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Effects of Integrating Football eSports into an Ecological–Dynamic Approach on the Development of Linear Speed in Young Soccer Players

Rosario Ceruso [1,2,*], Tiziana D'Isanto [1], Italo Sannicandro [3], Antonio Tessitore [4] and Francesca D'Elia [5]

1 Research Center of Physical Education and Exercise, Digital Pegaso University, 80143 Naples, Italy; tizidisanto@gmail.com
2 Department of Neuroscience, Biomedicine and Movement, University of Verona, 37129 Verona, Italy
3 Department of Clinical and Experimental Medicine, University of Foggia, 71122 Foggia, Italy; italo.sannicandro@unifg.it
4 Department of Movement, Human and Health Sciences, University of Rome "Foro Italico", 00135 Rome, Italy; antonio.tessitore@uniroma4.it
5 Department of Human, Philosophical and Education Sciences, University of Salerno, 84084 Fisciano, Italy; fdelia@unisa.it
* Correspondence: rosario.ceruso@univr.it

Abstract

Football-themed eSports, combining entertainment and learning elements, are booming, offering benefits in terms of cognitive and motor skill development. Despite this, with the increasing use of eSports and their impact on cognitive and motor skills, there is still a paucity of empirical studies that systematically explore how cognitive stimulation from eSports can translate into psychomotor performance on the field, particularly with regard to linear speed. The aim of this study was to investigate the effects of an ecological–dynamic training protocol, integrated with football eSports, on the development of linear sprint speed in young soccer players. Thirty-two male youth football players (age range: 12–16 years) participated in the study. Participants were divided into an experimental group, which followed a combined ecological–dynamic training protocol including football eSports, and a control group, which performed standard training sessions. Pre- and post-intervention assessments of 30 m sprint performance were conducted using electronic timing gates. Statistical analysis using repeated-measures ANOVA indicated a marked improvement in 30 m sprint performance within the experimental group, decreasing from 4.908 s to 4.651 s. A significant time × group interaction was observed ($F = 74.076$, $p < 0.001$). Moreover, a robust main effect of time emerged ($F = 141.12$, $p < 0.001$), confirming consistent gains in linear sprint speed. Post hoc comparisons revealed significant differences across all assessment points ($p < 0.001$). The findings suggest that embedding football eSports into an ecologically grounded training framework may enhance the development of linear speed in young soccer players. This integrated approach shows potential as an innovative tool for performance enhancement, although further investigations are needed to confirm long-term efficacy and generalizability to other sporting populations.

Keywords: video games; psychophysical performance; football; sprint

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1. Introduction

Football-themed eSports, combining entertainment and learning elements, are booming, offering benefits in terms of developing cognitive and motor skills. The edutainment approach, combining play and learning, is proving to have positive effects not only on the development of cognitive skills, but also on motor skills [1]. In particular, those related to speed, a key element for sports such as football, where the ability to respond quickly to external stimuli can make the difference between success and failure [2]. Although eSports are traditionally seen as a sedentary activity, the intensive cognitive training they require stimulates rapid decision-making processes, improving not only concentration, but also the speed with which a player can adapt to changing situations [3].

Himmelstein et al. [4] observed that eSports professionals exhibit reaction times similar to those of elite athletes in traditional sports, a sign that involvement in competitive video games may have direct parallels with high-level sports performance. These results suggest that the intense mental preparation required to compete in eSports may develop skills similar to those required in physical sports, such as speed and quick reaction times [5]. This phenomenon becomes particularly interesting when one considers that speed skills themselves, understood as the execution of quick and precise movements, are crucial for football, a sport that requires immediate decisions in highly dynamic situations [6]. In fact, speed is not only a matter of physical movement, but also of instantaneous response to stimuli, as suggested by Gibson's [7] theory of direct perception, which emphasises that the ability to perceive and respond quickly to external stimuli, such as visual and auditory stimuli, is fundamental to effective performance in high-intensity sporting contexts.

The physical aspect of eSports, although limited, is also an important stimulus to movement, particularly in interactive gaming platforms such as the Nintendo Wii, which promote more physical activity than traditional video games [8]. However, the real challenge emerges when trying to combine the intensive cognitive training of eSports with physical protocols structured to improve athletic performance, in particular speed [9]. Speed, understood as the ability to execute quick and precise movements, is fundamental to football, as it directly affects the ability to react and respond to external stimuli promptly [10].

