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Original Article

Attention, Cognitive Flexibility, and Spatial Skills Across Online and Offline Gameplay

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Abstract - *Games have always been more than entertainment, offering an opportunity to work on cognitive and mental skills. The study looks into the effects of games in online and offline games, which are chess, a turn-based, strategic board game; football, a team game; and FIFA, a fast-paced football simulation video game, on three cognitive abilities, which include attention, cognitive flexibility, and spatial awareness. A sample of 70 respondents that consisted of teenagers, young adults, and adults who had at least four months of gaming experience was studied. The structured questionnaire with three validated scales, including an adapted Attention subscale (ATTC), Cognitive Flexibility Inventory, and the Spatial Ability Instrument, was used to collect the data. Independent samples t-tests, one-way ANOVA, and Pearson's correlation coefficient were used to conduct statistical analysis. There was a significant difference in the scores of the virtual chess players on attention measures, which supported the concept that turn-taking games based on strategy are useful in enhancing sustained attention. By contrast, the trend of increased spatial awareness was observed in FIFA players, but the differences were not statistically significant. The two groups did not differ significantly with respect to cognitive flexibility, which implies that both categories of gameplay increase adaptability and cognitive skills in a similar way. The amount of time taken in playing the two games was positively correlated with improvements in the three cognitive domains. These results outline the cognitive benefits that are distinct and supportive of both games in-person and online, adding to the possible development of skills other than being a mere hobby.*

Keywords - *Attention, Cognitive flexibility, Chess, Football, Spatial awareness.*

1. Introduction

Games have been a significant tradition in the culture of people, as they are organized actions that require their attention, decisiveness, and the ability to solve problems creatively. However, over the past years, the scholarly community has shifted its focus towards the idea that games are considered leisure, and there has been a shift among scholars to investigate their importance in the cognitive growth of an individual. Board games, digital video games, and physical sports are nowadays known to be important contexts for active attention, executive functions, and stimulation and practice of spatial processing.

It is also worth noting, however, that gameplay is not a cognitively homogeneous phenomenon. Different games place different cognitive burdens on players depending on their structure, including speed, complexity, and physical or perceptual intensity. As an example, strategy games that are played in turns presuppose increased attention and careful consideration, whereas digital games in a hurry demand the fast processing of information and fast adjustments. Physical sports provide one more dimension as they combine physical movement and instantaneous decision-making. Thus, to get an idea of the influence games have on the mind, it is necessary to take a closer look at a genre of the game and the way the player interacts with the game. Even though studies have been growing on the association of gameplay with mental capabilities, a considerable portion of existing literature is still disjointed.

There are numerous studies that study different types of games independently, concentrating either on online platforms or the real world, where they can be practiced, without comparing the two. Moreover, scholars tend to assess individual cognitive aspects separately, and this will provide little understanding of how different executive functions interact in combination in different kinds of play. This absence of comparative data makes it hard to ascertain the extent to which unique gaming experiences actually determine cognitive functioning. The current paper fills these gaps by analyzing three activities that have a significant difference in structure and format: chess, FIFA, and football. Chess is an example of a strategic board game with a set of rules that require playing in turns and high concentration. FIFA is a digital simulation, played in real time, which requires continuous eye monitoring and quick decision-making, and

football is a physical activity that involves moving, space navigation, and coordination. The analysis of these activities in a single framework will help the research to shed light on the relationships between various forms of play and attention, cognitive flexibility, and spatial awareness.

To be more precise, this study will examine the claims of the cognitive differences between playing online and offline games, the connection between the duration of the gaming experience and the mental results, as well as the relationship between the focus and flexibility among diverse players. The aim of placing these findings in the wider argument of cognitive transfer and processing, therefore, is to present a more holistic approach to the relationship between our varied experiences of games and the manner in which we think.

The current study has three major contributions. Firstly, it provides a comparison of the three different forms of a sport, namely a board game, a computer sport simulation, and a physical sport, in a single study design. Secondly, it compares the virtual and physical forms of sport gameplay directly. Thirdly, it investigates the relationships among the various executive functions, rather than examining isolated cognitive performance.

1.2. Literature Review

Games are being acknowledged to be not merely a hobby, but intricate processes involving a broad scope of mental processes, including attention, executive functions, working memory, and spatial reasoning. Studies point out that the cognitive effects of a play are mainly in the aspects of the structural nature of the game, e.g., its pacing, difficulty, and whether it is a digital or physical game. Indicatively, meta-analyses have indicated that action and strategy games have the potential of enhancing visuospatial attention and task-switching as compared to non-gamers. These effects are, however, found to differ considerably by genre, and not all areas of cognitive performance end up being improved to an equal degree. These outcomes can only be comprehended through the principle of transfer of training.

Near transfer is associated with game-based skills that directly apply to a particular task, and far transfer is associated with a more general use of those skills to other aspects of life. Although the near-transfer effects of digital games are usually a powerful phenomenon (that is, when a player becomes better at doing the task, which is closely related to the game), far transfer into other cognitive fields is less predictable. This indicates that as one gains in a certain aspect, like visual attention, this may not always confer a general increase in brainpower unless the demands of the underlying mental requirements are well matched. Investigations of embodied cognition also indicate that playing with the real world would develop the brain in a different way compared to playing on the screen. Football and other physical sports demand executive control, perception, and movement coordination under the pressure of the real world. Such a setting promotes awareness of the current situation and fast decision-making. Although we are aware that overall physical exercise is good for the brain, we really do not know how the specific needs of the brain that are put into action by organized sports are a strategic mixture of thinking and activity that is an active pursuit of research.

There is evidence that digital games, especially high-speed action games, can train visual attention and processing speed both in the short-term training and the long-term playing phase. Recent findings show that the games can even cause alterations in the brain networks that control cognition. The effects of this advantage are most extreme in games where perceptual loads are high, and the feedback rate is rapid, such as in sports simulation, where players are required to constantly adjust to new information as opposed to the slower turn rate of a turn-based game.

In comparison, the mental profile of strategic board games such as chess is a more sustained and long-term oriented pattern recognition plan. It is indicated that regular players tend to excel at activities that involve abstract thinking and decision-making. Nonetheless, like all other types of play, the degree to which these abilities apply to non-gaming situations usually relies on the degree of intentional training and the degree to which the requirements of the game are similar to the situation in the real world.

