Exploring the Link between Smartphone Social Media Use and Performance, Focus of Young Table Tennis Players

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Abstract: This study aimed to explore the immediate effects of smartphone-based social media use on table tennis performance variables such as reaction speed, stroke execution accuracy, and focus. A total of 14 young athletes, consisting of 7 males and 7 females (10.86 ± 1.83 years; 2.43 ± 0.65 years of experience in table tennis) participated in a randomized and counterbalanced quasi-experimental study divided into two groups: (a) social media group (SMG) and (b) table-tennis videos group (TTVG). The study assessed four variables: Stroop Test, reaction speed, a specific table tennis test, and focus (Toulouse-Piéron Test). The results indicated significant pre- and post-differences in hits, errors, and total points for both groups (p < .01), with no significant differences between groups in the three field tests. In conclusion, a 30-minute exposure to either game-related videos or social media stimuli in children led to improved scores, hits, and errors in the Stroop Test. These results suggest that acute exposure to virtual stimuli, regardless of type, enhances inhibitory control and attention abilities.

Keywords: Table tennis, social media, smartphones, focus, sports performance.

INTRODUCTION

The use of technology in sports has spread exponentially to improve athletic performance, develop tools for achieving sports justice, enhance communication and marketing strategies, and provide ease and accessibility for assessing mental, physical, and physiological performance (1,2). Technologies such as wearable devices, smartphones, and cameras are examples of technological tools currently available and constantly evolving, which allow for the improvement of technical and physical capabilities, as well as a means of performance evaluation (3,4).

While the extensive availability of new technologies (e.g. smartphones, tablets, laptops) in sports can bring certain benefits, the negative impact on athletic and academic performance as a consequence of their use has also been explored (5–7). The use of social media through smartphones has been shown as one of the factors that can acutely and chronically affect health (chronic sleep deprivation, decreased academic performance, socioemotional disturbances, cognitive control) (8–10) and athletic performance (decreased multitasking abilities, problem-solving and decision-making skills, and decreased physical and technical capabilities) (8,11,12).

In the case of table tennis, athletic performance is considered multifactorial, with factors including technical efficiency (13,14), concentration and reaction time (15), and timely, effective, and efficient decision-making and management of mental fatigue (14). Mental fatigue is defined as a psycho-biological state caused by prolonged and highly demanding cognitive tasks (16), which could lead to impairments in decision-making and technical performance due to the alteration of executive functions (17). This alteration not only leads to acute effects but also chronic effects that create an unstable environment and contribute to the athlete’s
susceptibility (18). In this sense, a previous study suggested that this negative influence is greater for offensive actions than for defensive actions (16).

One of the recently studied factors that cause alterations in mental fatigue is the use of social media (8, 19). Especially in athletes, the use of social media prior to training and competition can be critical when analyzing its negative effect on cognitive, physical, and technical actions (20). In this sense, while evidence exists on the effect of social media use on athletic performance in disciplines such as swimming (21), boxing (11), volleyball (22), American football (6), and soccer (12, 23), there is no scientific basis for the study of these effects in table tennis players. For the reasons abovementioned, the purpose of this study was to analyze the acute effect of social media use, with smartphones, on athletic performance in table tennis players concerning reaction time, stroke execution precision, and concentration.

METHODS

Design

This quantitative quasi-experimental study used a randomized parallel counterbalanced design. Fourteen participants with an equal gender distribution were included in the study and randomly assigned to either the social media group (SMG) or the sports video group (SVG). The participants were assessed before and after each experimental condition using the Stroop test. Between stimuli, 72 hours of rest was realized. After each experimental condition, the following three variables were evaluated: reaction speed, hit accuracy, and concentration. The design was based on previous studies (23) and is presented as follows (see Figure 1): The study variables were designed as follows, where (O) assessment (reaction speed, shot precision and focus), (X$_1$) social media group and (X$_2$) table tennis videos group:

\[
R^{E_1}X_1O \quad E_2 \quad X_2O
\]

Insert here >>> Figure 1. Study design

Participants

Fourteen national-level table tennis players (seven males and seven females) were recruited for the current study. The participants’ mean age was 10.86 ± 1.83 years, mean weight was 36.92 ± 9.29 kg, mean height was 1.50 ± 0.12 m, and mean sports experience was 2.43 ± 0.65 years. Participants were divided into two groups: (a) a social media group (SMG) and (b) a table tennis video group (TTVG). The selection criteria included regular table tennis training at least three times a week in the past three months, a minimum of two years of sports experience in this discipline, and the absence of health or injury conditions that prevent regular play. All participants were in a competitive phase.

