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***Cognitive-behavioral techniques applied to  
youth soccer players – multidimensional  
investigation***

**THESIS SUMMARY**

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## List of original published works

- Pop, R.-M., & Grosu, E. (2022). Physical Activity of Middle School Students from Cluj-Napoca during the Covid-19 Pandemic. *Revista Românească pentru Educație Multidimensională*, 14(4), 524–537. <https://doi.org/10.18662/rrem/14.4/655>
- Pop, R.-M., Grosu, E. F., & Zadic, A. (2021). A Systematic Review of Goal Setting Interventions to Improve Sports Performance. *Studia Universitatis Babeş-Bolyai Educatio Artis Gymnasticae*, 66(1), 35–50. [https://doi.org/10.24193/subbeag.66\(1\).04](https://doi.org/10.24193/subbeag.66(1).04)
- Pop, R.-M., Grosu, V., Grosu, E., Zadic, A., Măță, L., & Dobrescu, T. (2022). The Effects of Small-Sided Games and Behavioral Interventions on the Physical and Motivational Outcomes of Youth Soccer Players. *International Journal of Environmental Research and Public Health*, 19(21), 14141. <https://doi.org/10.3390/ijerph192114141>
- Pop, R.-M., Grosu, V. T., Ordean, M. N., & Rusu, A. S. (2022). INTERDISCIPLINARY INVESTIGATION OF THE IMPACT OF A BEHAVIORAL INTERVENTION ON THE TOTAL DISTANCE COVERED IN SMALL-SIDED SOCCER GAMES. *ICERI2022 Proceedings*, 3526–3534. <https://doi.org/10.21125/iceri.2022.0864>

**Keywords:** small-sided games, soccer, physical exertion, aerobic capacity, behavioral techniques, goal setting, motivation.

## **Theme introduction and argumentation**

### ***Motivation for choosing the theme***

Soccer players need both a high aerobic capacity and a well-developed anaerobic capacity to cope during matches and training. Even if in practice coaches predominantly use exercises specific to athletics to develop aerobic capacity, the results of studies show additional technical and motivational benefits when using means specific to soccer, such as small-sided games (Little & Williams, 2007; Los Arcos et al., 2015).

Besides the small-sided games implemented in compliance with methodological requirements, our intervention also involves a behavioral component to increase the intensity of the effort (Miltenberger, 2015). Behavioral modification techniques are effective in influencing the behavior of people in sport and in other fields (for a review, see Schenk & Miltenberger, 2019).

### ***Theme delimitations in scientific research***

The successful use of small-sided games requires an integrative approach that considers players' participation in sports activity from a physical, cognitive, and emotional point of view (Clemente, 2016). Therefore, this thesis is an interdisciplinary research that can have implications for the theory of sports training in soccer.

### ***Theme actuality***

The topic approached in the present paper is contemporary in the light of numerous studies that have recently investigated the use of small-sided games in soccer and the impact of their use on physiological variables such as aerobic and anaerobic capacity, psychological variables such as the positive subjective perception for sports activity, commitment, and motivation and on skill development in the game of soccer (Aguiar et al., 2012; Clemente, 2016; Dellal et al., 2012; Hill-Haas et al., 2010; Los Arcos et al., 2015; Williams & Owen, 2007).

### ***Novelty elements***

The novelty elements that we propose in this paper are the following:



- It is the first paper that presents an intervention based on behavioral modification techniques to increase the physical effort exerted in small-sided games.
- It is the first work to use an intervention package composed of behavioral monitoring, goal setting, public posting, and positive reinforcement.
- For the use of positive reinforcements, we applied an approach that presents novelty elements and in which we integrated the token economy.
- For behavioral monitoring, we used GPS-type devices designed for soccer players, which quantify their movements during games.
- This paper proposes to investigate changes at individual and group levels in increasing athletes' physical effort.
- The present work aspires to examine the effects of a couple of interventions on physical variables (total distance covered and total sprint distance), motivational variables (motivational climate), and physiological variables (estimated aerobic capacity).

### ***Thesis objectives***

The general aim of the thesis was to test the psycho-physiological and physical effects of interventions based on small-sided games and behavioral strategies. The specific objectives of the thesis were as follows:

- Conducting a systematic review concerning the interventions that use goal setting in the sports field;
- Conducting preliminary research to verify the feasibility of the intervention, to test the effects of the intervention at the individual level and its social validity;
- Testing the effectiveness of the intervention at the group level on aerobic capacity, physical, and motivational indices.

## PART I. THEORETICAL GROUNDS

### Summary of Chapter 1. Physiological bases of physical effort

The human individual uses daily nutrients obtained from the consumption of plants or animal food to have enough energy to support cellular activity (Porcari et al., 2015). The most important energy sources used during physical activities are carbohydrates, fats, and proteins (Powers & Howley, 2017).

Yet, energy is stored inside cells in a compound called *ATP* or *adenosine triphosphate* (Kenney et al., 2012). The primary energy systems involved in the production of ATP are the phosphagen system (also called *ATP-PCr*, *the phosphocreatine-creatine system*), the glycolytic system (also called *the glycogen-lactic acid system* or *the lactic anaerobic system*), and the oxidative system (also called *the oxidative aerobic system*).

One of the essential biological systems for practicing physical exercise is the neuromuscular system. The muscular system is the active part of the musculoskeletal system, responsible for the movement of different body parts, thus allowing it to practice physical activities (Porcari et al., 2015). Human skeletal musculature contains two main types of muscle fibers that differ depending on their metabolic and contraction properties: slow and fast fibers, or type I and *type II muscle fibers* (Hoffman, 2014). The type of muscle fibers used is critical because this aspect determines the strength and duration of muscle contraction (Porcari et al., 2015).

The circulatory system has the primary function of delivering oxygen and nutrients to the cells of the body and eliminating carbon dioxide and metabolic waste from cells (Guyton & Hall, 2007). *The heart rate* represents the number of cardiac cycles performed in a unit of time and can be measured using the stethoscope, the electrocardiograph, by palpation of a peripheral artery in the body, or by the use of clocks or cardiac thoracic belts (Bricout et al., 2010).