The comparison of digital sports simulations, like FIFA, to real-life one can help to emphasize the role of a game mode of play. Both involve having players follow moving objects, make decisions in split seconds, and anticipate the next move of an opponent. Recent studies of esports indicate that the cognitive flexibility and visual processing of competitive gamers are comparable to those of conventional athletes, but they might acquire them through different neural mechanisms.

Based on the current literature, it is proposed that the mental health benefits of the play are influenced by the mode of the game, its structure, and the demands that the game puts on players. Although we are well aware that action games, board games, and physical sports are all executive exercises in their own right, there is no research that compares the three together in one study. This gap is necessary to better comprehend the operation of the various functions of attention, flexibility, and spatial awareness in the varied landscape of contemporary play.

Although there have been numerous studies on individual genres of games, there is a lack of integrative research that compares cognitively demanding tasks directly across both digital and offline formats. The current literature does not often investigate similar tasks, such as online and offline sports, using the same framework of analysis. Moreover,

previous research has tended to investigate isolated cognitive measures rather than exploring the combined relationship of attention, cognitive flexibility, and spatial skills to gameplay. The current study will fill this void by offering a comparative analysis of chess, FIFA, and football in online and offline versions.

1.3. Physical Games

Physical games have been a crucial part of human culture for centuries since they offer an immersive and practical experience, which extends beyond just entertainment. Conventional games such as chess, checkers, GO, and various card games involve physical contact with concrete objects, such as pieces, boards, and decks, which gives the players a great sense of sensory experience. Playing the game physically develops a better connection between the players and the game mechanics, as every action requires proper performance (Suits, 1978).

The physical aspect of games encourages fine motor skills and hand-eye coordination, which emphasizes the importance of fine motor skills and accuracy when playing a strategic game. Besides the mechanical elements, physical games emphasize personal interaction, which creates a social environment that promotes communication, competition, and teamwork. These games also bring people together in their informal events, and during competitions, players are required to read the facial expressions of their opponents, anticipate their moves, and engage in strategic discussions. To be more exact, face-to-face play has a more psychological depth, as bluffing, falsehood, and emotional intelligence are aspects that are diminished in an online format.

Strategic and chance board games like Monopoly and Scrabble ensure that each game is different and maintain replayability and continued interest in the long run. However, despite the benefits, there are also negative aspects of physical games. Games also require them to be in a physical location, which makes playing on a regular basis challenging in the hurried world these days. They have a very long history of setup and usually require the maintenance of components, such as chess pieces or playing cards, which can easily get lost or damaged. Where digital games can refresh themselves frequently and have set difficulty settings, physical games are comparatively constant and have fewer variations. Besides, board games and traditional physical games foster interaction between people; they can isolate those who do not know the rules, which makes it hard to learn more complex games. Irrespective of these constraints, physical games have learning advantages that ensure their continued importance over time.

1.4. Digital Games

With the evolution of digital technology, gaming has evolved significantly since it started with board games, and then it evolved to very realistic virtual worlds. Unlike the old-fashioned games, digital games offer a dynamic, interactive experience, thus allowing the player to experiment with a vast, fully configurable world with an infinite number of possibilities. This change broadened the range of player involvement with the introduction of new features of the game, such as AI-controlled enemies, real-time physics, and difficulty levels that could be set (Gee, 2003).

Digital games attract a large audience with different gaming interests and skills, such as fast-paced shooters, such as Call of Duty, or strategy-oriented simulations, such as Civilization. Global access and connectivity of digital games is one of the most radical features thereof. Through digital platforms, real-time multiplayer enables the use of appropriate formats that allow interaction with players located over a broad geographical area, unlike in physical games, which need physical interaction. Esports tourism, including in Dota 2, League of Legends, and FIFA, has developed professional gaming communities within which players compete internationally in competitions to earn prestige and money.

Virtual communities through online platforms, including Steam and PlayStation Network, have also allowed players to create virtual ones, developing friends and enemies across physical boundaries (Taylor, 2006). Also, digital games offer an adaptive learning experience and cognitive training platform, improving problem-solving, reaction speed, and critical thinking. Puzzle games (including Portal) involve spatial reasoning skills, whereas multiplayer Role-Playing Games (RPGs) are games that involve collaboration, negotiation, and making decisions under pressure. In addition, the choice of customising the gameplay, including difficulty levels and in-game customization, makes digital games enjoyable and available to a wide range of players.

Despite these pros, digital games also have various challenges. Screen time and health implications can be mentioned as one of the primary concerns because there is a correlation between long screen time, eye strain, sedentary behaviour, and disturbed sleep patterns (Granic, Lobel, and Engels, 2014). Also, online games may lead to addictive behaviour, especially in versions of the games where players interact online and tend to spend longer periods of time playing the game due to their reward-based systems and ranking players by their achievements.

In contrast to playing games in real life, where people can easily get in close contact, digital games might sometimes make people socially isolated because people might spend too long in the virtual world instead of having the proper physical connection. In addition, digital games may be expensive, including spending money on the purchase of expensive gaming consoles, powerful personal computers, or even advanced online subscriptions. This economic barrier could play a role in preventing equal access to particular games, particularly in less technologically accessible regions. Digital gaming faces risks from technical problems, including server

outages, software bugs, and cyber risks, all of which can interfere with gameplay and influence player experiences. Nonetheless, in spite of these limitations, the adaptability, international scope, and growing possibilities of digital games ensure that they continue to be a crucial element of entertainment and skill enhancement.

1.5. Chess

Chess is one of the most famous and difficult board games in the world, which is played or at least watched by millions of people of different cultures and generations. Chess originated in the sixth century CE in India as Chaturanga, and after hundreds of years of enhancements and development of strategies, the game assumed its modern shape (Murray, 1913). The game is no longer a secret, and the best players around the world take part in events such as the World Chess Championship, Candidates Tournament, and Chess Olympiad.

Its applicability is seen especially in the context of India, where the likes of grandmasters such as Viswanathan Anand, the first World Chess Champion of the country and a role model to a new generation of Indian players, have helped it reclaim its reputation. The complexity of the game is due to the peculiarities of the rules and strategy, as well as a plethora of possible movements. Castling is one of these rules; it is a special move that helps to coordinate and protect pieces better and provides a player with an opportunity to move their king and rook simultaneously.