The sample size was estimated based on a counterbalanced experimental study to reduce progressive error and distribute it equally between the experimental conditions (24). This calculation was performed using the G-Power software for repeated measures MANOVA statistical analysis between factors. The resulting sample size was a total of 12 participants with two groups, and an effect size of F = 0.5, with a 1-beta probability of error of 0.95.

This protocol will be evaluated by the Scientific Ethics Committee of the National University of Costa Rica (UNA-CECUNA-0185-2022) under the guidelines of Costa Rican Research Law No. 9234. The protocol will be conducted in accordance with the biomedical research guidelines based on the Helsinki Declaration. Due to the participation of minors, an informed consent form was signed by the participants, legal guardians, and researchers.

Instruments and procedures

Before the evaluation sessions, participants were asked to avoid using smartphones and social media for at least two hours before data collection (11). Participants assigned to the SMG group used their smartphones...
for 30 minutes prior to the assessments (e.g., TikTok or Instagram). Meanwhile, the SVG group watched videos of professional table tennis games for 30 minutes on a wall projector. These conditions were similar to those used in previous studies (21,22). After exposing the table tennis players to the stimuli, three tests were conducted to assess the different technical skills related to game performance.

**Stroop test**

The Stroop Test is a neuropsychological test used to evaluate an individual’s ability to ignore irrelevant stimuli and focus on relevant stimuli. Therefore, this test evaluates the ability to inhibit the cognitive interference that occurs when processing a specific feature of the stimulus, which hinders the simultaneous processing of a second attribute of the stimulus (25), which is known as the Stroop effect (26).

The task involved reading words written in different colors, but the words themselves may conflict with the colors of the letters. For example, the word “red” could be written in green. The goal of the test is to determine how long and how many errors make participant makes when trying to ignore irrelevant information (the meaning of the word) and respond to relevant information (the color of the word). During this test, the susceptibility to interference from conflicting stimuli was assessed (i.e., how the brain handles contradictory information and how it selects relevant information to perform a task) (27).

This test was conducted using a mobile application called the Stroop Effect (iOS 9.0, Attila Hegedűs, Hungary). The mobile application displays a label centered at the top of the screen in either green or red color with the words “green” or “red,” and two labels are placed in the bottom left and right corners, respectively, in the same way. The task involves selecting the appropriate label from the bottom, whose text indicates the color of the upper label. Errors, correct responses, and total scores were recorded in this test.

**NeuroPhys Sports Reaction Test**

The reaction speed was evaluated using the NeuroPhys Sports Reaction Test, which utilizes a wireless light system (Fitlight Trainer, Miami, Florida, USA). The test was modified to be performed with the hand in the bipedal position in front of a table tennis with short displacement, simulating specific sports movements. The protocol consists of five lights arranged in a semicircle on the official game table (Pro-9, Champion, Seoul, Korea). The lights were placed at each 45° intersection (see Figure 2). Participants were instructed to start by placing their hands with the racket at the starting point (described as 0 in Figure 2). After a signal from the researcher, the test begins and the lights turn on randomly for 30 seconds until participants turn them off one by one, passing the racket through an invisible light beam with a height range of 80 cm. Once a light is turned off, another one immediately turns on. The test consisted of 2 series of 30 seconds. The test required participants to turn off the lights as quickly as possible. The variables hit counts (lights turned off, n) and speed reaction average at each light (ms) were analyzed for each participant.

**Specific Table Tennis Test**

To perform this test, a robot was used (Robo-Pong 540, Newgy Industries, Hendersonville, Tennessee, USA), which sends balls at programmable frequency and speed. In this test, the participant performed a series of strokes for 30 seconds, trying to place the ball on a specific area on the opposite side of the table, where each demarcated zone corresponded to a score of 8, 6, 4, or 2 points (see Figure 3). No score is assigned to balls that are off the table or missed.

During the study, the robot was programmed to send balls without spin or oscillation at a frequency of one ball every two seconds, which is related to the average hit frequency in high-performance table tennis (28). The location of players on the table was selected by each player to represent a real-game situation. Before starting the test, each player performed a 20-minute general and specific warm-up. The values were presented as a percentage (%) of balls in each zone.

**Figure 2.** Disposition of NeuroPhys Sports Reaction Test for table tennis

**Figure 3.** Distribution of score zones for the specific table tennis test.
Test de Toulouse-Piéron

This test evaluates the identification in the shortest time possible (<20 seconds) of specific figures previously given from a group of figures (see Figure 4) (29). Each test series includes an accumulation phase (20 seconds of Burpee), followed by a concentration phase (until the figure is located or 20 seconds of the Toulouse-Piéron test are exceeded). This series is repeated continuously and without rest until the athlete reaches fatigue. The figure to be located in the concentration phase changes in each series. The number of completed series (n), the number of accumulation phases (n), concentration phases (s), and the perception of effort (arbitrary units, a.u.) were recorded.

