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An Incongruent 2-Minute Stroop Task Alters the Response Time Performance in Semi-Elite Soccer Players: A Pilot Study

Andrés Prieto-Sánchez [1], Juan M. García-Ceberino [2], Juan Luis Leon-Llamas [1,*] and Santos Villafaina [1]

[1] Grupo de Investigación en Actividad Física, Calidad de Vida y Salud (AFYCAV), Departamento de Didáctica de la Expresión Musical, Plástica y Corporal, Facultad de Ciencias del Deporte, Universidad de Extremadura, Av. de la Universidad s/n, 10003 Cáceres, Spain; anprietos@alumnos.unex.es (A.P.-S.); svillafaina@unex.es (S.V.)

[2] Facultad de Educación y Psicología, Universidad de Extremadura, Av. de Elvas, s/n, 06006 Badajoz, Spain; jmanuel.jmgc@gmail.com

* Correspondence: leonllamas@unex.es

Abstract: Introduction: Mental fatigue is a key factor in soccer that can affect physical performance. Mental fatigue protocols based on the Stroop test used in soccer involve extensive time, ranging from 10 to 30 min. Offering a protocol with a shorter duration that is more applicable in ecological situations seems to be an exciting challenge. Objective: To analyze the effects of a mental fatigue induction protocol (2 min Stroop test in its incongruent mode) on decision-making, response time, and technical execution accuracy in soccer players. Methods: A total of 18 semi-elite soccer male players, 25.83 (4.71) years from a Spanish soccer team, participated in this cross-sectional study. The 2 min incongruent Stroop test was used like mental fatigue protocol, followed by a specific analytical soccer task. The Wilcoxon signed-rank and Chi-squared tests were used to analyze the statistical differences. Results: A significant increase in participants' response time after the fatigue protocol ($p < 0.001$; r = 0.878) was observed. Regarding the variables of correct decision ($p = 0.457$; r = 0.031) and technical execution accuracy ($p = 1$; r < 0.001), no significant differences were found. Additionally, no differences were observed between the first and second attempts of the 2 min incongruent Stroop test, in terms of execution accuracy, errors, or total words. Conclusions: The 2 min Stroop incongruent task may induce some degree of mental fatigue, leading to slower response time during certain technical tasks in semi-elite soccer players. However, this Stroop task was insufficient to promote significant changes in the accuracy of technical execution and the effectiveness of decision-making.

Keywords: mental fatigue; mental effort; small-sided games; training intervention

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1. Introduction

The combination of physical, technical, tactical, and cognitive demands of soccer significantly impacts players, who must sustain high levels of both individual and team performance throughout the season. These demands are evident in various movement skills essential to the game, such as sprints, jumps, directional changes, and technical maneuvers, all of which lead to notable physiological changes [1]. Therefore, soccer players must continuously adapt to the environment, making numerous decisions under time- and space-constrained conditions [2,3]. This can lead to mental fatigue, as a soccer player makes over 2500 decisions in just 90 min, compared to around 6000 decisions for an average person over an entire day [4]. Mental fatigue significantly influences athletic performance by affecting a player's physical responses, technical skills, and tactical decisions.

During the game, fatigue can be defined as a moderating state affecting physical and mental responses during play [5]. Physical fatigue is caused by demands on muscular strength, flexibility, and agility [6]. It is usually measured through physiological variables associated with performance (e.g., heart rate, blood lactate, maximum oxygen consumption, cardiac output, or maximum aerobic capacity, among other variables) [7]. On the other hand,

mental fatigue is a psychobiological state resulting from prolonged demanding cognitive activities, characterized by an increase in feelings of tiredness or even exhaustion [7,8]. Although there are different methods to evaluate mental fatigue, the usual practice is based on subjective measures, which assess the perceived level of fatigue due to their economic cost and ecological validity [9].