Another rule of importance is en passant, which is a rare, yet crucial capture of pawns, which, under certain conditions, forbids the evading of enemy pawns. In order to ensure that unnecessary drawn games do not occur, the 50-move rule ensures that, in case the 50 moves are made without any capture or any kind of move made with the pawn, the game is declared a draw. Moreover, threefold repetition does not encourage long repetitions of the moves because the players may claim a draw when the same position on the board is repeated 3 times.

Chess can be categorized into three separate stages, i.e., opening, middlegame, and endgame, with each of them demanding certain abilities. The initial stage is memorised sequences, called openings, which preconditions the middlegame. The endgame, on the other hand, is about making the most accurate choices, identifying patterns, and reducing an advantage to a victory. The art of these stages requires not only a basic capacity to do calculations but also solid strategic planning, visualisation, and flexibility.

1.6. Cognitive Abilities in Chess

In addition to its cultural and competitive value, chess is widely known to have a great influence on cognitive abilities. The game involves forecasting the moves of an opponent, strategizing, and identifying patterns, and all these involve higher-order executive functions. Experts in chess have been demonstrated to make better problem solvers, working memory, and cognitive flexibility because of planning and mental visualisation requirements (Bilalic, Langner, Erb, and Grodd, 2010). These abilities are developed in the course of constant exposure to complicated posts, and the players are required to weigh various options and compare them with long-term outcomes.

Studies indicate that chess has the capability to boost fluid intelligence, which is the capability to reason and solve new problems, through training the brain to consider numerous possibilities and outcomes at the same time (Gobet and Charness, 2006). Working memory is also enhanced by chess because one has to recollect the past play, foresee future plays, and have in mind several board positions to play a game.

The neuroimaging research indicates that competent chess players stimulate the prefrontal cortex, which is associated with decision-making and cognitive control, compared to novice players, which points to the plasticity of the brain to chess training (Campitelli and Gobet, 2011). Moreover, chess improves endurance, thinking ability, and tactical reasoning since players have several hours before winning a game, making them able to concentrate all the time and think critically.

Chess is a valuable cognitive training exercise because its skills and capabilities are similar to the real world of making decisions, strategizing, and changing plans to unforeseen actions. Chess, being an in-depth intellectual game with so much strategy involved, is not just a game but a demanding workout of the mind, which helps to sharpen the thinking faculties, increase problem-solving abilities, and improve overall cognitive ability.

1.7. FIFA

FIFA is a football simulation video game series created by EA Sports, and is a mainstream game in the gaming community since it was first launched in 1993. The game, named after the Federation Internationale de Football Association, has been developed over decades of technological revolution and has emerged as one of the highest-selling video game franchises ever. The authenticity of FIFA, its realistic gameplay, and the official licensing of teams, associations, and athletes have made FIFA tremendously successful with millions of players all over the world, including both amateur gamers and esports professionals (Encyclopaedia Britannica, 2025).

The game became a massive hit in the late 2000s, with players able to compete worldwide as the online multiplayer modes were introduced, which made FIFA not only a game but also a competitive sport on its own. As FIFA Ultimate Team (FUT) was launched in 2009, the franchise began to pick up even more momentum, with players being able to

create their own squads, compete online, and even hold virtual tournaments.

One of the events that has strengthened FIFA as a game powerhouse that plays competitively is the FIFA eWorld Cup, which is an officially sanctioned esports event, attracting the top players and a huge global fan base (FIFA Esports History, 2023). FIFA, in contrast to other turn-based strategy games, is a real-time sports simulation game that engages its users most of the time, demands fast skill in making decisions, and requires well-developed knowledge about football tactics. The game follows the traditional football rules, but some in-game rules distinguish it from the real-life game.

Skill moves, like stepovers, roulettes, and flick-ups, enable the players to avoid defenders through highly skilled maneuvers. The advanced shooting mechanic is called timed finishing, and it is necessary to press the buttons accurately in order to make powerful and accurate shots on goal. The player chemistry, which is a critical aspect of FUT mode, influences the performance of the team due to the relationships and affiliations with leagues as well as country affiliations among players. This, together with the fact that the players are forced to adapt fast to the style of play of opponents, makes FIFA more than a casual form of entertainment, but a strategic and intellectually engaging experience (The Editors of Encyclopaedia Britannica, 2025).

1.8. Cognitive Abilities in FIFA

In addition to being a form of entertainment, FIFA has been identified to have a beneficial effect on different cognitive skills. In comparison to board games like chess, which depend greatly on long-term strategic planning capabilities, FIFA is placing the players into situations where split-second decisions in dynamic, high-speed environments must be made. This perpetual need for real-time plasticity has been attributed to a rise in cognitive flexibility, i.e., the capability to alternate among various strategies and reactions depending on the evolving conditions (Vestberg, Gustafson, Maurex, Ingvar, and Petrovic, 2012).

It has been indicated that action video games such as FIFA can considerably improve the level of visuospatial attention, which involves controlling numerous moving objects on the screen and at the same time strategizing the next course of action (Verburgh et al., 2014). The skill to predict the movement of players, their passes, and the response to stimuli on the field is converted to improved hand-eye coordination and quicker reaction rates. Moreover, FIFA also involves working memory because players should remember the opponent's strategy, retrieve the game maneuvers, and make predictions. The studies that have been conducted on professional football players have revealed that FIFA gameplay has a strong relationship with superior executive performance, particularly on issues like response inhibition and attentional control (Vestberg et al., 2017).

Players should not make risky decisions, such as passing the ball through impulsive passes, but rather take thoughtful actions. In addition, remaining focused on the dynamic exercise of FIFA improves the awareness of the situation, which is an important cognitive skill to pursue playing in both virtual and actual environments. FIFA is a cognitive training tool that enhances reaction time, decision-making under pressure, and flexibility in strategy through simulating real football scenarios with a regulated digital environment. Played either in a recreational or a competitive mode, FIFA strengthens important mental capabilities, which are a challenge to cognitive adaptability and strategic thinking.

This study aims to establish relationships between attention, flexibility of the mind, and spatial awareness with different types of games. The outcomes of the current research will assist in making a conclusion whether different kinds of games can affect cognitive capabilities in unique ways that imply the possibility of applying these games in the classroom setting. If some games or formats prove to be able to improve cognitive skills, they can be introduced as a worthy tool to facilitate learning and academic progress.