Despite the growing popularity of eSports and their impact on cognitive and motor skills, there is still a paucity of empirical studies that systematically explore how cognitive stimulation from eSports can translate into psychomotor performance on the field, particularly with regard to speed. Much of the existing literature has treated the effects of cognitive and physical training separately, without considering how a synergistic combination can improve an athlete's overall performance [11]. A potential link between physical training and cognitive stimulation is represented by small-sided games (SSG), forms of reduced play widely adopted in youth soccer players [12]. SSGs, characterised by a limited space and a small number of players, promote constant interaction with the environment, while at the same time soliciting conditional, technical and decision-making components [13]. Several studies [14,15] have shown that this training modality increases game intensity, stimulates tactical thinking and develops cognitive-motor reactivity due to spatio-temporal constraints requiring quick decisions under pressure. From an ecological–dynamic perspective, SSGs represent an effective tool to train perception, decision-making and execution in an integrated manner, creating a realistic context that facilitates the transfer from the training situation to the competition situation [16]. The ecological–dynamic approach is based on the interaction between athlete, task, and environment, where learning emerges from the exploration of functional movement solutions rather than the repetition of predefined patterns [17]. In this perspective, motor behaviour is shaped by constraints (task, individual, and environment) that guide the adaptation of the player to variable situations. This contrasts with cognitive–prescriptive methods, which focus on predefined technical gestures and isolated repetition [18].

Motor learning has traditionally been interpreted according to two main approaches: the cognitive approach and the ecological–dynamic approach. The cognitive approach is based on the idea that learning occurs through the construction and automation of defined patterns or patterns, where the athlete processes information, selects the most appropriate response and executes it by means of programming and correction processes based on feedback [19]. In this model, training tends to break down the technical gesture into parts, with isolated exercises aimed at perfecting execution form. In contrast, the ecological–dynamic approach views learning as a process emerging from the continuous interaction between athlete, task and environment. According to this paradigm, motor skills develop by exploring functional motor solutions, without resorting to predefined internal representations, but adapting to contextual variables and information from the environment [20].

The integration of digital elements such as eSports in this context can further enhance the cognitive load and foster greater adaptability of the young athlete to the demands of the game. Another aspect that has been neglected in the research is the integration of football-themed eSports in an ecological–dynamic context, especially in youth sports. This approach might be able to improve not only speed, but also the ability to make quick decisions under pressure, which are key skills in football.

Purpose of Study

The present study aimed to examine the impact of integrating football eSports within an ecological–dynamic training framework on the development of linear sprint speed in young soccer players.

2. Materials and Methods

The study was conducted in a parallel-group experimental design, with randomised assignment of participants to a control group (CG) and an experimental group (EG). Although a double-blind design was not adopted, rigorous procedures were followed to minimise bias, in particular through the use of objective instruments for measuring performance (photocells) and uniformity of the testing context.

2.1. Study Participants

The study involved a cohort of 62 youth soccer players, both male and female, who were actively engaged in competitive practice. The athletes had an average age of 13.85 $\pm$ 1.21 years (range: 12–16 years). Their mean stature was 160.0 $\pm$ 8.0 cm, body mass 52.0 $\pm$ 7.0 kg, and body mass index (BMI) 20.3 $\pm$ 1.7 kg/m^2. Although the sample was balanced for age and gender, no subgroup analysis was performed. It is recognised that biological variability due to differences in gender and age (12–16 years) may have influenced the results.

Inclusion criteria were: being active soccer players registered in local clubs, regular training participation (minimum 3 times per week), and absence of musculoskeletal injuries in the last 6 months. Exclusion criteria were: previous participation in structured speed training programmes or competitive level eSports activity.

The sample was split into an EG, which performed the ecological–dynamic protocol including football eSports, and a CG, which continued with standard football training. Details on the same cohort have been reported in a previous study by our group focusing on reactivity [21], while the present work examines linear sprint speed as a distinct performance outcome.

2.2. Test

Sprinting ability was assessed by means of a 30-m linear running test. The 30-m linear sprint was selected as the primary test because it represents a widely standardised and validated measure for assessing sprint ability in youth soccer players. While acceleration, change of direction and sprinting with the ball are also relevant for football performance, the 30 m sprint is considered a robust proxy of linear speed and allows comparability with existing studies.

Each participant performed three trials, starting from a static position (two feet behind the starting line), with at least two minutes recovery time between each trial. The test was administered by an external evaluator, an expert in sports performance assessment, in order to ensure the objectivity of the measurement and reduce potential coach-related errors. The best recorded time, expressed in seconds, was taken as the benchmark for the statistical analysis. For the precise measurement of running times, Microgate's Witty photocells were used, a highly reliable system for recording passing times. The photocells were positioned at the start and finish points of the test, with the precision of recording times in milliseconds, allowing sprint performance to be monitored with high accuracy. The Witty photocells are able to detect the passage of the subject precisely, without external interference, ensuring that every reaction and running time is recorded correctly. The photocells (Microgate Witty) were positioned at a height of 1.0 m from the ground, in line with the participants' trunk, to minimise errors due to limb movements. Before testing, all players performed a standardised warm-up consisting of 10 min of light running, dynamic stretching, and progressive accelerations. Tests were conducted on a synthetic grass pitch under standard weather conditions.