This mental fatigue can affect physical performance, increasing the risk of errors [7]. Athletes experiencing mental fatigue show an increased subjective perception of effort and decreased cognitive capacity [10]. Cognitive capacity encompasses decision-making, attention, and perception abilities [11]. Mental fatigue can impact various aspects of soccer performance, such as running [12], technical–tactical actions [13], and decision-making [12]. Mental fatigue can manifest subjectively (i.e., increased feeling of tiredness or lack of energy), behaviorally (i.e., performance decrease: response time or technical accuracy), and physiologically [7]. Therefore, in the field of sport, different interventions have been proposed to improve reaction time and decision-making accuracy [14].

When inducing mental fatigue, various methods have been used in previous studies, such as the Stroop test [11–13] or the AX-Continuous Performance Task (AX-CPT) [12]. Cognitive tasks involving different cognitive functions, such as sustained attention, working memory, and response inhibition, have also been proposed to induce mental fatigue [15]. The Stroop test [16], specifically its incongruent condition, has been widely used to induce mental fatigue. In this condition, cognitive inhibition is assessed by a test where the subject must indicate the ink color in which a word is written that does not match its meaning [17]. Different studies have employed this protocol to induce fatigue. However, there is no consensus on the necessary time to induce mental fatigue, ranging from 10 min [18], to 20 min, up to 30 min, which is the most commonly used option [12,13,17,19]. Two modalities of this protocol exist, one using paper [12], and another electronically, by using a computer, tablet, or smartphone [13,19].

In recent research on mental fatigue, a study conducted by Soylu et al. [20] used the Stroop test for 30 min as a fatigue protocol and measured performance through small-sided games (SSG). After the fatigue protocol, it was demonstrated that players lost more balls and made more unsuccessful passes during the SSG. A review by Skala and Zemková [11] determined that fatigue causes a decrease in decision-making capacity, attention, and perception. The same review also found that accuracy was impaired after inducing mental fatigue. In another review conducted by Grgic et al. [21], they assessed performance after fatigue protocols using the Loughborough Soccer Passing Test (LSPT) and the Loughborough Soccer Shooting Test (LSST). In the passing test, they increased the time to perform the task and the penalty time. In the shooting test, scores and shot speed decreased. Finally, in a study by Filipas et al. [22], following a fatigue protocol (Stroop test), technical performance was evaluated using LSPT and the LSST, showing that both passing and shooting performance decreased due to mental fatigue.

Previous studies' limitations include the fact that mental fatigue has been assessed primarily using subjective scales. Assessing mental fatigue from the point of view of the loss of performance in a task can be interesting and objective, as opposed to using scales on the perception of fatigue reported by the athlete. Additionally, protocols used to induce mental fatigue are often considered to lack ecological validity [23], which may lead coaches and physical trainers to perceive them as less useful. Moreover, the duration of cognitive tasks can vary significantly across studies investigating mental fatigue. In a previous review, Van Cutsem et al. [7] excluded tasks shorter than 30 min, arguing that such brief durations do not produce sufficient mental fatigue or cognitive load to negatively impact subsequent physical performance. However, the literature on self-control and ego depletion [24] presents evidence that shorter tasks can substantially diminish the availability of mental resources, thereby affecting physical performance [25]. In this regard, previous studies have tried to induce mental fatigue with 10 min [18,25] and 12 bouts of 30 s (6 min) [26,27], applying the Stroop test. Similarly, the practice of soccer analytical tasks of less than 6 min has been sufficient for young players to reach vigorous physical activity

values [28]. Moreover, previous studies have found that two consecutive chess tasks of 2 min and a half can reduce heart rate variability as a consequence of cognitive tasks [29]. Furthermore, a recent meta-analysis [25] indicated that the duration of the prior cognitive task does not reliably predict the magnitude of subsequent performance impairment. This raises questions about the importance of task duration, the minimum dose required, and potential individual differences in resilience to mental fatigue. To address these complexities, some researchers [30–32] have suggested that shorter, more complex, and individualized cognitive tasks, such as dual-task, can induce mental fatigue more effectively and quickly than longer standardized tasks like the AX-Continuous Performance Task. However, it has not been explored whether it is possible to achieve this state of mental fatigue with even shorter trials (less than five minutes), which could expand the range of possibilities in the design of training tasks focused on the manipulation of mental fatigue. In addition, isolating the effects caused exclusively by mental fatigue is a crucial aspect to know if the physical component is not influencing and thus be able to develop more specific tasks for players to improve cognitive aspects.