2. Materials and Methods

2.1. Aim

This research compares the effects of chess and FIFA on the cognitive abilities of players by focusing on three distinct abilities: spatial awareness, attention, and cognitive flexibility.

2.2. Objectives

1. To compare attention, cognitive flexibility, and spatial awareness between participants who play virtual chess and those who play virtual FIFA.
2. To compare attention, cognitive flexibility, and spatial awareness between participants who play football (physical) and those who play chess (in-person).
3. To examine whether the duration of gameplay (3 to more than 6 years vs. less than 1 to 3 years) influences attention, cognitive flexibility, and spatial awareness.
4. To test whether game format (virtual, physical, or both) is associated with differences in attention, cognitive flexibility, and spatial awareness.
5. To examine the interrelationships among the three cognitive constructs: attention, cognitive flexibility, and spatial awareness.
6. To provide descriptive comparisons of all study variables across groups and formats.

2.3. Design Rationale

The choice of chess, FIFA, and football games was based on their differing levels of structural and cognitive complexity. Chess can be considered a turn-based strategic task that involves planning and attention. FIFA can be considered a digital simulation of sports that involves real-time visuospatial processing. Football can be considered a physical sport that involves movement and spatial navigation.

The three games will enable the study of cognitive outcomes based on different gameplay formats.

2.4. Hypothesis

H1: There is a difference between the *Chess (Virtual)* and *FIFA (Virtual)* groups with respect to the dependent variable, Attention scale

H2: There is a difference between the *Chess (Virtual)* and *FIFA (Virtual)* groups with respect to the dependent variable, Cognitive flexibility

H3: There is a difference between the *Chess (Virtual)* and *FIFA (Virtual)* groups with respect to the dependent variable, Spatial Awareness

H4: There is a difference between the *Football (Physical)* and *Chess (In-Person)* groups with respect to the dependent variable, Attention scale

H5: There is a difference between the *Football (Physical)* and *Chess (In-Person)* groups with respect to the dependent variable, Cognitive flexibility

H6: There is a difference between the *Chess (In-Person)* and *Football (Physical)* groups with respect to the dependent variable, Spatial Awareness

H7: There is a difference between the *3 to more than 6 years* and the *Less than 1 to 3 years* groups with respect to the dependent variable Spatial Awareness.

H8: There is a difference between the *3 to more than 6 years* and the *Less than 1 to 3 years* groups with respect to the dependent variable, Attention scale

H9: There is a difference between the *3 to more than 6 years* and the *Less than 1 to 3 years* groups with respect to the dependent variable Cognitive flexibility.

2.5. Sample and Sampling Technique

The purposive sampling method was used in the study to make sure that people with varying degrees of experience in chess and FIFA were covered. The target group was represented by players of various age groups (teenagers, young adults, adults), genders, and regions. The research surveyed 70 individuals (at least 35 of each gender) playing chess, FIFA, or both in order to make meaningful comparisons. The participants had to have at least four months of experience in playing their own different games to help legitimately validate their results.

2.6. Research Design

The present paper adopted a quantitative research design in addressing the correlation between certain games (chess, FIFA, football) and the most important cognitive characteristics of spatial awareness, cognitive flexibility, and attention. An organized questionnaire that consisted of previously proven scales was used, and numerical data were gathered by self-reports of the participants. Quantitative approach allows a statistical analysis of patterns and relationships between variables, therefore providing objectivity, reproducibility, and applicability of the obtained results to demographic groups (age, gender, and region).

2.7. Instrumentation

The study utilised a composite questionnaire that included three sections:

2.7.1. Spatial Awareness

Spatial awareness was assessed with the help of items that were developed based on the validated spatial ability instrument created by Nazareth et al. (2014). This was an instrument that was initially created to measure individual discrepancies in mental rotation and spatial orientation. In the current research, 14 items were picked for the measure. The tool has been commonly employed in previous studies to test the differences in spatial ability and has shown a good psychometric performance.

2.7.2. Cognitive Flexibility Inventory (CFI)

The Cognitive Flexibility Inventory (CFI), created by Dennis and Vander Wal (2010), was used to measure cognitive flexibility. CFI is a self-report instrument that aims at describing the capability of individuals to switch between cognitive sets, adjust according to the evolving situational requirements, and think multiple times in problem-solving situations. This study has used the original form of the instrument that has been validated. Earlier studies have determined the reliability and construct validity of the CFI on various samples.

2.7.3. Attention Control Scale(ATTC)

Attention control was assessed with the help of the Attentional Control Scale (ACS) elaborated by Derryberry and Reed (2002). The ACS is a 20-item self-report instrument that evaluates two key concepts of attentional control, which include focusing (maintenance of attention in the face of distraction) and shifting (flexibility of attention between stimuli or tasks). Each of the items has a 4-point Likert scale of 1 = Almost never to 4 = Always, and the greater the rating, the greater the perceived control regarding attentional control. In this research, 11 items were selected out of the 20 items of the original ACS on the basis of content relevance. The chosen items cover the areas of attentional focusing and shifting to give a succinct but exhaustive measure of attentional control.

Shortened versions of the Attentional Control Scale and the spatial ability test were employed in order to minimize fatigue and facilitate the completion of the responses. The selection of the items was based on relevance and the coverage of the sub-dimensions of the original test. This approach has been used in previous studies on cognition and behavior, where it was impractical to administer the full scale. However, the approach is a limitation in the study.

2.8. Data Collection Procedure

The survey was conducted online, and the data gathering was done over various platforms, such as social networking sites, academic forums, and face-to-face recruitment. To make the survey inclusive and diverse, it was open to all participants

irrespective of their age, gender, and geographic location. The respondents were made aware of the purpose of the study and provided with clear instructions on how to complete the questionnaire. The time indicated to complete the questionnaire (almost 10-15 minutes) was specified. In order to make the survey comprehensive, the questionnaire was formulated in such a way that the respondents had to respond to a particular item before proceeding to the next part.