During the test, the participants had to run a distance of 30 m as fast as possible, starting from a static position. The parameter calculated during the test was the average linear speed, which was obtained by dividing the distance covered (30 m) by the time recorded by each subject's best step. Each test was performed under standardised conditions, with an appropriate interval between repetitions to minimise fatigue and ensure optimal performance. This approach made it possible to collect objective data on the participants' linear speed, which is essential for analysing the improvements achieved in response to the training protocols. The use of Witty photocells ensured precise and reliable measurements, with no margin of error, for accurate assessment of sprint performance. Although the average linear speed value was also calculated in the descriptive phase, for the purposes of statistical analysis the primary parameter considered was the 30-m completion time, in line with the scientific literature for similar tests.

2.3. Protocol of Study

The CG continued with a conventional football training program that emphasized analytical exercises and prescriptive teaching methods. In contrast, the EG completed a protocol that combined traditional practice with the integration of the EA Sports FC 25 video game. The eight-week, three-times-a-week, integrated training protocol is designed to improve linear speed, promoting the development of game fundamentals. Its structuring is based on the cognitive load theory, which concerns the amount of information that the working memory can process simultaneously. When planning the weekly training schedule, coaches and practitioners should account for the load imposed by each activity to ensure that the complexity of the tasks is properly managed [22,23]. Within this framework, the use of a video game can serve as an additional resource, supporting the modulation of the cognitive demands of training [24].

2.3.1. Control Group Protocol

The CG took part in a conventional football training program that adopted a prescriptive teaching style. The sessions primarily consisted of isolated drills targeting technical skills and basic motor tasks, with the aim of consolidating predetermined movement patterns through frequent repetition. Such an approach emphasized precise execution and the automation of motor gestures, which are distinctive features of analytical training. Moreover, the practice sessions were structured to impose only a limited cognitive load and offered little variability, thereby reducing the necessity for adaptive or decision-making processes during training.

Thus, the main objective was to improve movement efficiency through repetition, reducing the intensity of cognitive involvement and the demand for adaptation to real game situations.

2.3.2. Experimental Group Protocol

The EG completed three training sessions per week, structured around tasks emphasizing 1-on-1 situations in restricted spaces and ball possession games under time pressure. Depending on the intended stimulus, the drills were performed either individually or in small sub-groups of 4–6 athletes. During the 1-on-1 duels and small-sided games (SSGs), players rotated systematically so as to compete against different opponents, thereby guaranteeing both fairness and variability in the proposed challenges. In the case of possession-based drills, the groups were formed according to players' technical level, ensuring balanced teams and a stimulating competitive environment. The 1-on-1 duel was conducted on a 12 × 8 m mini-pitch equipped with a single goal. Each action began with the defender serving the ball to the attacker, who was required to dribble past the opponent and conclude the action by attempting to score. As the weeks progressed, the training design evolved by incorporating SSGs that introduced additional cognitive demands. These included unexpected modifications of tactical themes or strategic goals in response to coach instructions [25]. The SSGs were carried out on a 20 × 12 m field, with two teams composed of three players each.

Each SSG session lasted approximately 20–25 min within the overall training unit. Games were organised in 3–4 bouts of 4–6 min each, interspersed with 2–3 min of passive recovery. The number of players per game (from 1 vs. 1 to 3 vs. 3) and the size of the pitch (from 12 × 8 m to 20 × 12 m) were manipulated to progressively increase the cognitive and physical demands. Although internal and external load variables (e.g., heart rate, GPS, RPE) were not monitored, the structure of the tasks was standardised to ensure comparability between sessions and across participants.

A central element of the training design was the application of time restrictions, which required players to pass the ball after a limited number of touches. Furthermore, every offensive sequence had to be completed within a set time window, with the coach introducing tactical modifications depending on the evolution of play [26].

The EG also engaged in 30-min football eSports sessions using EA Sports FC. These sessions introduced *Scrim* formats and matches with predefined objectives, specifically designed to enhance decision-making ability, tactical awareness, and cognitive responsiveness.