Thus, this study aimed to analyze the influence of mental fatigue on soccer players' performance in decision-making, response time, and technical execution accuracy, utilizing a 2 min incongruent Stroop test. This cognitive fatigue test is designed to approximate the ecological contexts found in soccer training, simulating real-game situations by integrating key skills such as decision-making, accuracy, and technical execution under conditions of mental fatigue. We hypothesize that this specific test, by inducing mental fatigue, will lead to increased response time, reduced accuracy, and correct decision-making.

2. Material and Methods

2.1. Participants

A total of 18 male players from a soccer team (in the Group I of the Extremadura Second Division, Spain) classified as 'semi-elite' based on the taxonomy proposed by Swann et al. [33] participated in this study. To define the sample size, the systematic review by Kunrath et al. [19] and da Silva et al. [34] was used as a reference, where they showed nine studies ranging from six to 20 participants. We used a priori analysis ([β] = 0.8; effect size dz = 0.7; test family = *t* test; statistical test = means: Wilcoxon signed-rank test, matched pairs) that provided a sample of 15 participants. However, to avoid losses in statistical power we decided to increase the sample number by 20%, in case any participant could not complete the study. The G*Power software (version 3.1.9.7; Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany; http://www.gpower.hhu.de/ (accessed on 8 April 2024)) was used for this purpose. All participants signed an informed consent form previously approved by the bioethics and biosafety committee of the University of Extremadura (ethics committee approval reference number: 111/2023) in accordance with the Declaration of Helsinki. The descriptive characteristics of the participants are shown in Table 1.

Table 1. Characteristics of the participants.

Variables	Mean (SD) or Frequency (Percentage)
Age (years)	25.83 (4.71)
Weight (kg)	73.17 (5.88)
Height (cm)	176.06 (6.28)
Years of competition	19.39 (4.51)
Educational level	
University degree	9 (50%)
Professional education	5 (27.8%)
High school level	4 (22.2%)

Note: SD = Standard deviation.

2.2. Study Design, Task and Procedure

Study design. The cross-sectional study [35] consisted initially of a cognitive task (aimed at inducing mental fatigue) followed by a perception–decision–technical execution task (see Figure 1). This procedure was carried out on two consecutive Tuesdays (the first session of the training week). Therefore, the players were randomly divided into two groups. On the first day, nine developed a mental fatigue induction protocol using a 2 min Stroop test, whereas the rest of the players conducted the evaluation test without it. Next week, the order was inverted. The measurements took place at the facilities of the Torreorgaz soccer team during the month of May. The tests were carried out between 17.00 h and 18.00 h, without the public, and an average ambient temperature of 25 °C was recorded on the different days of intervention with dry and sunny weather.