2.9. Ethical Considerations

Ethical protocols were carefully followed throughout the study. Participants were presented with an informed consent form at the beginning of the survey, which clearly explained the study's purpose, the voluntary nature of participation, and their right to withdraw at any time without penalty. Respondents were assured that all responses would remain confidential and be used solely for academic research purposes. Data was anonymised, and no personally identifiable information was collected. Instructions were provided to ensure participants understood how to complete the survey accurately and honestly. Data analysis was conducted using statistical software.

2.9.1. Methodological Considerations

The study did not control for potentially relevant confounding variables, such as socioeconomic status, educational background, baseline intelligence, and associated cognitive or psychological conditions. Such factors may affect both gameplay engagement and cognitive performance.

2.10. Statistical tests used

Descriptive statistics (means, standard deviations, and frequencies) were used to summarise participant demographics and overall responses. In order to test the hypotheses, t-tests, one-way ANOVA tests, and Pearson's correlation coefficient were used. A significance threshold of $p < 0.05$ was adopted to determine statistical significance.

3. Results and Discussion

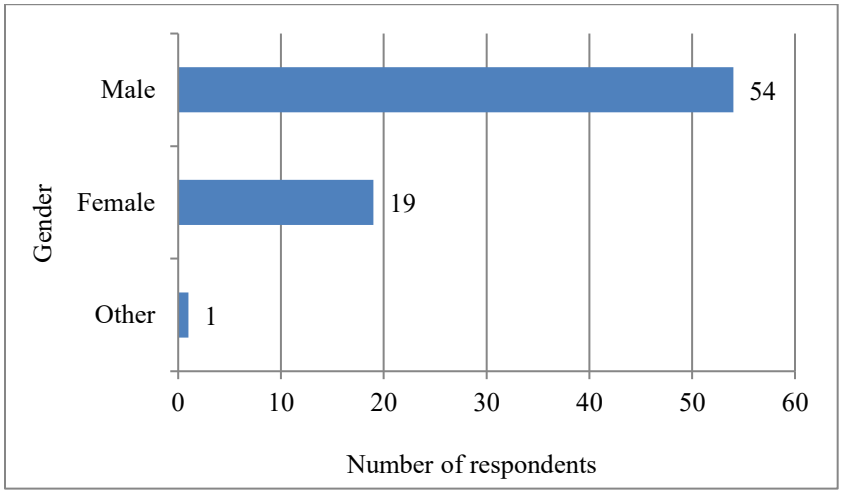

Fig. 1 Shows the gender distribution of the respondents.

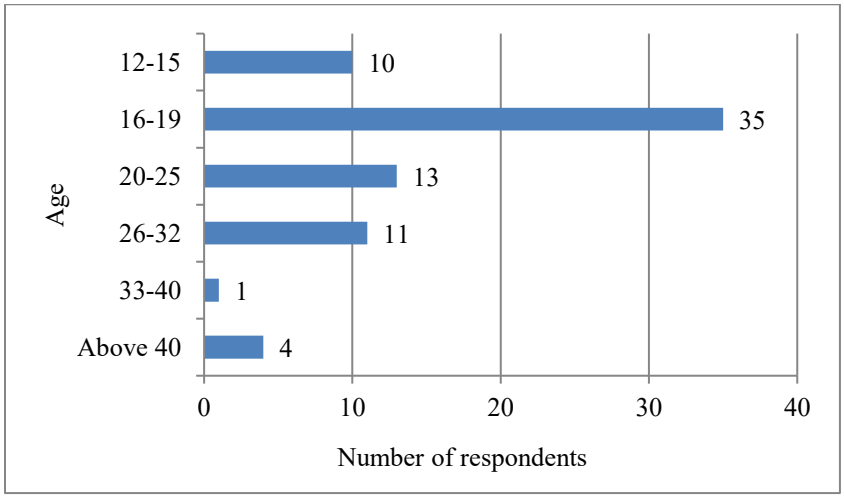

Fig. 2 Illustrates the distribution of respondents across different age categories

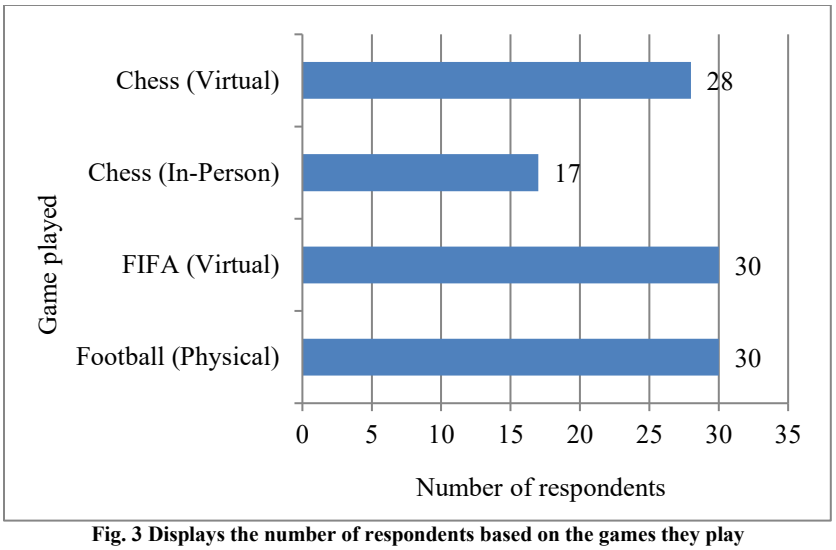

Fig. 3 Displays the number of respondents based on the games they play

Table 1. T-test values for Chess (Virtual) and FIFA (Virtual) groups with respect to the dependent variable Attention

	Chess (Virtual)	FIFA (Virtual)
n	15	13
M	39.03	36.15
S.D.	4.08	3.21
t	2.69	-
df	26	-
p	.012	-
Cohen's d	1.02	-

An independent sample T Test was conducted to compare attention scores across participants who played Chess(n=15) and FIFA(n=13) virtually. The results indicated that there is a statistically significant difference in attention scores across the two groups, t=2.69, p=0.012 (p<0.05). Respondents who played chess virtually(M=39.93, S.D.=4.08) reported a higher mean score than respondents who played FIFA virtually (M=36.15, S.D.=3.21). The Cohen's d value of 1.02 suggests a very large effect size.