After each accumulation phase, the participant’s perceived effort was assessed using the Borg scale. The perceived effort (RPE) was recorded as a marker of the effort of fatigue. This variable indicates the subjective effort experienced by the athlete during and after exertion. Participants were familiar with the use of RPE and were evaluated using the Borg Scale 0-10, where 0 was defined as a "very, very light” effort and 10 as a "maximum, strenuous” effort (30).

**Insert here>> Figure 4. Example of focus phase in Toulouse-Piéron test.**

**Statistical analysis**

Firstly, descriptive statistics of each variable were obtained by the mean and standard deviation (M ± SD ). Then, the data distribution was analyzed by the Shapiro-Wilk test and Levene test which confirm the data normality and homogeneity of variances. For the Stroop Test variables, the delta of change was calculated, and a two-way analysis of variance (ANOVA) was performed to explore potential differences in means between groups’ measurements (groups x time of measurement). In the reaction speed test and concentration test, differences between groups in variable results were explored through a one-way ANOVA (groups). Regarding the results of the specific table tennis test, the results were analyzed through a two-way ANOVA, comparing groups in each of the five score categories (groups x score). The magnitude of the difference will be estimated using partial omega squared (ω²) for F, using the following thresholds: <0.01 trivial, >0.01 low, >0.06 moderate, and >0.14 high (31). Significance will be previously established at p <0.05. Data will be analyzed using the Statistical Package for Social Science for Windows (version 22, IBM Corporation, Armonk, New York, USA).

**RESULTS**

**Stroop Test**

The effect of groups, time of measurements, and the interaction between them in the Stroop Test was shown in figure 5. Statistical differences were found between the time of measurement (pre vs post; p< .01) in the three analyzed variables: (a) correct responses (ω² = 0.4, high effect; post > pre); (b) incorrect responses (ω² = 0.1, moderate effect; pre > post); and (c) total score (ω² = 0.4, high effect; post > pre). No differences were found between groups (SMG vs TTVG).

**Speed reaction test and Toulouse-Piéron test**

Table 1 shows the statistical analysis between SMG and TTVG groups in the total number of hits and reaction speed during the speed reaction test, and in series performed, accumulation phases, focus phase, and rated of perceived exertion during the Toulouse-Piéron test.

In the speed reaction test, no differences were found between the total number of hits and reaction speed between groups (SMG vs TTVG). As the same, no differences were found between groups in the series performed, accumulation phases, focus phase, and rate of perceived exertion in the Toulouse-Piéron test.

**Insert here>> Table 1. Statistical differences between SMG and TTVG groups in speed reaction test and Toulouse-Piéron test.**
Specific table tennis test

Figure 6 shows the scores obtained in a specific table tennis test in SMG and TTVG groups. Statistical differences were not found in the percentage of points per zone in between groups comparison. Instead, differences were found between the score zones ($\omega^2 = 0.8$, high effect; 8 points > 6 points > 0 points > 2 points > 4 points)

**Figure 6.** Score zones in SMG vs TTVG during a specific table tennis test.

Discussion

Currently, social media is one of the primary applications of technology across all age groups. Its use affects directly health and athletic performance, being decision-making and mental fatigue one of the most important factors of success (8,11,12). Previous research found a direct effect of social media use and its influence on athletic performance in different sports such as swimming, boxing, soccer, or volleyball (11,12,21,22), but there is a gap in knowledge regarding the effect in table tennis players. Additionally, available evidence thus far has analyzed adult amateur and professional populations, so the effects of social media use on athletic performance in children and adolescents are scarce. Therefore, this study aimed to analyze the acute effect of using social media with smartphones on the athletic performance of table tennis players regarding reaction speed, stroke execution accuracy, and focus.

Previous evidence suggests that the use of social media for 30 minutes before training may compromise athletic performance in adult athletes concerning decision-making (12,23), focus (11), and endurance (21) as a response to mental fatigue. Mental fatigue has been evaluated using the Stroop test, which assesses inhibitory control (e.g., the ability to delay or stop an automated cognitive response) and selective attention, two factors considered components of cognitive function. In contrast, the results of this study indicate that 30 minutes of exposure to social media or sports video viewing in children, on the other hand, results in an improvement in scores, hits, and errors in the Stroop Test. This indicates that acute exposure to virtual stimuli, regardless of type, leads to a potentiation of inhibitory control and attention ability.

This difference in inhibitory response in children and adults has been previously reported and is influenced by factors such as reading ability and emotions. The ability to inhibit behavior depends on prior learning and experience and this can define the differentiated response between age populations. This inhibition can be behavioral (e.g., executive or motivational) or automatic (e.g., attention) (32) and the ability to control impulses is achieved at around 10-12 years old (33). It is suggested that the ability to suppress automatic response and discriminate irrelevant information is lost with age (34,35). Based on the above, there may be differences between adults and children in terms of potential factors that improve inhibitory capacity, and further research is needed to investigate if acute exposure to social media can be a stimulant of this attention capacity in children.