The respiratory system is also important for practicing the game of soccer. For the muscles to contract and for the neuromuscular system to enter its role, they need energy, and an essential element in ensuring a large amount of energy is breathing (Plowman & Smith, 2013). The volume of air displaced during ventilation is measured by a technique called spirometry, which measures changes in the volume of inhaled and exhaled air (Kenney et al., 2012).

Although intense physical activity can be a stress factor for the human body, it can adapt to prolonged physical exertion, at the level of physiological indices (McArdle et al., 2010). In this thesis, we have synthesized both aerobic and anaerobic adaptations that occur at the metabolic, neuromuscular, cardiovascular, and pulmonary levels.

### **Summary of Chapter 2. Scientific approaches to sports training**

According to Kenney, Wilmore, & Costill (2012), the general principles of sports training are the principle of individualization, the principle of specificity, the principle of reversibility, the principle of progressive overload, and the principle of variation. During the coaching process, soccer coaches must apply these principles so that athletes' benefits from practicing sports training are at a high level.

*Planning* refers to the "process of arranging the training program in long and short phases to meet the training goals" (Bompa & Buzzichelli, 2015, p.88). *Programming* is "completing this structure with content in the form of training modalities" (Bompa & Buzzichelli, 2015, p.88). *Periodization* is a method by which sports training is divided into smaller segments in the form of periods or cycles of preparation (Bompa & Haff, 2009).

Physical effort can be assessed by its size as exhaustive, maximal, submaximal, medium, or small and can be characterized by several indicators, including the volume, intensity, specificity, density, and complexity of effort (Dragnea, 1996).

### **Summary of Chapter 3. The game of soccer**

The most important situations of the game, decisive for the fate of a soccer game, often involve maximal or exhaustive efforts using the phosphagen system (McArdle et al., 2010). The glycolytic system is also used in soccer, with lactic acid concentrations of 12 mmol/l in professional players (Clemente, 2016). The oxidative system also contributes to much of the total energy produced and consumed during a soccer game (Bangsbo, 2014). Thus, the human body uses a combination of metabolic pathways to deliver energy in the game of soccer, and understanding the relative contribution of the systems used is essential for planning an effective physical training program (Powers & Howley, 2017).

From the point of view of maturation, according to Strudwick (2016), young players go through three stages of development: the fundamental acquisition phase, the development phase, and the performance phase.

*The foundation phase* (6-11 years) is characterized by a few differences in psychological development and some differences in physical development (Strudwick, 2016). In this phase, children benefit from practicing several sports disciplines (Varghese et al., 2022).

*The development phase* (12-15 years) has the main characteristic of large variations in physical development and important differences between athletes in psychological attributes relevant to the game of soccer (Strudwick, 2016). At this age, a single sport discipline's specialization usually occurs (Varghese et al., 2022). Physiologically, soccer players in their teens have lower levels of exercise capacity than adults (Stølen et al., 2005).

*The performance phase* (16-19 years) is associated with the reduction of inter-individual differences in physical and psychological development, which makes athletes with developmental delays approach the level of those who developed earlier (Strudwick, 2016). Around the age of 16, athletes usually have cognitive and motor skills formed for advanced specialization in sports (Weinberg & Gould, 2018). It seems that as athletes grow older, there is also an increase in exercise capacity (Helgerud et al., 2001).

According to Bompa (2003), there are three types of endurance: an aerobic type (aerobic endurance) and two anaerobic types: lactic endurance and alactic endurance.

*Aerobic endurance* refers to the ability of the human body to tolerate physical exertion for a long time, without interruption; for this, it is necessary to use enough oxygen (FIFA Education and Technical Development Department, 2016).

*Lactic endurance* refers to the ability of the human body to tolerate intense physical exertion without needing oxygen consumption (FIFA Education and Technical Development Department, 2016). This type of endurance involves physical activities with an average duration of 30-90 seconds and a higher intensity of effort than aerobic endurance (Bompa, 2003).

*Alactic endurance* is the body's maximum ability to tolerate fatigue produced over short periods (under 10-12 seconds) during maximum-intensity physical activities that have as a source of energy phosphocreatine and ATP stored in the muscles (Bompa, 2003).

For the development of endurance are used several methods, such as the continuous training method and the interval training method (interval training, pyramid interval training, Fartlek method) (FIFA Education and Technical Development Department, 2016; Raiola & D'Isanto, 2016; Reilly, 2007).

Due to the specific character of the soccer game, interval training is the most used unit of comparison by researchers who wanted to test the effectiveness of small-sided games (Clemente, 2016). The results show no significant differences between the two training methods regarding adaptations in aerobic and anaerobic systems (Delextrat & Martinez, 2014; Impellizzeri et al., 2006).

However, to manipulate the volume and intensity of physical effort in small-sided games, coaches must take into account several variables such as the format of the small-sided games (the number of players in the team), the size of the pitch or the modification of some rules of the game (for example, the number of touches of the ball or the type of marking) (Clemente, 2016).

#### **Summary of Chapter 4. Motivation in sports**

Motivation is defined as the focus and intensity of a person's effort, where the focus of the effort is represented by the situations that the individual is attracted to and that he addresses, and the intensity of effort refers to how much effort the person puts into that situation (Weinberg & Gould, 2018).

An approach to motivation from an interactionist perspective is represented by achievement motivation. Murray (1938) defines achievement motivation as "a person's efforts to master a task, to achieve excellence, to overcome obstacles, to perform better than others, and to feel pride in the exercise of talent" (as cited in Weinberg & Gould, 2018, p. 62). Achievement theory has aroused the interest of several researchers over time, and their contribution has laid the foundations of four important theories: need achievement theory (Atkinson, 1974 as cited in Weinberg & Gould, 2018), attribution theory (Weiner, 1972), competence motivation theory (Weiss & Chaumeton, 1992) and achievement goal theory (Duda & Hall, 2001).