Table 2. T-test values for Chess (Virtual) and FIFA (Virtual) groups with respect to the dependent variable Cognitive Flexibility

	Chess (Virtual)	FIFA (Virtual)
n	15	13
M	67.2	62.1538
S.D.	10.818	12.2396
t	1.1584	-
df	26	-
p	.257	-
Cohen's d	0.4389	-

An independent sample T Test was conducted to compare cognitive flexibility scores across participants who played Chess(n=15) and FIFA(n=13) virtually. The results indicated that there is no statistically significant difference in cognitive flexibility scores across the two groups, t=1.1584, p=0.257(p>0.05). Respondents who played chess virtually(M=67.2, S.D.=10.818) reported a higher mean score than respondents who played FIFA virtually (M=62.1538, S.D.=12.2396). The Cohen's d value of 0.4389 suggests a moderate effect size.

Table 3. T-test values for Chess (Virtual) and FIFA (Virtual) groups with respect to the dependent variable Spatial Awareness

	Chess (Virtual)	FIFA (Virtual)
n	15	13
M	32.6667	31.9231
S.D.	6.4217	5.6489
t	0.3229	-
df	26	-
p	.749	-
Cohen's d	0.1224	-

An independent sample T Test was conducted to compare spatial awareness scores across participants who played Chess(n=15) and FIFA(n=13) virtually. The results indicated that there is no statistically significant difference in cognitive flexibility scores across the two groups, t=0.3229, p=0.749 (p>0.05). Respondents who played chess virtually (M=32.6667, S.D.=6.4217) reported a higher mean score than respondents who played FIFA virtually (M=31.9231, S.D.=5.6489). The Cohen's d value of 0.1224 suggests a small effect size.

Table 4. T Test for Football(Physical) and Chess (In-Person) groups with respect to the dependent variable Attention

	Football(Physical)	Chess(In-person)
n	13	8
M	38.2308	36.625
S.D.	5.7177	7.2099
t	0.5664	-
df	19	-
p	.578	-
Cohen's d	0.2545	-

An independent sample T Test was conducted to compare attention scores across participants who played Football(n=13) and Chess(n=8) offline. The results indicated that there is no statistically significant difference in attention scores across the two groups, t=0.5664, p=0.578(p>0.05). Respondents who played Football physically(M=38.2308, S.D.=5.7177) reported a higher mean score than respondents who played Chess in person (M=36.625, S.D.=7.2099). The Cohen's d value of 0.2545 suggests a small effect size.

Table 5. T Test for Football(Physical) and Chess (In-Person) groups with respect to the dependent variable Cognitive Flexibility

	Football(Physical)	Chess(In-person)
n	13	8
M	69.6923	71.375
S.D.	6.713	11.7222
t	-0.4211	-
df	19	-
p	.678	-
Cohen's d	0.1892	-

An independent sample T Test was conducted to compare cognitive flexibility scores across participants who played Football(n=13) and Chess(n=8) offline. The results indicated that there is no statistically significant difference in spatial awareness scores across the two groups, t=-0.4211, p=0.678(p>0.05).

Respondents who played Chess in person (M=69.6923, S.D.=6.713) reported a higher mean score than respondents who played Football physically(M=71.375, S.D.=11.7222). The Cohen's d value of 0.1892 suggests a small effect size.

Table 6. T Test for Football(Physical) and Chess (In-Person) groups with respect to the dependent variable Spatial Awareness

	Football(Physical)	Chess(In-person)
n	13	8
M	33.2308	36.375
S.D.	5.2782	6.163
t	-1.245	-
df	19	-
p	.228	-
Cohen's d	0.5594	-

An independent sample T Test was conducted to compare spatial awareness scores across participants who played Football(n=13) and Chess(n=8) offline. The results indicated that there is no statistically significant difference in spatial awareness scores across the two groups, t=-1.245, p=0.228(p>0.05).

Respondents who played Football physically(M=33.2308, S.D.=5.2782) reported a higher mean score than respondents who played Chess in person (M=36.375, S.D.=6.163). The Cohen's d value of 0.5594 suggests a moderate effect size.

Table 7. T Test for 3 with more than 6 years and less than 1 to 3 years groups with respect to the dependent variable Attention.

	3 to more than 6 years	Less than 1 to 3 years
n	39	35
M	38.9231	37.3429
S.D.	5.07	4.6775
t	1.3883	-
df	72	-
p	.169228	-
Cohen's d	0.3232	-

An independent sample T Test was conducted to compare attention scores across participants who played their respective games for 3 to more than 6 years(n=39) and less than 1 to 3 years(n=35) offline. The results indicated that there is no statistically significant difference in attention scores across the two groups, t=1.3883, p=0.169(p>0.05).

Respondents who played their respective games for 3 to more than 6 years (M=38.9231, S.D.=5.07) reported a higher mean score than respondents who played their respective games for less than 1 to 3 years(M=37.3429, S.D.=4.6775). The Cohen's d value of 0.3232 suggests a small effect size.

Table 8. T Test for 3 with more than 6 years and less than 1 to 3 years groups with respect to the dependent variable Cognitive Flexibility

	3 to more than 6 years	Less than 1 to 3 years
n	39	35
M	67.9487	66.7143
S.D.	7.5112	10.5065
t	0.5858	-
df	72	-
p	.56	-
Cohen's d	0.1364	-

An independent sample T Test was conducted to compare cognitive flexibility scores across participants who played their respective games for 3 to more than 6 years(n=39) and less than 1 to 3 years(n=35) offline. The results indicated that there is no statistically significant difference in cognitive flexibility scores across the two groups, t=0.5858, p=0.56(p>0.05).

Respondents who played their respective games for 3 to more than 6 years (M=67.9487, S.D.=7.5112) reported a higher mean score than respondents who played their respective games for less than 1 to 3 years(M=66.7143, S.D.=10.5065). The Cohen's d value of 0.1364 suggests a small effect size.

Table 9. T Test for 3 to more than 6 years and less than 1 to 3 years groups with respect to the dependent variable, Spatial Awareness

	3 to more than 6 years	Less than 1 to 3 years
n	39	35
M	34.7692	32.6571
S.D.	4.7265	6.097
t	1.6746	-
df	72	-
p	.098	-
Cohen's d	0.3899	-

An independent sample T Test was conducted to compare spatial awareness scores across participants who played their respective games for 3 to more than 6 years(n=39) and less than 1 to 3 years(n=35) offline. The results indicated that there is no statistically significant difference in spatial awareness scores across the two groups, t=1.6746, p=0.098(p>0.05). Respondents who played their respective games for 3 to more than 6 years (M=34.7692, S.D.=4.7265) reported a higher mean score than respondents who played their respective games for less than 1 to 3 years(M=32.6571, S.D.=6.097). The Cohen's d value of 0.3899 suggests a small to moderate effect size.