Throughout the gaming activities, players were challenged to adapt their strategies in real time, respond rapidly to pressure situations, and refine their handling of the ball within complex game scenarios. Matches were conducted in both single-player and multiplayer modes, with the coach offering constant feedback and requiring tactical adjustments as the play unfolded. Some sessions additionally incorporated a post-match debrief, during which the athletes' choices were reviewed, highlighting strengths and weaknesses. This reflective component aimed to foster deeper tactical understanding and promote more deliberate, focused learning.

2.4. Statistical Analysis

Statistical analyses were performed using JASP software (version 0.16.3, University of Amsterdam). To examine differences in reaction times between the three time points (pre, mid, post) and between groups (control vs. experimental), a repeated measures ANOVA was applied. To detect significant differences between pairs of groups, Bonferroni-corrected post hoc tests were performed. The effect of the independent variable was quantified by calculating the partial square age (η^2). For pairwise comparisons, effect size indices (Cohen's d) were also calculated. The statistical significance threshold was set at $p < 0.05$, to identify relevant differences.

3. Results

Average times (in seconds) were collected for the 30-m sprint at the three time points (Pre, Mid, Post) for both groups (CG and EG). The CG results can be observed in Table 1.

Table 1. Control Group 30-m Sprint Test Results.

Control Group			
Sprint 30M	**Time Required (in Seconds)**		
Athlete	**Pre**	**Mid**	**Post**
1	6.03	6.01	5.98
2	5.07	5.05	5.05
3	5.84	5.79	5.75
4	5.11	5.09	5.08
5	6.15	6.12	6.11
6	5.21	5.21	5.2
7	5.83	5.81	5.79
8	5.68	5.65	5.64
9	6.15	6.12	6.09
10	6.49	6.42	6.4
11	6,21	6.2	6.18
12	5.91	5.88	5.87
13	6.45	6.43	6.41
14	6.04	6.03	5.99
15	5.97	5.95	5.93
16	5.09	5.07	5.05
17	4.96	4.95	4.93
18	4.93	4.93	4.92
19	5.9	5.88	5.87
20	5.06	5.03	5.01
21	5.27	5.26	5.24
22	5.26	5.24	5.22
23	4.86	4.81	4.77
24	4.77	4.71	4.7
25	5.64	5.62	5.61

Table 1. *Cont.*

Control Group			
Sprint 30M	**Time Required (in Seconds)**		
Athlete	**Pre**	**Mid**	**Post**
26	4.91	4.89	4.88
27	5.32	5.31	5.29
28	4.89	4.88	4.86
29	4.93	4.91	4.89
30	5.12	5.11	5.11
31	5.15	5.12	5.11

Table 2 reports the results collected for the EG.

Table 2. Results of 30 m Test Sprint inExperimental Group.

Experimental Group			
Sprint 30M	**Time Required (in Seconds)**		
Athlete	**Pre**	**Mid**	**Post**
1	5.26	5.18	5.11
2	4.81	4.77	4.7
3	4.8	4.67	4.61
4	4.71	4.62	4.53
5	4.84	4.73	4.52
6	5.35	4.91	4.72
7	5.01	4.7	4.58
8	4.6	4.51	4.38
9	4.26	4.21	4.13
10	5.01	4.91	4.72
11	5.28	5.14	5.02
12	4.72	4.54	4.25
13	4.56	4.27	4.12
14	4.98	4.79	4.71
15	4.95	4.77	4.62
16	4.71	4.69	4.51
17	4.64	4.49	4.41
18	5.35	5.29	5.22
19	5.27	5.21	5.13
20	5.32	5.15	5.07
21	4.69	4.62	4.51
22	4.74	4.37	4.34
23	5.54	5.32	5.21
24	4.27	4.15	4.09

Table 2. *Cont.*

Experimental Group			
Sprint 30M	**Time Required (in Seconds)**		
Athlete	**Pre**	**Mid**	**Post**
25	4.89	4.72	4.53
26	4.87	4.81	4.59
27	4.72	4.63	4.54
28	4.91	4.82	4.67
29	4.73	4.66	4.59
30	5.22	5.07	5.03
31	5.13	5.07	5.02

After collecting the data from the 30 m sprint test, descriptive statistics were computed for both groups across the different measurement points. The outcomes are presented in Table 3.

Table 3. Descriptives Statistics of 30m Sprint.

Sprint 30 m	Group	N	Mean	SD	SE	Coefficient of Variation
Pre	Control	31	5.490	0.530	0.095	0.097
	Experimental	31	4.908	0.312	0.056	0.064
Mid	Control	31	5.467	0.527	0.095	0.096
	Experimental	31	4.767	0.308	0.055	0.065
Post	Control	31	5.449	0.525	0.094	0.096
	Experimental	31	4.651	0.319	0.057	0.069

Subsequently, a repeated-measures ANOVA was performed, and the corresponding outcomes are presented in Table 4.