*Achievement goal theory* (Duda & Hall, 2001) is a theory of motivation that considers how people's thoughts orient them toward the behavior of achievement and success. Moreover, according to Duda & Hall (2001), the theory states that each person is driven by goals and that they act rationally according to these goals that govern their decisions and behavior in the context of achievement. The

theory proposes three basic concepts: *states of goal involvement*, *goal orientations*, and *goal climates* (Eklund & Tenenbaum, 2013).

There are two types of motivational climate: task-oriented and ego-oriented. The task-oriented motivational climate promotes the sports team effort, cooperation, and emphasizes learning, while the ego-oriented motivational climate supports competition, social comparison, overcoming opponents and teammates, and punishing mistakes made by athletes (Tenenbaum & Eklund, 2007).

To increase motivation and change the undesirable behaviors of athletes, one of the recommendations addressed to coaches in the literature relates to the use of behavioral modification techniques (Weinberg & Gould, 2018). Among the behavioral modification techniques that have been successfully used in the sports field are: positive and negative reinforcements, feedback, the token economy (reinforcements using tokens), behavioral modeling, goal setting, prompting, behavioral monitoring, public posting, and others (for a review, see Schenk & Miltenberger, 2019).

## **PART II. ORIGINAL CONTRIBUTIONS**

### **Summary of Chapter 5. A systematic review of goal setting interventions to improve sports performance<sup>1</sup>**

#### ***5.1. Theoretical framework***

Goal setting theory (Locke & Latham, 1990) is a motivational theory based on more than 400 studies and suggests that specific and demanding goals lead to higher levels of performance in task than easy or vague ones. Applied behavior analysis also uses goal setting as a behavioral modification technique, both as a singular strategy or in conjunction with other procedures such as monitoring, public posting, feedback, and positive reinforcement (Cooper et al., 2014).

#### ***5.2. Objectives***

In this research, we aimed to synthesize the methodological trends related to goal setting in sports and to offer an updated theoretical framework. Therefore, the study aimed to systematically review interventions based on goal setting in the sports field.

#### ***5.4. Inclusion and exclusion criteria***

We used the following inclusion criteria: implementing an intervention containing goal setting and using target behaviors related to sports performance. Studies that were not written in English, that did not implement an intervention in the research, and articles regarding the participants' physical activity level were excluded.

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<sup>1</sup> This study has been published.

Pop, R.-M., Grosu, E. F., & Zadic, A. (2021). A Systematic Review of Goal Setting Interventions to Improve Sports Performance. *Studia Universitatis Babeş-Bolyai Educatio Artis Gymnasticae*, 66(1), 35–50.  
[https://doi.org/10.24193/subbeag.66\(1\).04](https://doi.org/10.24193/subbeag.66(1).04)

### ***5.5. Search strategy***

The systematic search was carried out on the 1st of October 2020 in the subscribed databases of the "Lucian Blaga" Central University Library Cluj-Napoca: Scopus, ScienceDirect, Directory of Open Access Journals (DOAJ), Educational Resources Information Center (ERIC), Social Sciences Citation Index (SSCI), Science Citation Index (SCI) and APA PsycArticles. We used the terms "goal setting" and sport\* as keywords.

### ***5.6. Data analysis***

As a result of the systematic search in the literature, we identified 1520 papers, and after eliminating the duplicates, 1354 articles were kept and included for the abstract review. While reviewing the abstracts, two evaluators (the author of the thesis and another Ph.D. student in the field of sports science) independently evaluated the articles using the Rayyan software program (Ouzzani et al., 2016).

As a result of this approach, 22 articles were kept. Subsequently, we analyzed the bibliographic list of the articles and identified seven other relevant articles. In the end, 29 articles were evaluated as full-text, and two of them were removed, eventually resulting in 27 articles included in our systematic review.

### ***5.7. Results***

#### **5.7.1. Participant characteristics**

A total of 770 participants took part in interventions based on goal setting in the reviewed articles. Both female (400) and male (370) athletes, aged between 7 and 36, participated in these interventions.

#### **5.7.2. Included sports**

The results show that only three studies used interventions that involved goal setting in soccer (Brobst & Ward, 2002; Holt et al., 2012a, 2012b). Other sports games included were the following: volleyball (6) (e.g., Palao, 2016), basketball (4) (e.g., Ortega et al., 2013), American football (2) (e.g., Ward & Carnes, 2002), and rugby (1).



Among individual sports were the following: tennis (2) (e.g., Boyce et al., 2001), triathlon (2) (e.g., Thelwell & Greenlees, 2001), track & field (2) (e.g., Thelwell & Greenlees, 2003) and table tennis (1) (Liu et al., 2012).

### **5.7.3. Experimental design characteristics**

From the point of view of experimental design characteristics, we noticed that many studies used variants of the single-participant design. Of these, the most used were the multiple baseline across participants design (5) (e.g., Thelwell & Greenlees, 2003) and the multiple baseline across behaviors design (2) (e.g., Ward & Carnes, 2002). Other research used a group-level design approach: quasi-experimental (e.g., Palao, 2016) and experimental (e.g., Corrêa et al., 2006).

### **5.7.4. Type of goal setting intervention**

We have identified both studies that have used goal setting as a single strategy, as well as in intervention packages. In the first category, we found 15 studies, and within them, some authors evaluated only the effectiveness of the intervention (e.g., Ortega et al., 2013), while others also focused on correlated variables such as the difficulty of the objectives (e.g., Dutra et al., 2017) and the specificity of the goals (e.g., Corrêa et al., 2006).

The studies that used intervention packs applied the following strategies: feedback and group contingency (Holt et al., 2012a), public posting (Ward & Carnes, 2002), public posting and verbal feedback (Brobst & Ward, 2002; Smith & Ward, 2006), planning (Bieleke et al., 2019) or positive self-talk and imagery (Heydari et al., 2018).

