D tasks to men's and women's computer games, 3D tasks in computer games are more difficult for men. That is, the more difficult and powerful the task. The difference is greater in favor of men. In addition, the recording of brain waves by EEG is one of the cases that has been used for many years for various psychological studies. The advantage of this method is that it uses brain waves to identify mental conflicts in specific areas of the brain. EEG results show that the activation of brain waves in the brain areas of individuals varies according to gender. Men showed more activity in the left parietal region and women in the central point of the left cortex and activity in the left forehead. As it has been proven, the left parietal region in which men are more involved is for problem solving and spatial abilities, and in women this activity was in the temporal region, which is more related to verbal abilities (1).

In fact, age variables should always be considered when discussing gender differences. The three general principles of the interaction of gender differences with age are: 1- According to age in spatial tasks adults perform better than children 2- Men and women show differences in some cases but not in boys and girls. 3- Men do better homework than boys, while women do not do this better than girls and need more research (1). Therefore, the lack of effect of gender difference may be due to the age of the subjects (9 to 10 years), which is consistent with the research literature. What studied over the years are hormonal differences in spatial abilities that can help researchers understand why men and women differ. Discussion of hormonal differences can further argue for a sensitive period that hormonal influx in critical periods of life, such as infancy or puberty, has a direct effect on brain mechanisms leading to spatial task function and activation. Argument and problem solving is possible. This suggests that hormone levels may vary during space tests, which may be a reason for differences in gender and individuals in spatial ability (1). In addition, boys travel more socially than girls and gain more special experiences. These experiences, such as motorcycling, cycling in the park, going to parents' workplaces, shopping in the market, etc., are more focused on boys, and girls are less likely to receive social experiences outside of school (1). This article points out that boys are more involved in different experiences affecting spatial abilities and mental rotation, and according to the culture of social acceptance, boys can more freely achieve in different environments outside the school environment. Such experiences should be considered. These cases point to a differentiated experience between boys and girls, which is more and different for boys than for girls. It should be noted here that due to the lack of research similar to the present study, to achieve practical results and use these results to develop the spatial and cognitive abilities of individuals, the need for similar studies and extensive studies More in this area.

Also in the present study, a course of taekwondo and gymnastics has increased the mental rotation performance of students aged 9 to 10 years. The results are based on the results of Johnson and Peach, (2010), Johnson et al., (2011), Johnson and Lehman, (2013), Johnson, Kellner and Reader, (2013) who have shown that exercise and physical activity can affect the function of mental rotation, is consistent (12,13,14,20). In general, the result of examining this question is consistent with previous research. Johnson et al., (2011) in a study of craft training and manipulation on the mental rotation function in girls (20). In this study, two groups of girls performed two types of motor exercises.

The control group received light strength training and the control group underwent three months of dexterity and manipulation motor training. The results of this study showed that children who learned to perform dexterity and manipulation performed the task of mental rotation in periods of reaction time, without a zero degree angle, faster than those who practiced strength. Finally, the overall results of this study suggest that since mental rotation skills increase spatial power, imagination, problem solving, and mathematical skills (20), craft training may be another area. Increase cognitive skills and be a valuable practical tool in educational processes that show that practicing exercise program can have positive effects in increasing the ability of mental rotation. These results are consistent with the results of the second question. In another study, Johnson, Kellner, and Ryder (2013) examined the effect of a creative dance practice session on the mental rotation performance of elementary school children. The results showed that the exercise program improved people's performance on the mental rotation test (13). These results were also in line with our question.

## 5. Conclusion

The results of the present study show that Taekwondo or gymnastics training program has an effect on the ability to rotate the mind, but this effect is not gender-dependent. In fact, both taekwondo and gymnastics can be used to increase the mental rotation of these students. In addition, there is no difference between girls and boys in this area and the same exercises can be used for them.

## 6. References

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