Table 10. ANOVA test between the format of the game played and Attention

	Virtual/ Online	Both	Physical/ Offline
n	27	25	22
M	38.52	39.64	36.09
S.D.	4.15	4.1	6.02
t	3.35	-	-
df	0.41	-	-
η2	.009	-	-

A one-way ANOVA was conducted to examine whether the format of games played had a significant effect on attention scores. The results indicated a statistically significant difference across the 3 game format groups, with F=3.35, p=0.041(p<0.05). η2 suggests that the format in which respondents played games had a moderate effect on attention (η2=0.09). The respondents who played games in both formats (M=39.64, S.D.=4.1) had the highest attention scores than those who played games online (M=38.52, S.D.=4.15) and those who played games offline (M=36.09, S.D.=6.02).

Table 11. ANOVA test between the format of game played and Cognitive Flexibility

	Virtual/ Online	Both	Physical/ Offline
n	27	25	22
M	65.4444	69.32	67.5
S.D.	10.5113	6.5366	9.3389
t	1.2116	-	-
df	.304	-	-
η2	0.033	-	-

A one-way ANOVA was conducted to examine whether the format of games played had a significant effect on cognitive flexibility scores. The results indicated no statistically significant difference across the 3 game format groups, with F=1.2116, p=0.304(p>0.05). η2 suggests that the format in which respondents played games had a moderate effect on cognitive flexibility scores (η2=0.033). The respondents who played games in both formats (M=69.32, S.D.=6.5366) had the highest cognitive flexibility scores than those who played games offline (M=67.5, S.D.=9.3389) and those who played games online (M=65.4444, S.D.=10.5113).

Table 12. ANOVA test between the format of the game played and Spatial Awareness

	Virtual/ Online	Both	Physical/ Offline
n	27	25	22
M	32.5556	35.24	33.5909
S.D.	5.8922	4.5118	5.8118
t	1.5979	-	-
df	.21	-	-
η2	0.0431	-	-

A one-way ANOVA was conducted to examine whether the format of games played had a significant effect on spatial awareness scores. The results indicated no statistically significant difference across the 3 game format groups, with F=1.5979, p=0.21(p>0.05). η2 suggests that the format in which respondents played games had a moderate effect on cognitive flexibility scores (η2=0.0431). The respondents who played games in both formats (M=35.24, S.D.=4.5118) had the highest cognitive flexibility scores compared to those who played games offline (M=33.5909, S.D.=5.8118) and those who played games online (M=32.5556, S.D.=5.8922).

Table 13. Correlation matrix for Cognitive flexibility, Attention, and Spatial awareness

		CF	A	SA
CF	**Correlation**	1	0.26	0.31
	p		.028	.008
A	**Correlation**	0.26	1	0.4
	p	.028		<.001
SA	**Correlation**	0.31	0.4	1
	p	.008	<.001	

*CF = Cognitive Flexibility, A = Attention, SA = Spatial Awareness

The Pearson Correlation analysis was conducted to examine the relationship among Cognitive flexibility, attention, and spatial awareness. Overall, the results have revealed a significant positive correlation between all three variables. Cognitive flexibility and attention were significantly positively correlated with r=0.26, p=0.028 (p<0.05). This indicated that higher levels of cognitive flexibility are associated with greater attention. Attention and spatial awareness were significantly positively correlated with r=0.4, p=<0.001 (p<0.05). This indicated that higher levels of

attention are associated with greater spatial awareness. Spatial awareness and cognitive flexibility were also significantly positively correlated with r=0.31, p=0.008 ($p<0.05$).

4. Discussion

In the game of virtual chess, the study presents a clear benefit of the group of players in terms of attention skills over the group of players in terms of virtual FIFA. Even when played online, chess demands long-term attention, observation, and tactical planning, and these characteristics might lead to better performance in attention. This is supported by prior studies, which suggest that attentional control may be improved with the help of strategic games such as chess (Sala and Gobet, 2016; Gobet and Campitelli, 2007).

Sports video games such as FIFA, which focus more on reaction time and coordination, might not be as effective in causing sustained attention, although they can have some effects on visual and spatial abilities (Green and Bavelier, 2003; Boot et al., 2008). Thus, the strategic and mindful character of chess must be the reason why a greater degree of attention was recorded in this research. Nevertheless, these findings can possibly be affected by the factors, which include whether the game is played in real life or in a virtual environment, the previous experience in playing the games, and the type of attention measures taken. Unlike the attention results, there was no significant group difference in cognitive flexibility, the ability to alternate tasks, change strategy, and react to new circumstances. It is one of the major elements of executive function (Diamond, 2013).

Although chess involves the ability to predict the moves of one's opponent and change tactics, thus possibly improving the flexibility of the thinking process (Burgoyne et al., 2016), FIFA also requires the flexibility of having to react to unforeseen circumstances on the field and the strategy of the opponent (Boot et al., 2008; Green and Bavelier, 2012). The absence of a significant difference in this study indicates that both types of games can train cognitive flexibility using various but equally efficient mechanisms. The results might be affected by factors like the length of play sessions and experience, which would have resulted in a small gap between significant groups.

There was no marked difference in the scores of spatial awareness between the virtual chess and virtual FIFA groups. Therefore, the requirements of both kinds of games are specific to spatial processing. FIFA is a dynamic movement following, space location, and fast decision-making in a dynamic field that may contribute to visuospatial awareness (Boot et al., 2008; Spence and Feng, 2010). Chess, however, involves spatial thinking by using the mind to manipulate the chessboard and anticipate moves of the opponent (Sala and Gobet, 2016). The lack of a significant difference suggests that while these skills are trained differently, both games may offer comparable overall benefits for spatial ability in the short term. It is also possible that the relatively brief duration of gameplay in this study limited the extent of measurable differences.