### **5.7.5. Target behavior**

#### *5.7.5.1. Technical performance*

Most of the studies in our systematic review have targeted this area of sports training. In soccer, technical elements such as passing the ball (Holt et al., 2012a), the highest number of consecutive touches of the ball or juggling in the correct sequence (Holt et al., 2012b), and variants of movement with the ball (Brobst & Ward, 2002) were targeted. Authors also investigated the effectiveness of goal setting interventions to improve technical performance in other sports: volleyball (Bieleke et al., 2019; Corrêa et al., 2006; Dutra et al., 2017; Zetou et al., 2008), boxing (O'Brien et al., 2009), or tennis (Boyce et al., 2001).

#### *5.7.5.2. Tactical performance*

A few studies (4) focused on tactical performance using goal setting. These studies aimed to improve the offensive tactical game of tennis players (Vidic & Burton, 2010), the perception and use of statistics related to the game in volleyball (Palao, 2016), the correct routes run (Smith & Ward, 2006) and the anticipation of the game in American football (Ward & Carnes, 2002). In soccer, we have not identified studies targeting this aspect of sports training.

#### *5.7.5.3. Physical performance*

Physical performance has also been little studied by researchers who have used goal setting interventions. In soccer, Holt et al. (2012b) used as a measure of the intensity of effort the total number of touches performed by players in repeated tasks lasting 4 minutes. In other sports, among the variables of interest in terms of physical performance were: the recorded times of the swimmers (Simoes et al., 2012), the times recorded in triathlon (Thelwell & Greenlees, 2001), the distance covered in an endurance running task in track & field (Bueno et al., 2008), or the effort capacity of tennis players (Vidic & Burton, 2010).

#### *5.7.5.4. Psychological performance*

As for aspects of psychological performance, we have identified a single study that used goal setting for this purpose in soccer. More specifically, Holt et al. (2012a) have tested such an intervention to increase awareness and orientation during the game. Psychological performance has also been targeted in other sports: track & field (McCarthy et al., 2010; Wikman et al., 2014), basketball (Durdubas et al., 2019; Ortega et al., 2013), swimming (Wikman et al., 2014), tennis (Vidic & Burton, 2010), or triathlon (Thelwell & Greenlees, 2001, 2003).

### ***5.8. Discussions and limits***

This work aimed to synthesize articles that used interventions based on goal setting to increase sports performance. Compared to athletes that participated in control or baseline groups, participants who used goal setting improved their performance, demonstrating consistent behavioral changes. Even if interventions that use goal setting to increase sports performance are effective, future research should investigate the extent to which results can be generalized under competitive conditions.

Most of the studies included in this review focused on technical or psychological changes in sports performance, and a few studies investigated the changes at the physical or tactical level. On a physical level, included studies emphasized the volume and intensity of effort. From our point of view, both variables of effort can be influenced by the use of goal setting, and the appearance of GPS devices for athletes gives coaches the possibility to get more information about the physical effort of athletes and set goals to improve it (Malone et al., 2017).

### ***5.9. Conclusions***

- Goal setting is an efficient strategy for the multidimensional increase of sports performance, both in individual and collective sports;
- A small number of studies (3) investigated the effect of a goal setting intervention in samples of soccer players;
- A relatively small number of studies (6) assessed the effect of a goal setting intervention targeting the physical performance of athletes;
- A single study of those examined the effect of a goal setting intervention on the physical performance of soccer players;
- The research that used goal setting applied both experimental designs at the group level and the individual level (single-subject experimental design);
- The fields of sports science and psychology are related and there is a need for interdisciplinarity in future studies;
- Goal setting is often used in intervention packs along with other strategies derived from the field of psychology (e.g., mental imagery, feedback, or public posting).

## **Summary of Chapter 6. Preliminary research. Interdisciplinary research of the impact of a behavioral intervention on the total distance covered in soccer small-sided games<sup>2</sup>**

### ***6.1. Theoretical framework***

From the systematic review that we conducted in the previous research, it emerged the effectiveness of goal setting strategy to improve sports performance. In addition to goal setting, other procedures derived from the behavioral sciences are efficient in the field of sports performance (for a review, see Schenk & Miltenberger, 2019).

Regarding the dependent variables examined, the authors were particularly interested in variables related to the technical performance of soccer players, such as passing the ball (Luyben et al., 1986; Ziegler, 1994), heading the ball, throw-ins, and goal kicking (Rush & Ayllon, 1984). In contrast, none of the studies identified showed any interest in the physical performance of soccer players or the application of a behavioral intervention during the small-sided games.

### ***6.2. Objectives***

The main aim of the preliminary research was to verify whether the implementation of a behavioral intervention composed of public posting, goal setting, and positive reinforcement affects the distance covered by soccer players in small-sided games.

Another objective of this research was to test the social validity of our proposed behavioral intervention program. According to Snodgrass et al. (2018), when behavioral interventions with novelty elements are implemented, the procedures must be perceived as valuable and acceptable to participants.

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<sup>2</sup> This study has been published.

Pop, R. M., Grosu, V. T., Ordean, M. N., & Rusu, A. S. (2022). INTERDISCIPLINARY INVESTIGATION OF THE IMPACT OF A BEHAVIORAL INTERVENTION ON THE TOTAL DISTANCE COVERED IN SMALL SIDED SOCCER GAMES. *ICERI2022 Proceedings*, 3526–3534. <https://doi.org/10.21125/iceri.2022.0864>

Another objective of the preliminary research was to verify the intervention's feasibility to identify its possible weaknesses and improve it.

#### ***6.4. Research methods***

The first method used was the semi-structured interview. The semi-structured interview has an exploratory role, and during its application, the participants are guided in the conversation to particular topics of interest for research (Magaldi & Berler, 2020). Also, the survey method appeals to participants to obtain information about them by asking questions, usually structured in standardized and valid instruments (Dane, 1990).

The single-subject experiment is an effective, rigorous research method that allows testing for changes that occur within dependent variables (Barker et al., 2011). Repeated measurements are made to test these changes and to examine trends occurring within the data.