Table 4. Repeated Measures ANOVA of 30 m Sprint.

Cases	Sphericity Correction	Sum of Squares	df	Mean Square	F	p	ω^2
Sprint 30 m	Greenhouse-Geisser	0.689	1.37	0.503	141.12	6.552×10^{-23}	0.020
Sprint 30 m * Group	Greenhouse-Geisser	0.362	1.37	0.264	74.076	1.228×10^{-15}	0.010
Residuals	Greenhouse-Geisser	0.293	82.24	0.004			

Repeated-measures ANOVA analysis showed a significant main effect of time on performance in the 30-metre sprint test, F(1.37, 82.24) = 141.119, $p < 0.001$, $\eta^2 p = 0.77$, indicating a significant improvement in linear speed over the three measurements (Pre, Mid, Post), considering the entire sample. Particularly significant was the interaction between time and group: F (1.37, 82.24) = 74.076, $p < 0.001$, indicating that the two groups (GS and GC) showed different improvement trends. It should be noted that the partial eta squared ($\eta^2_p = 0.77$) indicated a large effect, whereas omega squared ($\omega^2 = 0.01$–0.02) provided more conservative estimates. This discrepancy reflects the statistical properties of the two indices, with η^2_p tending to overestimate effect sizes in small samples. Therefore, the results should be interpreted with caution, considering both indicators.

The EG demonstrated greater performance gains compared to the CG, indicating the effectiveness of the training protocol. A Bonferroni post hoc test was then conducted for the 30 m sprint, with the results shown in Table 5.

Table 5. Post Hoc Comparisons—30 m Sprint.

		Mean Difference	SE	df	t	p_{bonf}	p_{holm}
Pre	Mid	0.082	0.009	60	9.097	2.032×10^{-12}	6.773×10^{-13}
	Post	0.149	0.011	60	13.371	3.575×10^{-19}	3.575×10^{-19}
Mid	Post	0.067	0.006	60	11.941	5.100×10^{-17}	3.400×10^{-17}

Post-hoc comparisons with Bonferroni correction showed that all differences between the time points were statistically significant:

- Pre–Mid: t(60) = 9.097, $p < 0.001$
- Pre–Post: t(60) = 13.371, $p < 0.001$
- Mid–Post: t(60) = 11.941, $p < 0.001$

Descriptive statistics confirm the strongest improvement in the GS: the mean time increased from 4.908 s (SD = 0.312) to 4.651 s (SD = 0.319). In contrast, the CG showed little change, from 5.490 s (SD = 0.530) to 5.449 s (SD = 0.525). These data are summarised in Table 4. To conclude, the graph of averages (Figure 1) shows a steeper trend for the EG, suggesting a steady and substantial improvement in linear speed over 30 metres, while the CG shows an almost stable trend over time.

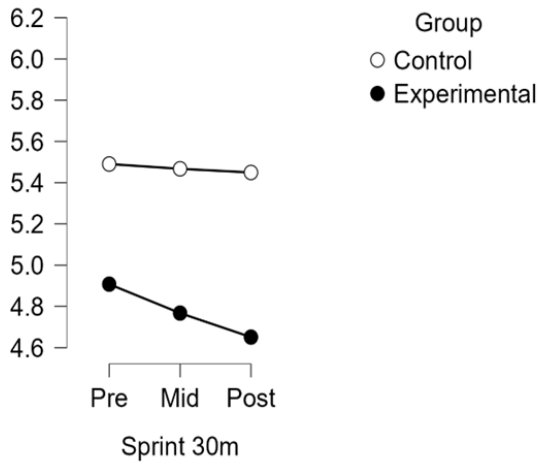

Figure 1. Descriptives Plots for 30 m Sprint.

4. Discussion

The aim of this study was to explore the effectiveness of two training protocols, one traditional, based on analytical and prescriptive exercises, and one innovative, based on the ecological–dynamic approach with integration of football eSports, in the development of linear speed in young soccer players. The results obtained suggest that the integration of cognitively stimulating and virtual components, such as sessions with EA Sports FC 25, within an SSG-based programme can lead to a more pronounced improvement in sprint performance than traditional analytical methods.

Repeated-measures ANOVA analysis showed a significant main effect of time, indicating that both groups made progress over the eight-week intervention period. However, the significant interaction between time and group showed that this progress was not uniform: EG showed a significantly greater improvement in 30-metre sprint performance than CG.

This observed improvement could be partly attributed to the greater cognitive activity involved in our integrated intervention: recent studies show that the ecological–dynamic approach, which incorporates variability and adaptation to contextual conditions, promotes not only technical skill in young soccer players but also decision-making flexibility and the ability to respond to unpredictable stimuli, key elements for linear speed in real-life situations [26].