When comparing offline formats, neither in-person chess nor football demonstrated clear advantages across the three domains. Prior literature offers a mixed picture: physical sports participation is often linked to broader benefits in attention and executive function via aerobic exercise and embodied coordination (Best, 2010; Hillman et al., 2008), while in-person chess and other strategy games are associated with domain-specific cognitive training effects (Sala & Gobet, 2016; Gobet & Campitelli, 2007). The current null results, therefore, may reflect counterbalancing mechanisms, physical activity boosting general executive processes, while chess strengthens strategic/problem-solving skills, resulting in no clear superiority on the measures used. Alternatively, sample size limitations and between-group variability (e.g., experience, fitness level) may have obscured real differences. The results of the T-Tests indicated no reliable differences in spatial awareness, attention, or cognitive flexibility between participants with more years of experience and those with less.

The trend of slightly higher scores for more experienced players aligns with the idea that longer engagement in cognitively demanding activities may improve certain skills, but the lack of significant findings suggests these effects are small or vary widely among individuals. It is supported in the previous studies, which indicate even small effects of practice due to regular involvement in these activities (Sala and Gobet, 2016), but also point to considerable individual differences that may diminish the effects on the group level (Burgoyne et al., 2016; Ullén et al., 2016). The marginal rises in scores of more experienced players may require bigger samples or research followed up on the same persons over time to be verified. Therefore, even though the years of experience demonstrate a tendency toward increased cognitive ability, no solid conclusions regarding the gains from the experience can be made.

Those who responded to their respective games, whether in the online or the offline version, recorded higher metrics of attention compared to those who responded to their respective games in either of the two formats. This implies that integrating physical play with virtual play can enhance attention by integrating the element of strategy with the physical coordination (Best, 2010; Tomporowski et al., 2008). Cognitive flexibility and awareness of space did not, however, differ significantly between different formats, but those who played all formats had a marginally higher score on the two abilities. These results can be discussed in terms of the research, which indicates that more specific or intensive training, in comparison with the training offered by casual play, may be required to improve broader cognitive abilities, such as flexibility or spatial awareness (Bediou et al., 2018; Uttal et al., 2013; Spence and Feng, 2010).

Although the findings may be viewed to conclude that a combination of play formats may be useful, attention seems to be more dependent on the difference in formats than on cognitive flexibility or spatial awareness in this group. Lastly, the research established positive relationships between attention, cognitive flexibility, and spatial awareness. In particular, it was found that the correlation between attention and spatial awareness was especially high. The participants who had better cognitive flexibility scored higher on attention measures, and better attention also demonstrated better spatial awareness. These results help prove the theory that attention, cognitive flexibility, and spatial skills are related cognitive abilities, which tend to act in harmony (Miyake et al., 2000; Uttal et al., 2013).

The increased relationship between attention and spatial awareness indicates that better attentional control is involved in spatial activities such as mental rotation. All in all, these relationships suggest that there are some processes common to these cognitive abilities, but we cannot say that one of them is caused by another. Part of these associations could also be attributed to other factors such as general intelligence, personal preference, or drive (Burgoyne et al., 2016).

5. Conclusion

This paper investigated the cognitive impacts of three different types of gameplay, namely chess, FIFA, and football, on attention, spatial awareness, and cognitive flexibility. The results indicate that virtual players of chess and physical players of football exhibit improved attention, which shows the need to have a sustained focus on playing the game in a strategic manner. FIFA players had slightly higher scores in spatial awareness, but not significantly, compared to football players with similar scores in spatial awareness and adaptability through teamwork, continuous strategic planning, and movement within a physical space. No difference was found in cognitive flexibility between the three groups, and it is possible to consider that both forms of chess and football enhance adaptability and other cognitive areas equally.

The majority of between-group differences did not prove to be statistically significant, with the exception of closer attention in virtual chess players. Significantly, the young players were found to score more in the attention scale as opposed to players in the older age groups. These findings point to the positive effects of various games on cognitive development.

This study highlights the need to appreciate games not only as a means of recreation but also as an excellent way of learning and developing certain cognitive skills by demonstrating the role that board games, video games, and physical sports play in the development of particular cognitive skills. This value can be applied to the educational and developmental settings, where the gameplay would be. included in the learning or training curricula to enhance cognitive ability in an interesting manner.

There are a number of constraints that need to be taken into consideration when interpreting the results of this research.

1. The sample size was 70 participants, which might limit the statistical power of the analyses and limit the extrapolation of the results to larger populations.
2. Self-reported questionnaires were used to assess all variables, and this technique is also prone to other types of bias in responses, such as social desirability, recall bias, or lack of introspective accuracy.
3. The experience with the gameplay was assessed only through the number of years played. This indicator failed to capture such significant attributes as frequency of play, session length, competitive level, or even a certain form of engagement, which may have a significant impact on cognitive outcomes.
4. The analysis was done on three games (chess, virtual and physical, virtual FIFA, and physical football). This is very limited in terms of conclusion, as far as other game genres, formats, or sports, which might involve other thinking processes, cannot be concluded.
5. It was only three cognitive constructs that were studied, and they are attention, cognitive flexibility, and spatial awareness. There was no assessment of other domains related to working memory, executive inhibition, decision-making speed, or emotional regulation, which might also be affected by the gameplay.
6. It also happened that some groups of games had significantly smaller sample sizes compared to other groups, which could have compromised the strength of between-group comparisons.
7. The research was cross-sectional; thus, it is not possible to determine causal links between gameplay and cognitive abilities. The correlations that have been found may be due to self-selection, where people with better cognitive abilities are more likely to play certain games.

Future Recommendations

1. Longitudinal or experimental designs should be used in future research, as cross-sectional data cannot be used to determine changes in the relationships between gameplay and cognitive development.
2. It would be better to increase the sample size and research people of various demographic profiles, i.e., people of different ages, genders, cultural backgrounds, and education levels, as it would contribute to the representativeness and generalizability of the results.
3. The inclusion of other types of games, including video games based on strategy, puzzle games, and other forms of physical sports, would permit a more detailed approach to the way various types of gameplay would affect different types of cognitive processes.

4. The future studies ought to use a combination of self-reporting questionnaires with objective methods, e.g., standardised neuropsychological testing or neuroimaging tests, to offer more valid evidence of the effect of gameplay on cognition.

The study of the application of gameplay to formal education or professional training might also yield important information on how planned gaming activities can improve certain cognitive abilities in practical and real-world settings.

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