#### ***6.5. Hypotheses***

**H<sub>1</sub>:** Using an intervention composed of behavioral monitoring, public posting, goal setting, and positive reinforcement will have an effect at the individual level on the total distance covered by soccer players during a task of small-sided games.

#### ***6.6. Design***

The design used was the experimental ABAB design (Pintea, 2015). This design consists of four phases: the initial phase (A), the intervention phase (B), the second initial phase (A), and the second phase of intervention (B) (Barker et al., 2011).

#### ***6.7. Research setup***

##### **6.7.1. Participants**

The participants were eight soccer players aged between 16 and 18 at the team C. S. Sănătatea Servicii Publice Cluj-Napoca. Participants absent from at least three training sessions in any phase were excluded from data analysis, resulting in five participants. In general, in studies using this type of design, between 3 and 5 participants were employed (Lammers & Badia, 2005).

### 6.7.3. Period and place

The data were collected between June and November 2020, and the training took place at the "Unirea" Sports Center in Cluj-Napoca.

### 6.8. Instruments

To measure the dependent variable "total distance covered" we used the PLAYR Football GPS Tracker, designed for soccer players (Catapult Group International Ltd, 2018). As for the investigation of social validity, we developed a questionnaire and a semi-structured interview for this research.

### 6.9. Procedure

The initial (baseline) and experimental phases involved participation in small-sided games 4 vs. 4 on a *pitch size* of 864 m<sup>2</sup>. We used *small goals* (1.5 x 1.2 meters), and the games were played *without a goalkeeper*. The athletes participated in 22 training sessions, of which ten were allocated to the two initial phases, and the remaining 12 training sessions were part of the two experimental phases. *The average weekly frequency* of the training dedicated to the intervention was two workouts/week, and the task duration was 17 minutes.

#### *Baseline*

In this phase, the athletes received a GPS device that measured the distance covered during the task. Although they were notified of the measurements made, they did not have information about their performance or the performance achieved by the other players.

#### *Experimental phase (public posting, goal setting, positive reinforcement)*

The components regarding the small-sided games have remained unchanged at this phase as well. But unlike the initial phase, we used *public posting* as a first strategy. Thus, the results obtained by the athletes were displayed in plain sight near the reserve bench.

A second strategy used in this phase was the *goal setting*. To ensure an average level of difficulty, the initial goals were set at a level of 10% higher than the performance of each player. Also, to take into account the individual characteristics of the players, such as the level of training, each player had customized goals. To ensure player progress, every time one of them met a goal, it would increase in difficulty by 5% of the value.

The intervention package used also consisted of *positive reinforcement*. Thus, when we noticed that an athlete put in high effort in the task, that behavior was positively highlighted. In the case of long-term goals, we used reinforcements with material value and promoted competition between athletes.

## **6.10. Data analysis**

### **6.10.1. Visual inspection of data**

To test the effect of the intervention on the dependent variable total distance covered, we used the technique called visual inspection in the data analysis approach. In the visual inspection of the data, we interpreted the level, the trend, and the variability of the scores and calculated the percentage of non-overlapping data and an indicator of the effect size, entitled  $\Delta$ -index (Barker et al., 2011).

### **6.10.2. Thematic analysis**

For the analysis of data on social validity, we used thematic analysis (Neuendorf, 2016). According to Braun & Clarke (2006), we have taken six steps to carry out this analysis: familiarity with the data collected, initial code generation, identification of themes based on initial codes, reviewing themes, defining and labeling themes, and drafting the report.

## **6.11. Results**

### **6.11.1. Results based on visual inspection of data and calculation of effect size**

The transition from the initial phase (A) to the experimental phase (B) led to improved performance for each participant in both replications, and this suggests that the intervention had a positive effect on the total distance covered. Below, we present the results obtained by each athlete:

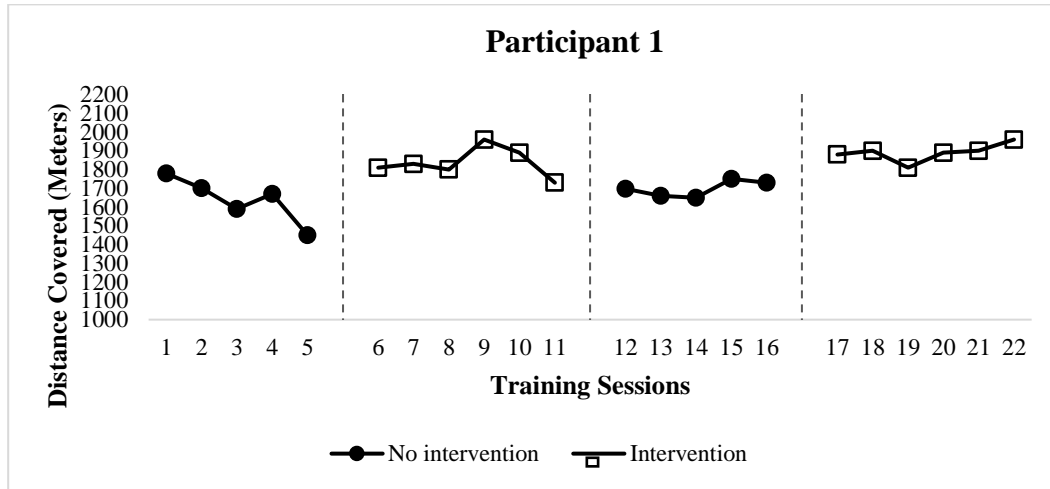
#### **6.11.1.1. Participant 1**

The average score of this participant was 1638 meters in the initial phase, followed by an increase of 198.66 meters in the total distance covered in the first experimental phase. As for the second replication, the average performance decreased again to 1697.6 meters in the initial phase and increased by 192.4 meters in the experimental phase (see Figure 3). The percentage of non-overlapping data was 66% for the first replication, 100% for the second replication, and 83.3% for the complete

design. The effect size for the first replication was  $\Delta$ -index = 1.58, and for the second replication  $\Delta$ -index = 4.45.