It is important to consider that speed is not purely a physical attribute, but it also depends on the interaction between perception and action: recent studies on young soccer players show that sprints and changes of direction improve when training includes stimuli that require quick decisions and reactions to external signals in dynamic contexts similar to competition [27,28].

In the context of youth football, such a gain in linear speed may be highly relevant, especially during match situations that require short bursts of acceleration such as winning 1-vs-1 duels, breaking away from defenders, or closing down opponents quickly. Therefore, the improvement observed in this study is not only statistically significant but also practically meaningful for enhancing football-specific actions. These results are in line with recent literature showing that high cognitive load training combined with interactive virtual stimuli can positively influence psychomotor parameters, including speed [29].

Furthermore, according to Gibson's [7] direct perception approach, readiness to respond to complex stimuli, such as those present in both the real game and football-themed video games, can significantly improve through continuous exposure to dynamic situations with high variability.

Virtual Scrim is likely to have promoted greater activation of decision-making processes, supporting a positive transfer to real physical performance, in line with the principles of transfer of learning [30]. However, it is important to note that the present study did not directly measure indicators of decision-making ability, selective attention or visuomotor readiness. Therefore, the hypothesis that eSport sessions produced cognitive transfer on the motor level remains plausible but not empirically proven and will need to be tested in future studies with direct measures. While the literature suggests possible cognitive–motor transfer effects from eSports to real performance, the present study did not directly measure cognitive functions such as reaction time, selective attention, or decision-making. Therefore, any interpretation in this regard remains hypothetical and should be addressed by future studies with specific testing.

Some studies also suggest limitations in the use of eSports as physical performance tools, emphasising the risk of sedentariness and the possible failure of motor transfer in ecologically valid contexts [31]. The present study represents a first attempt to overcome this dichotomy by integrating the virtual environment into a real, controlled motor protocol. Finally, the increased effectiveness of the experimental protocol could also be linked to motivational factors and increased engagement, given young athletes' strong interest in eSports. This dimension, although not explicitly investigated, represents a potential pedagogical and didactic lever to be explored.

4.1. Practical Applications

The results of this study suggest that the controlled integration of football eSports within youth training programmes could be a useful strategy to stimulate cognitive and motor components synergistically. Specifically, the use of structured video game sessions (Scrim) combined with high-cognitive-load SSGs could foster increased engagement and motivation in young athletes; the development of increased perceptual-motor alertness; and the integration of decision-making and reactive components into the weekly training load. Although modest in absolute terms, this reduction may represent a meaningful gain in match situations where short bursts of acceleration decide the outcome of 1-vs-1 duels, pressing actions, or runs into space. However, it is important to acknowledge that this improvement may fall within the natural variability of performance in youth football.

For coaches and trainers, this approach offers an operational cue to introduce alternative training moments, provided they are included with criterion, didactic intentionality and monitoring, and not as mere entertainment. It will be necessary, however, in the future, to test the model in different contexts (elite, professional) and to evaluate its effectiveness in relation to other conditional and coordinative skills.

4.2. Limitations

This study is not without limitations, which should be considered when interpreting the findings. The intervention lasted only eight weeks, preventing firm conclusions regarding the long-term effectiveness of the proposed protocol. Secondly, the performance evaluation was based exclusively on the time taken in the 30-metre linear sprint, excluding relevant components of situational speed in football, such as acceleration, changes of direction or ball speed. Furthermore, it was not possible to control the exposure time to eSports outside the protocol, which might have influenced the results of the EG. A further limitation is the possible effect of a higher emotional participation and motivational involvement on the part of the participants, linked to the novelty of the intervention, which might have contributed to the observed improvement independently of the specific effectiveness of the mixed protocol. Furthermore, an additional group that exclusively carried out eSport activities, without the football training protocol, was not included, an aspect that would have made it possible to isolate the effect of the video game and to better understand whether the observed benefits were attributable to the combined effect or to one of the two components (eSport or SSG) in a prevalent way. Moreover, although the intervention was based on the assumption of enhanced cognitive stimulation through eSports, no direct measurements of cognitive functions (e.g., attention, decision-making, visuomotor coordination) were included, making the proposed cognitive-motor transfer hypothetical rather than empirically verified.

Another limitation concerns the heterogeneity of the sample, which included athletes of both sexes aged between 12 and 16 years. This variability may have influenced the response to training, and future studies should consider stratified analyses to examine possible sex- or age-related differences.