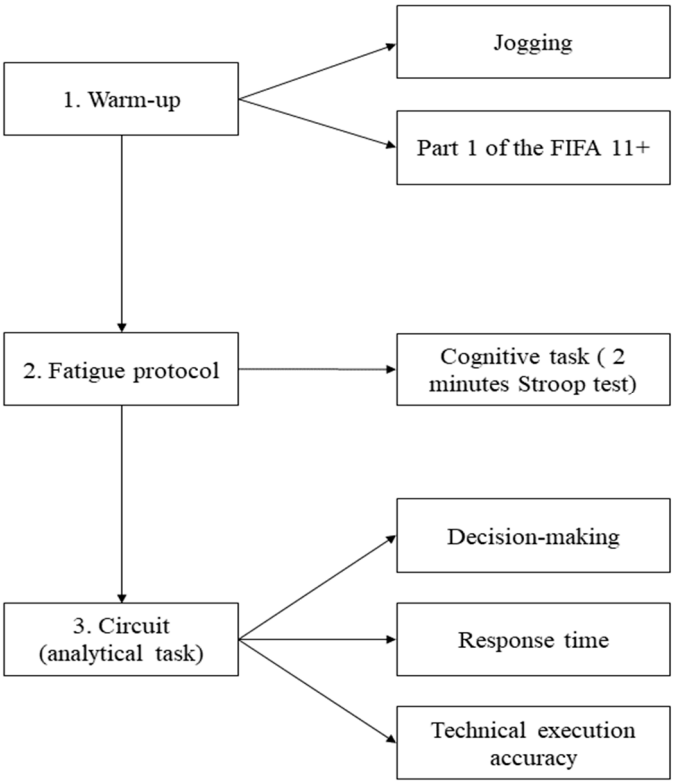

Figure 1. Flow chart of the study procedure.

Stress condition cognitive task. The Stroop Effect Color Game: Downloaded from Google Play (http://web.archive.org/web/20221213005926/https://play.google.com/store/apps/details?id=com.josesanchez.stroopeffect, accessed on 1 May 2024), compatible with Android operating system, was used to induce cognitive fatigue in the players. Although the literature has established time periods of 10, 15, 20, and 30 min to induce mental fatigue through the Stroop test, it was decided to establish a period of 2 min to bring the protocol as close as possible to a real training context, where the working time plays a very relevant factor. The Stroop test is characterized by requiring intensive attention and automatic response inhibition and induces mental fatigue based on the cognitive manipulations it generates [22]. A tablet (Lenovo M10 Plus, Lenovo Group Ltd., Beijing, China) was used to carry out the fatigue protocol. The Stroop test consists of four words (blue, yellow, red, and green) serially presented on the tablet screen, displayed for one second in a period of 60 s. This was repeated twice, which means that players conducted a total of two minutes of an incongruent Stroop test.

Execution task. For this study, a 1 vs. 0 + GK task combining decision-making, response time, and technical execution accuracy was designed. These actions would depend on the situation adopted by the goalkeeper. Half of a 100 m × 63 m playing field

was used. Figure 2 details the task graphically and the procedure section explains in detail how it is carried out.