**Figure 3**

*Participant 1: Distance Covered During the Task of Small-sided Games*



#### 6.11.1.2. Participant 2

The results showed that Participant 2 improved the average of his scores in the first experimental phase compared to the initial phase by 118.33 meters. In the second replication, although this participant also improved his performance between the two phases, the increase was only 60.6 meters.

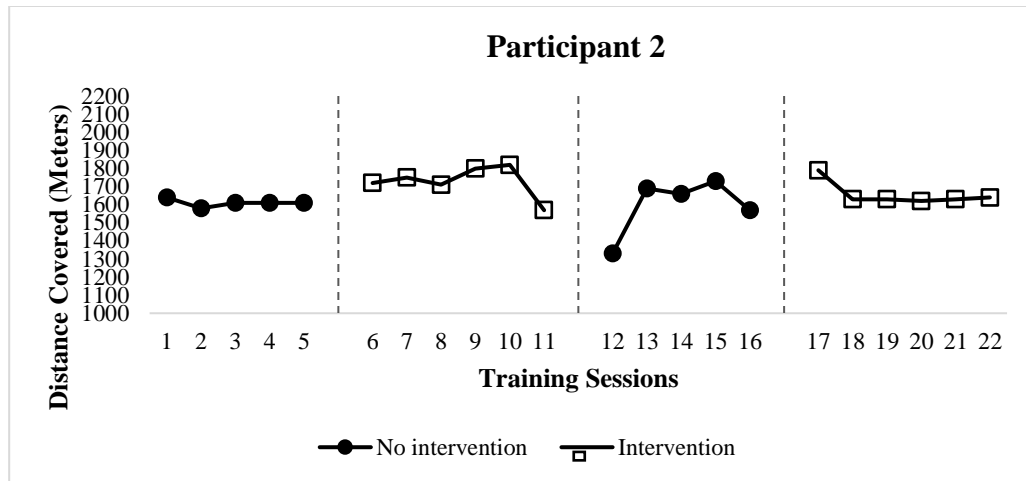
The percentage of non-overlapping data was 83% for the first sequence (A1-B1), 16% for the second sequence (A2-B2), and for both replications taken together, it was 33%. The effect size in the first sequence was high ( $\Delta$ -index = 5.57), while for the second sequence, it was at a low level ( $\Delta$ -index = 0.37).

Overall, even if the participant's scores showed a high effect size in the first sequence, the results show a low impact of the intervention, especially for the second replication. We summarized the data obtained by this participant in Figure 4.



**Figure 4**

*Participant 2: Distance Covered During the Task of Small-sided Games*

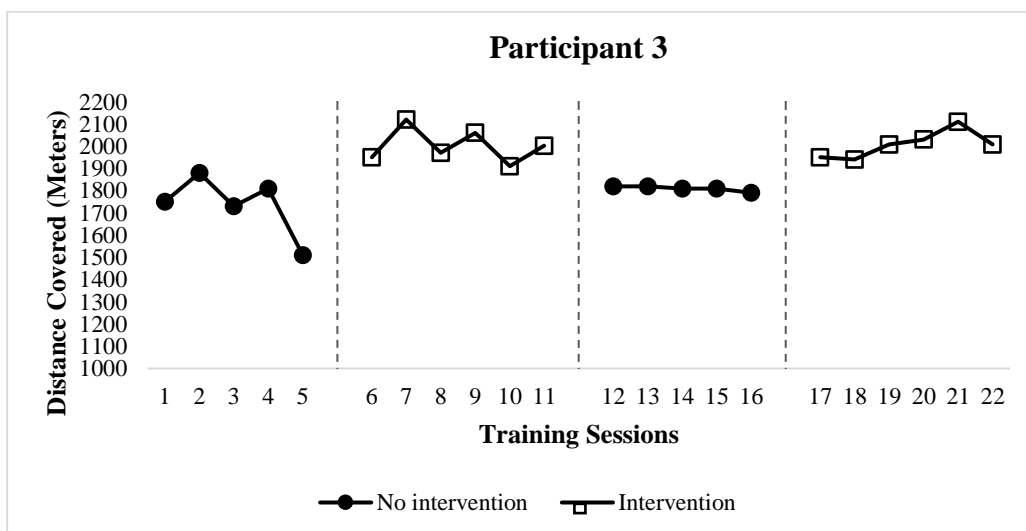


*6.11.1.3. Participant 3*

The results for Participant 3 show a strong effect of the intervention, highlighted by the immediate increase in performance in both experimental phases compared to the initial phases (Fig. 5). The percentage of non-overlapping data was 100% under all analyzed conditions. The effect size for the first replication was of medium level ( $\Delta$ -index = 1.91), while at the second replication, we noticed a high effect size ( $\Delta$ -index = 16.1).