Additionally, the lack of analysis on individual variables such as prior gaming or football experience may have influenced the outcomes in uncontrolled ways. Finally, the sample is limited to a specific age group (12-16 years) and to amateur athletes: this limits the generalisability of the results to other contexts.

5. Conclusions

This study showed how a training protocol based on the ecological–dynamic approach, enriched by the integration of football eSports, can produce positive effects on sprint performance in young soccer players, compared to a traditional cognitive–prescriptive approach. The findings support the effectiveness of an ecological–dynamic protocol with eSports integration on linear sprint performance. However, cognitive improvements remain a hypothesis, since no direct cognitive assessments were conducted.

The repeated-measures ANOVA revealed a significant main effect of time as well as a notable time $\times$ group interaction, emphasizing the effectiveness of the innovative protocol implemented with the EG. The integration of exercises with a high cognitive load (such as SSGs) and the use of strategically oriented sports video games allowed the physical component to be stimulated. These preliminary results indicate that multidimensional training, which takes into account both motor and cognitive aspects, may represent a new frontier in youth training, especially in situational sports such as football. In light of these results, it can be concluded that the adoption of mixed protocols, which integrate digital tools with sport activity, represents a promising strategy to optimise athletic performance in youth sectors, while improving athletes' motivation and engagement. However, further studies will be needed to explore the long-term sustainability of such approaches, their impact on other conditional and coordinative skills, and the most effective ways for the personalised integration of eSports into training plans.

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Informed Consent Statement: Informed consent was obtained from all participants involved in the study. Each participant was assured of anonymity and was provided with complete and transparent information about the content, purpose, and procedures of the research in a clear and understandable manner. Participation was entirely voluntary, and no one was forced to take part.

Data Availability Statement: The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding author.

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References

1. Jarvin, L. Edutainment, games, and the future of education in a digital world. *New Dir. Child. Adolesc. Dev.* **2015**, *2015*, 33–40. [CrossRef] [PubMed]
2. Granacher, U.; Lesinski, M.; Büsch, D.; Muehlbauer, T.; Prieske, O.; Puta, C.; Behm, D.G. Effects of resistance training in youth athletes on muscular fitness and athletic performance: A conceptual model for long-term athlete development. *Front. Physiol.* **2016**, *7*, 164. [CrossRef]
3. Chiu, T.K.; Churchill, D. Exploring the characteristics of an optimal design of digital materials for concept learning in mathematics: Multimedia learning and variation theory. *Comput. Educ.* **2015**, *82*, 280–291. [CrossRef]
4. Himmelstein, D.; Liu, Y.; Shapiro, J.L. An exploration of mental skills among competitive League of Legend players. *Int. J. Gaming Comput-Mediat. Simul.* **2017**, *9*, 1–21. [CrossRef]
5. Ward, P.; Williams, A.M. Perceptual and cognitive skill development in soccer: The multidimensional nature of expert performance. *J. Sport. Exerc. Psychol.* **2003**, *25*, 93–111. [CrossRef]
6. Cusano, P.; Giardullo, G.; Di Lascio, G.; Kaçurri, A.; Kasa, A. The impact of the new technological tool Sprint Resister on the training of young footballers: An 8-week experimental study. *Slobozhanskyi Her. Sci. Sport* **2025**, *29*, 52–59. [CrossRef]
7. Parker, S.T.; Gibson, K.R. A developmental model for the evolution of language and intelligence in early hominids. *Behav. Brain Sci.* **1979**, *2*, 367–381. [CrossRef]
8. Graf, D.L.; Pratt, L.V.; Hester, C.N.; Short, K.R. Playing active video games increases energy expenditure in children. *Pediatrics* **2009**, *124*, 534–540. [CrossRef]
9. Farrow, D.; Abernethy, B. Do expertise and the degree of perception–action coupling affect natural anticipatory performance? *Perception* **2003**, *32*, 1127–1139. [CrossRef]
10. Dwyer, D.B.; Gabbett, T.J. Global positioning system data analysis: Velocity ranges and a new definition of sprinting for field sport athletes. *J. Strength. Cond. Res.* **2012**, *26*, 818–824. [CrossRef]
11. Sweeting, A.J.; Cormack, S.J.; Morgan, S.; Aughey, R.J. When is a sprint a sprint? A review of the analysis of team-sport athlete activity profile. *Front. Physiol.* **2017**, *8*, 432. [CrossRef]
12. Esposito, G. The impact of visual occlusion during small-sided games on youth football players. *J. Hum. Sport. Exerc.* **2024**, *19*, 882–890. [CrossRef]
13. Halouani, J.; Chtourou, H.; Gabbett, T.; Chaouachi, A.; Chamari, K. Small-sided games in team sports training: A brief review. *J. Strength. Cond. Res.* **2014**, *28*, 3594–3618. [CrossRef]