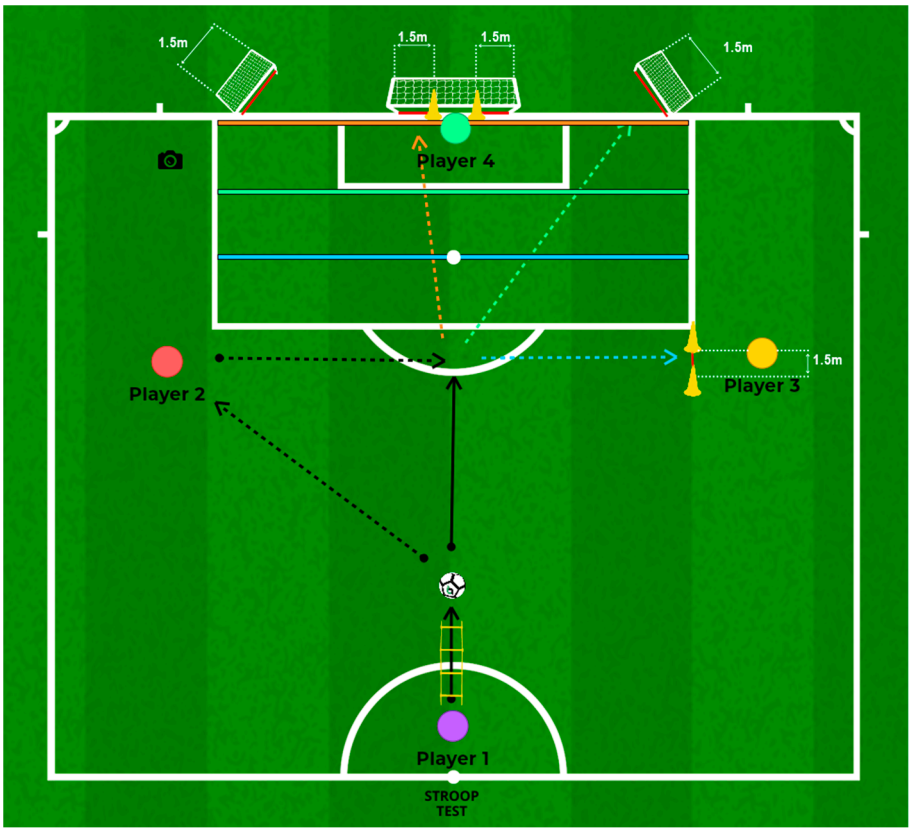

Figure 2. Evaluation test. Goal zone (orange line), 6-yard line box zone (green line), penalty spot zone (blue line). Orange arrow (if the goalkeeper does not come out and stays in the goal zone (orange line), the ball should go to one side of the goal), green arrow (if the goalkeeper comes out to the 6-yard line box zone (green line), the player should aim to send the ball into either of the two mini-goals) and, blue arrow (if the goalkeeper comes out to the penalty spot zone (blue line), the player should aim to pass the ball to a teammate).

Procedure. A warm-up was conducted independently of the selected protocol before performing the protocols. To standardize the warm-up, favor its replicability, and prevent it from being excessively prolonged in time, it was decided to establish two parts:

1. Jogging (5 min).
2. Part 1 of the "FIFA 11+" [36], known as running exercises, was developed (8 min). These exercises included:
    - Running straight ahead.
    - Running hip out.
    - Running hip in.
    - Running circling partner.
    - Running shoulder contact.
    - Running quickly forward and backward.

The fatigue protocol consisted of conducting the incongruent task of the Stroop test using the "Stroop Effect Color Game" application for smartphones with Android operating systems (available on Google Play). The game mode (as selected configuration) in the app was chosen, with a game duration of 60 s and a word duration of 1 s. This was repeated twice, which means that players conducted a total of two minutes of an incongruent Stroop test.

Immediately following the fatigue protocol, the player performed a circuit as follows: (1) agility coordination using a ladder; (2) wall exercises with a partner (the same partner on both days); (3) reception within the designated area (semicircle of the penalty area); and (4) finishing towards the goal (see Figure 2). To conclude, we have three options based on the goalkeeper's position:

1. If the goalkeeper does not come out and stays in the goal zone (orange line), the ball should go to one side of the goal.
2. If the goalkeeper comes out to the 6-yard line box zone (green line), the player should aim to send the ball into either of the two mini-goals.
3. If the goalkeeper comes out to the penalty spot zone (blue line), the player should aim to pass the ball to a teammate.

The position of the goalkeeper was randomized, balancing the randomization so that each option was repeated 6 times. The researcher instructed the goalkeeper on the position he should take, which was unknown to the players. Target goals are highlighted in Figure 2 (for a better comprehension see Video S1). All target goals had the same size (1.5 m) to test accuracy.

To have a record of all the activity, a recording of the activity was made at a resolution of 1080p and 30 fps, placing a video camera on the far left of the field so that all the executed actions could be observed. The videos were then imported into the free video software Kinovea® version 0.9.5 (Joan Charmant & Contributors, Bordeaux, France) to determine response time and accuracy.