**Figure 5**

*Participant 3: Distance Covered During the Task of Small-sided Games*



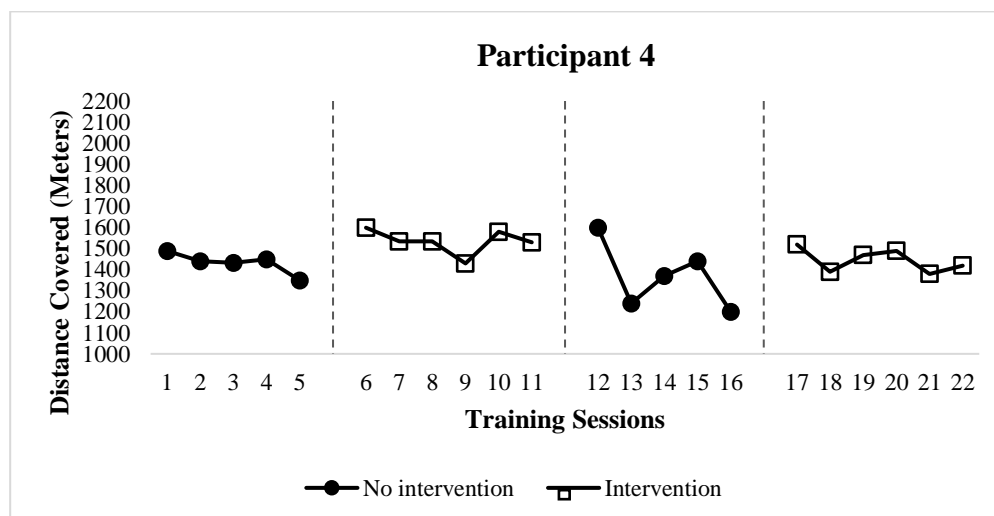
#### 6.11.1.4. Participant 4

For Participant 4, the results indicate an increase in performance in the first experimental phase compared to the conditions in the initial phase. However, the difference between the experimental and initial phases was insignificant for the second sequence of the experiment.

The percentage of non-overlapping data for the first sequence was 83%, but for the second replication, it was 0%, and for the entire data set was 0.08%. The reason for these results was represented by an extreme score that this participant had in the initial second phase. This participant's scores indicate an average effect size for the first replication ( $\Delta$ -index = 2) and a low effect size for the second ( $\Delta$ -index = 0.46). (Fig. 6).

**Figure 6**

*Participant 4: Distance Covered During the Task of Small-sided Games*



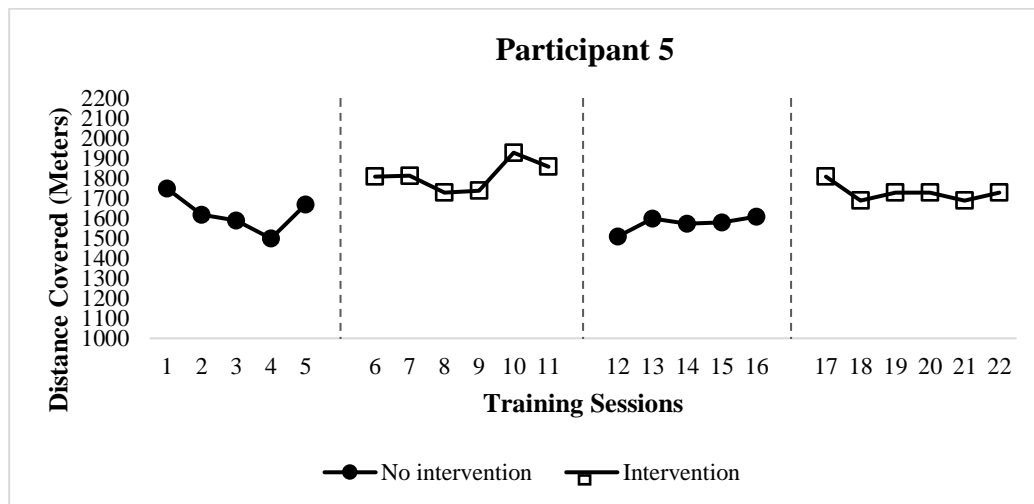
#### 6.11.1.5. Participant 5

For this participant, the observed progress was 188 meters for the first replication and 155 meters for the second. The percentage of non-overlapping data confirms the occurrence of the intervention effect with a score of 66% for the first replication, 100% for the second replication, and 41% for the entire data set.

In addition, the results obtained by this participant reveal an average effect size in the first sequence with an  $\Delta$ -index score = 2.02 and a high effect size in the second sequence with a score  $\Delta$ -index = 3.96. The results obtained by this athlete are presented in Figure 7.

**Figure 7**

*Participant 5: Distance Covered During the Task of Small-sided Games*



### 6.11.2. Social validity

As a result of the analysis of the data which originated from the social validity questionnaire, the results indicate that the participants in the study declared themselves satisfied with the intervention in which they participated ( $M = 5, SD = 0$ ), considered that they put more effort into small-sided games ( $M = 4.5, SD = 0.75$ ), enjoyed participating in the intervention ( $M = 5, SD = 0$ ), would like to participate in such interventions ( $M = 5, SD = 0$ ), and would recommend other athletes to participate in similar interventions ( $M = 5, SD = 0$ ).

Next, we analyzed the data from the semi-structured interviews. Following the application of the protocol recommended by Braun & Clarke (2006), we identified four themes that we classified in order of prevalence of the codes, namely: reasons for the efficiency of the intervention, benefits of the intervention, positive aspects of the intervention and causes for the inefficiency of the intervention and changes proposed by the participants. We later checked the consistency of the identified themes, their clarity, and we considered that they were appropriate.

## 6.12. Discussions

In general, our findings suggest that an intervention package composed of goal setting, public posting, and positive reinforcement improves the total distance covered by youth soccer players during

small-sided games. Participant 1, Participant 3, and Participant 5 improved their performance in both intervention phases compared to the baseline conditions, showing a robust effect of the intervention.

On the other hand, although Participant 2 and Participant 4 improved their performance, the visual analysis indicated that the intervention effect was weaker than the other players, especially for the second sequence. This was unexpected, as these participants had the lowest performance levels in the baseline conditions and had enough room for improvement. Furthermore, Participant 2 and Participant 4 had a second baseline with high variability of scores. A lack of motivation, mood, fatigue, injuries, or other factors could cause this. Another explanation could be the withdrawal of the intervention used in our design, which could mislead participants about the purpose of the study.

The results on the social validity of the intervention are also encouraging and provide prerequisites for applying intervention at a group level. Also, through our observations on the feasibility of the intervention, we wanted to complement the research results and provide an additional argument for applying the intervention in the fundamental research.

### ***6.13. Limits and future directions***

The limits identified in this research were related to the experimental design used, the absences of athletes from training, and the relatively low number of measurements in each phase.

Future research could improve research methodology by increasing the number of measurements in each phase, collecting complete data, or finding more effective methods to treat missing data. Also, in the future, it would be useful to conduct controlled randomized trials that can control for the effect of maturation and other possible confounded variables such as the age of the participants, the training level, motivation, or effort capacity.