14. O'Connor, D.; Larkin, P.; Williams, A.M. What learning environments help improve decision-making? *Phys. Educ. Sport. Pedagog.* **2017**, *22*, 647–660. [CrossRef]
15. Sarmento, H.; Clemente, F.M.; Harper, L.D.; Costa, I.T.D.; Owen, A.; Figueiredo, A.J. Small sided games in soccer–a systematic review. *Int. J. Perform. Anal. Sport.* **2018**, *18*, 693–749. [CrossRef]
16. Katis, A.; Kellis, E. Effects of small-sided games on physical conditioning and performance in young soccer players. *J. Sports Sci. Med.* **2009**, *8*, 374. [PubMed]
17. Altavilla, G.; Aliberti, S.; D'Isanto, T.; Raiola, G. A comparison between ecological-dynamic and cognitive approach to improve accuracy in basketball shot. *Stud. Sport.* **2022**, *16*, 6–12. [CrossRef]
18. Esposito, G.; Ceruso, R.; Aliberti, S.; Raiola, G. Ecological-Dynamic Approach vs. Traditional Prescriptive Approach in Improving Technical Skills of Young Soccer Players. *J. Funct. Morphol. Kinesiol.* **2024**, *9*, 162. [CrossRef]
19. Schmidt, R.A. A schema theory of discrete motor skill learning. *Psychol. Rev.* **1975**, *82*, 225. [CrossRef]
20. Davids, K.; Button, C.; Bennett, S. Dynamics of skill acquisition: A constraints-led approach. Champaign (IL): Human Kinetics. 2008. Available online: https://psycnet.apa.org/record/2008-04551-000 (accessed on 4 August 2025).
21. Ceruso, R.; D'elia, F.; Sannicandro, I.; Manzi, V.; Esposito, G. Effects of an Ecological-Dynamic Training Protocol Integrating Football eSports on Reactivity in Young Footballers: A comparative study. *Int. J. Kinesiol. Sports Sci.* **2025**, *13*, 12. [CrossRef]
22. Andrade, L. Teoría de la carga cognitiva, diseño multimedia y aprendizaje: Un estado del arte. *Magis Rev. Int. Investig. Educ.* **2012**, *5*, 75–92.
23. Raiola, G. Motor learning and teaching method. *J. Phys. Educ. Sport* **2017**, *17*, 2239–2243.
24. Mitre-Hernandez, H.; Carrillo, R.C.; Lara-Alvarez, C. Pupillary responses for cognitive load measurement to classify difficulty levels in an educational video game: Empirical study. *JMIR Serious Games* **2021**, *9*, e21620. [CrossRef]
25. Taylor, B.J.; Mellalieu, D.S.; James, N.; Barter, P. Situation variable effects and tactical performance in professional association football. *Int. J. Perform. Anal. Sport* **2010**, *10*, 255–269. [CrossRef]
26. Zhao, J.; Gu, Q.; Zhao, S.; Mao, J. Effects of video-based training on anticipation and decision-making in football players: A systematic review. *Front. Hum. Neurosci.* **2022**, *16*, 945067. [CrossRef]
27. Sanz-Matesanz, M.; Martínez-Aranda, L.M.; Gea-García, G.M. Effects of a physical training program on cognitive and physical performance and health-related variables in professional esports players: A pilot study. *Appl. Sci.* **2024**, *14*, 2845. [CrossRef]
28. Mancı, E.; Gençtürk, U.; Günay, E.; Güdücü, Ç.; Herold, F.; Bediz, C.Ş. The influence of acute sprint exercise on cognition, gaming performance, and cortical hemodynamics in esports players and age-matched controls. *Curr. Psychol.* **2024**, *43*, 19643–19654. [CrossRef]
29. Cabero-Almenara, J.; Llorente-Cejudo, C.; Martín-Párraga, L. Carga cognitiva y realidad mixta (aumentada y virtual). *Hachetetepé Rev. Cient. Educ. Comun.* **2023**, *27*, 1–15. [CrossRef]
30. Thiel, A.; John, J.M. Is eSport a 'real' sport? Reflections on the spread of virtual competitions. *Eur. J. Sport. Soc.* **2018**, *15*, 311–315. [CrossRef]
31. Vartanian, O.; Navarrete, G.; Chatterjee, A.; Fich, L.B.; Gonzalez-Mora, J.L.; Leder, H.; Skov, M. Architectural design and the brain: Effects of ceiling height and perceived enclosure on beauty judgments and approach-avoidance decisions. *J. Environ. Psychol.* **2015**, *41*, 10–18. [CrossRef]