2.3. Outcomes and Instruments

The outcomes assessed in this cross-sectional study were as follows:

- Correct decision: whether, based on the goalkeeper's position, the participant followed the established instructions.
- Response time: the time between receiving the pass (control) and making contact for the shot.
- Technical execution accuracy: if the players successfully put the ball into the goal.

The instruments used for data recording were as follows:

- Stroop Effect Color Game: Downloaded from Google Play (http://web.archive.org/web/20221213005926/https://play.google.com/store/apps/details?id=com.josesanchez.stroopeffect, accessed on 1 May 2024), compatible with Android operating systems. We used it on a Tablet (Lenovo M10 Plus, China) to carry out the fatigue protocol.
- Video Camera (Sony Handycam HDR-CX405, Shinagawa, Tokyo): this is used to record the action to calculate the execution time.
- Kinovea (Joan Charmant & Contributors, version 0.9.5): software employed to calculate the time between receiving the ball (control) and shooting it toward the goal.

2.4. Statistical Analysis

The Statistical Package for Social Sciences (SPSS) version 24.0 (IBM Corp., Armonk, NY, USA) was employed to analyze the extracted data. Data distribution was analyzed using the Shapiro–Wilk test. According to the Shapiro–Wilk results, non-parametric tests were employed [37]. The Wilcoxon signed-rank test was used to analyze the response time differences between fatigue and non-fatigue protocols. The Chi-squared test was used to analyze the differences between protocols regarding technical execution accuracy and correct decision outcomes. Moreover, the performance between the first and second minute of the incongruent Stroop test was analyzed using the Wilcoxon signed-rank test. The effect size [r] was calculated and classified as follows: 0.5 is a large effect, 0.3 is a medium effect, and 0.1 is a small effect [38,39].

3. Results

Table 2 shows the behavior of the response time, technical execution accuracy, and correct decision. The variables are presented alongside the two tests conducted (with

fatigue and without fatigue). A significant increase in participants' response time after the fatigue protocol ($p < 0.001$; r = 0.878) can be observed. Regarding the variables of correct decision ($p = 0.457$; r = 0.031) and technical execution accuracy ($p = 1$; r < 0.001), no significant differences were found.

Table 2. Comparison between mental fatigue and non-mental fatigue protocols.

Outcomes	Mean (SD) or Frequency (%) with Fatigue	Mean (SD) or Frequency (%) Without Fatigue	*p*-Value	Effect Size
Response time	1.14 (0.20)	0.93 (0.09)	<0.001	0.878
Technical execution accuracy	9 (50%)	12 (66.7%)	1.000	<0.001
Correct decision	13 (72.2%)	16 (88.9%)	0.457	0.031

Note: SD = Standard deviation.

The performance during the Stroop test was assessed twice during the mental fatigue protocol after the first and the second minute. Table 3 presents the accuracy, errors, and number of words performed during the first and second minute. Significant differences were not observed in technical execution accuracy, errors, or total number of words.

Table 3. Comparison between first and second attempt of the Stroop test.

Variable	Mean (SD) First Minute	Mean (SD) Second Minute	*p*-Value	Effect Size
Technical execution accuracy	70.28 (2.49)	70.50 (2.60)	0.735	0.080
Errors	2.44 (2.03)	2.50 (2.20)	0.754	0.074
Total words	72.72 (1.45)	73 (1.02)	0.434	0.184

Note: SD = Standard deviation.

4. Discussion

Significant differences were observed in the response time, with increased time elapsed from the player gaining ball control until executing the following action. However, the 2 min Stroop test was insufficient to promote significant changes in accurate decision and technical execution accuracy.