The findings of this study suggest that further analysis is necessary to determine if 30 minutes of exposure to social media or other virtual stimuli causes mental fatigue in children, as has been shown in adults. The difference in response to this type of virtual stimuli may be due to children growing up in a world centered around social media and technology (36,37). Mental fatigue in adults has been linked to decreases in dopamine (38,39), which compromises inhibitory control (40). However, exposure to social media in children has been found to release oxytocin and dopamine, which can cause long-term cognitive changes depending on the duration of exposure (41,42). Although the benefits of acute exposure to social media remain unknown, virtual scenarios have been shown to promote attention, interest, and motivation (43), which could impact inhibitory control by behavior. Therefore, the relationship between cognitive function and social media use in children requires further investigation (44,45), considering the potential problems, challenges, and opportunities for athletic performance.

The results of this study suggest that there were no significant differences in concentration, accuracy, or reaction time between the groups. However, the effects of exposure to stimulating virtual environments, such as social media and sports videos, could have influenced this response. Reaction time is a critical
ability in table tennis, as it evaluates the time between a sensory stimulus and the subsequent response, which is necessary to anticipate the direction and speed of the ball (46). Since the ball travels at high speeds and covers short distances in table tennis, minimal time is required to react and execute shots accurately (47). Reaction time has three components: perceptual, decision-making, and motor execution time. Nonetheless, exposure to virtual environments has been suggested not to compromise reaction time (48). Therefore, the acute use of social media or sports video viewing is unlikely to alter athletic and cognitive abilities. Moreover, digital visual stimuli may enhance the perception necessary for adequate reaction time by improving haptic perception through observation (49).

Finally, hand-eye coordination is a crucial aspect of table tennis, requiring players to concentrate on discerning different scenarios and placing the ball precisely at the desired location (50). In the current study, no significant differences were observed in technical or precision ability, or concentration capacity. However, research has shown that virtual environments can enhance the accuracy and precision of manual tasks (51). Despite this, there is a lack of scientific evidence on how social media or sports video use can affect technical gestures, precision, and accuracy, highlighting the need for further analysis.

Although the present study is the first to evaluate the effect of social media on concentration and athletic performance in young table tennis players, it presents various limitations that must be described. Firstly, the sample size could not be large enough to obtain significant results, considering that cognitive variables can vary greatly among populations. It is important to note that children and adults differ in their maturation, cognition, and physical-technical abilities, which could affect the results of the study. While there is existing evidence for adults, it may not be enough to fully explain the findings for children. Moreover, the relatively high variability in the sample could introduce bias, making it difficult to draw significant conclusions. These differences could be attributed to the maturation differences between the age groups studied. Finally, the lack of a control group not exposed to virtual environments could affect the interpretation of the results.

Conclusions

The study results suggest that using technology for 30 minutes can improve inhibitory control and attention ability, leading to a positive impact on sports performance and focus. The study focused on youth table tennis players and found that social media or specific sports video games could provide the same stimuli. These findings have implications for athletes and coaches who can incorporate technology-based interventions in their training routines due to the potential benefits of technology-based interventions on cognitive abilities in youth table tennis players.

References


Tables and figures

Table 1. Statistical differences between SMG and TTVG groups in speed reaction test and Toulouse-Piéron test.

<table>
<thead>
<tr>
<th></th>
<th>SMG</th>
<th>TTVG</th>
<th>F</th>
<th>p</th>
<th>$\omega^2$</th>
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<td>Total number of hits (n)</td>
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<td>0.7±0.1</td>
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<td><strong>Toulouse-Piéron test</strong></td>
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<td>Total series (n)</td>
<td>9.2±1.2</td>
<td>9.0±1.9</td>
<td>0.1</td>
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<td>6.7±1.1</td>
<td>6.6±1.2</td>
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<td>0</td>
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<td>Rated of perceived exertion (a.u.)</td>
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<td>8.3±2.2</td>
<td>0.1</td>
<td>0.8</td>
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</tbody>
</table>
Figure 1. Study design

Figure 2. Disposition of NeuroPhys Sports Reaction Test for table tennis in the present study.
Figure 3. Distribution of score zones for the specific table tennis test.

Figure 4. Example of focus phase in Toulouse-Piéron test.
Figure 5. Differences between stimuli and time of measurement in Stroop Test variables: (a) correct responses; (b) incorrect responses; and (c) total score.
Figure 6. Score zones in SMG vs TTVG during a specific table tennis test.