Our results showed that the response time could be increased in participants after undergoing the 2 min Stroop test mental fatigue protocol. Our results align with those found by Gantois et al. [40], where it was observed that after performing the Stroop test for 15 min, response time increased when proceeding to the next 30 min Stroop test. However, the protocol used by these authors differed since they conducted two consecutive Stroop tests without subsequently engaging in sport-specific tasks. In contrast, we employed a shorter Stroop test duration and became involved in a soccer-specific task (see Figure 2). Although not identical to the procedure conducted in the present study, the response time was increased. In line with these findings, the study by Smith et al. [12] reported differences in the execution time of technical gestures, which increased under conditions of mental fatigue. This study followed a similar approach to ours, where the Stroop test was conducted first, followed by specific tests such as the Yo-Yo intermittent recovery test (level 1), LSPT, and LSST tests. In the same line, Migliaccio et al. [41] used a 15 min Stroop task to induce mental fatigue in athletes, and their results showed an increase in reaction time. Although the proposed task focused on hand–eye coordination, it underscores the importance of utilizing perceptual, motor, and cognitive resources to execute rapid movements in response to visual stimuli. The incongruent 2 min Stroop test may have disrupted the afferent–afferent closed-loop system, resulting in slower reactions from

players during specific technical tasks. However, a systematic review examining mental fatigue in football [19] indicated that the effects of mental fatigue on behaviors such as reaction time have been minimally studied. The authors emphasized this as an important area for future research. Despite few studies having analyzed this in the field of sport, our results align with previous studies that analyzed the effects of drivers driving safely and efficiently regarding their ability to process incoming afferent information [42,43]. These studies showed that when drivers were fatigued, their ability to process information about the driving environment decreased, increasing the likelihood of an accident.

Regarding accuracy and correct responses, the 2 min Stroop test was insufficient to promote significant changes. These results differ from those of Kunrath et al. [19], whose systematic review concluded that mental fatigue protocols led to significant decreases in passing accuracy, as well as in the speed and precision of passes. It also deviates from the results found in the study by Smith et al. [12], where significant decreases were observed in pass accuracy and speed. In line with previous studies, Soylu et al. [20] reported a significant increase in failed passes and lost balls by players after undergoing the mental fatigue protocol. These substantial differences may be attributed to the Stroop test duration, which lasted for 30 min [12,13,17,20], while our protocol administered the Stroop test for two minutes. In this regard, when comparing the first- and second-minute results, differences were not observed in accuracy, errors, or total words. Moreover, looking for the minimum dose to induce mental fatigue, our results showed that two minutes of the incongruent Stroop task was insufficient to cause mental fatigue, affecting the accuracy of technical execution and successful decision-making.

Although traditionally, longer cognitive tasks have been associated with greater mental fatigue, emerging literature suggests that shorter tasks can also induce notable ego depletion [24], impacting subsequent physical performance [28]. In this regard, short-term mental fatigue protocols based on 10 min of the Stroop test were enough to induce this fatigue state [18,25]. Nevertheless, there are others studies that did not induce mental fatigue using 10 min of dual-tasking [32]. In relation to this, previous studies in the field of tennis have demonstrated that 12 bouts of 30 s (6 min) of the Stroop test [26,27] combined with physical exercise may induce mental fatigue. In the same line, a previous study with chess players demonstrated that heart rate variability can be decreased after 5 min of problem solving task [29]. Interestingly, heart rate variability can be considered an indicator of fatigue due to its relationship with autonomic nervous system regulation [44]. Variations in HRV reflect changes in the balance between sympathetic and parasympathetic activity, which often accompany physical and mental fatigue [45]. Therefore, future studies should design protocols that not only measure end results but also incorporate continuous monitoring to identify the precise onset of mental fatigue during tasks. Integrating heart rate variability (HRV) and electroencephalographic (EEG) evaluations would be beneficial; HRV can provide insight into autonomic fatigue responses, while EEG, specifically monitoring theta wave activity, could serve as a robust neuronal biomarker of mental fatigue [46]. Although this approach may be complex due to equipment costs and setting constraints, it could offer valuable insights for team sports training and performance optimization. In addition, future studies should explore the role of supplementation, such as caffeine, in the mental fatigue [47].

The fatigue protocol used in this study was the Stroop test, which involves interference ability (participants must indicate the color of the ink with which a word is written, not matching its meaning) [16]. This task can be conducted using paper-based [12] or electronic devices such as computer, tablet, or smartphone [12,13,17]. In our study, we opted for an electronic device, such as a tablet, due to its ease of use and speed when processing data. Existing literature suggests a fatigue-inducing time ranging from 10 min [18] to 30 min [12,13,17]. We proposed a more ecological approach by conducting 2 min of cognitive task without breaks. This brevity allows for the administration of shorter tasks in real-world contexts, addressing potential resistance from coaching staff concerning time limitations during training sessions. The proposed task focuses on soccer actions, which

combines decision-making, response time, and technical execution accuracy, aligning with previous studies that have utilized small-sided games [13,17,20], LSPT, or LSST to evaluate the consequences of mental fatigue [12]. Therefore, conditioning staff could incorporate these brief cognitive tasks into regular training sessions to help athletes improve their mental resilience and performance under pressure, ultimately enhancing their ability to make quick decisions and execute technical skills during matches. For instance, conditioning staff could implement the 2 min Stroop test as part of their warm-up routines or as a transitional drill between physical exercises, allowing players to experience cognitive load without significantly disrupting the flow of practice. Additionally, conditioning staff can design tasks that simulate real-game situations under conditions of mental fatigue induced by cognitive tasks, such as the Stroop test or dual-tasking. They can also incorporate tasks that involve interaction with a partner to mimic the variability and unpredictability of a competitive environment, making the activities practical and relevant for soccer training. The cognitive involvement of the tasks also increases with a higher number of players, leading to higher training intensity [48]. However, conditioning staff should not perform it close to the competition [49].

This study has some limitations that should be acknowledged. Firstly, this cross-sectional study was conducted only with male players. Therefore, results cannot be extrapolated to female soccer players. In addition, although the sample was small, the statistical power achieved was acceptable. Moreover, we used several participants higher than the 89% of the studies reported by Kunrath et al. [19] in their systematic review. Nevertheless, the results should be taken cautiously, and we encourage future research to expand the number of participants to establish consistent findings. Secondly, participants were recruited from Group I of the Extremadura Second Division (Spain), and professional players may behave in the same way as non-professional players. In this regard, however, the participants were non-professional soccer players who had jobs before training, potentially influencing mental fatigue levels. Thirdly, the study did not consider or quantify the subjective fatigue of each participant. Fourth, the sleep, motivational state or negative feelings that players may have had were not controlled. Fifth, the age difference in participants could have influenced physical and technical performance in response to mental fatigue [22]. Future studies should consider homogeneous age groups or analyze the effects of mental fatigue in each age group to obtain more precise conclusions. Sixth, the experimental design could have included more temporal choices of protocols to induce mental fatigue or other types of training tasks. However, this initial simplified study could establish a basis for more in-depth investigations that could enrich the understanding of our proposal. Nevertheless, this study also has strengths. For instance, it was conducted using an ecological task that combined time response, decision-making, and technical execution accuracy, while avoiding the need for extensive resources for task administration, measurements, and subsequent data analysis. Furthermore, to the best of our knowledge, this is the first study to observe a potential behavioral effect of a very short-term (2 min) protocol for inducing mental fatigue.

5. Conclusions

The findings suggest that a 2 min incongruent Stroop task may induce a degree of mental fatigue, as indicated by increased response times in semi-elite soccer players. However, this duration appears to be insufficient to significantly impact technical execution accuracy or decision-making performance. These results highlight the need for further investigation into the optimal duration for cognitive fatigue protocols. Additionally, the integration of brief cognitive tasks into training sessions offers a practical approach for coaches to monitor mental fatigue without disrupting training schedules.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/app142210296/s1, Video S1: Soccer task options based on goalkeeper position.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data will be available upon reasonable request to the corresponding author.

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