Future studies could also contribute to the literature by investigating the extent to which the effects of the intervention are generalized. Also, a future direction of research could be represented by examining how increasing effort during small-sided games can further contribute to long-term effects on athletes' aerobic or anaerobic capacity.

### ***6.14. Conclusions***

Following the conduct of this research, we have drawn the following conclusions:

- All study participants improved their performance in the experimental phases compared to the baseline phases in which they participated;
- The results suggest that the intervention composed of goal setting, public posting, and positive reinforcement is efficient in increasing the distance covered by soccer players during small-sided games;
- In the case of two athletes, even if they have improved their performance in the experimental phases, the results are not conclusive. The reasons for these results may be associated with withdrawal of the intervention specific to the experimental design, injuries, mood, fatigue, or other factors;
- We believe that the research results have high practical and applicative value. They have novelty elements and can contribute to the development of the literature in the domain of the use of small-sided games;
- The social validity of the intervention was at a high level. The athletes considered that the intervention they took part in was efficient and pleasant;
- There is a need for experimental studies at the group level to complement the results of the research. The use of the ABAB design has advantages, such as the possibility to test the intervention at the individual level and the opportunity to control the effect of maturation or training, but also disadvantages, such as the low ability to control for other external variables and to extrapolate the results obtained at the population level;
- The intervention protocol did not raise significant feasibility issues. However, we propose some improvements to it:
  - the difficulty of the objectives to increase by a fixed value, to avoid them being very difficult to achieve towards the end of the intervention;
  - behavioral reinforcements should also be related to short-term objectives, be diversified, and *have a generalized conditional reinforcement* character. To comply with this desideratum, we propose the use of the *token economy*.

## **Summary of Chapter 7. Fundamental research. The effect of small-sided games and a behavioral intervention on the physical, physiological, and motivational parameters of soccer players<sup>3</sup>**

### ***7.1. Theoretical framework***

Several studies have shown the effectiveness of small-sided games in increasing the aerobic capacity of athletes (for a review, see Clemente et al., 2021). However, to be effective, several variables must be successfully manipulated within these games (Sarmiento et al., 2018).

Taking into account the encouraging results of the preliminary research on the use of behavioral modification techniques at the individual level, we considered it appropriate to integrate them into an improved training protocol and applied at the group level. Also, in addition to preliminary research, we found it useful to test the effect of the intervention on several behavioral, motivational, and physiological variables.

### ***7.2. Research questions***

1. Are there physical, motivational, and physiological differences between athletes who participate in an intervention based on small-sided games and athletes who participate in an intervention composed of small-sided games and a behavioral component (monitoring, public posting, goal setting, and positive reinforcement)?
2. Are there any physical, motivational, and physiological differences between the initial and final measurements of the athletes participating in the two interventions?
3. Is there an interaction between the two independent variables ("experimental group" and "repeated measurements") on the dependent variables (total distance covered, total sprint distance, aerobic capacity, task-oriented motivational climate, and ego-oriented motivational climate)?

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<sup>3</sup> This study has been published.

Pop, R.-M., Grosu, V., Grosu, E., Zadic, A., Mățã, L., & Dobrescu, T. (2022). The Effects of Small-Sided Games and Behavioral Interventions on the Physical and Motivational Outcomes of Youth Soccer Players. *International Journal of Environmental Research and Public Health*, 19(21), 14141. <https://doi.org/10.3390/ijerph192114141>

### ***7.3. Objectives***

This research aimed to test the effect of two types of intervention, oriented towards increasing the effort of soccer players during small-sided games, on several physical variables (total distance covered and total sprint distance), motivational variables (task-oriented motivational climate and ego-oriented motivational climate) and a physiological variable (estimated aerobic capacity).

### ***7.5. Research methods***

In our research approach, we used the experimental method and the questionnaire survey method. Through its characteristics, the experiment allows to demonstrate a cause-and-effect relationship between several variables (McQueen & Knussen, 2002). The experimental approach involves, among the conditions, the manipulation of independent variables, the use of control or comparison groups, and the measurement of one or more dependent variables (Millsap & Maydeu-Olivares, 2009).

### ***7.6. Hypotheses***

#### **Total distance covered**

**H<sub>1</sub>(1.1):** Athletes in the experimental group participating in an intervention composed of small-sided games and behavioral techniques will have higher levels of the total distance covered at the end of the intervention than athletes in the experimental group participating in an intervention based solely on small-sided games.

**H<sub>1</sub>(1. 2.):** Athletes who participate in the interventions within the research will have higher levels of the total distance covered at the end of the intervention compared to its beginning.

**H<sub>1</sub>(1. 3.):** The interaction between independent variables "repeated measurements" and "type of intervention" will have a significant effect on the total distance traveled by athletes in small-sided games.

#### **Total sprint distance**

**H<sub>1</sub>(2.1.):** Athletes in the experimental group participating in an intervention composed of small-sided games and behavioral techniques will have higher levels of total sprint distance at the end of the

intervention than athletes in the experimental group participating in an intervention based solely on small-sided games.

**H<sub>1</sub>(2. 2.):** Athletes who participate in the interventions within the research will have higher levels of total sprint distance at the end of the intervention compared to its beginning.

**H<sub>1</sub>(2. 3.):** The interaction between independent variables "repeated measurements" and "type of intervention" will have a significant effect on total sprint distance by athletes in small-sided games.

### **Estimated aerobic capacity**

**H<sub>1</sub>(3.1.):** Athletes in the experimental group participating in an intervention composed of small-sided games and behavioral techniques will have higher levels of aerobic capacity at the end of the intervention than athletes in the experimental group participating in an intervention based solely on small-sided games.

**H<sub>1</sub>(3. 2.):** Athletes who participate in the interventions within the research will have higher levels of aerobic capacity at the end of the intervention compared to its beginning.

**H<sub>1</sub>(3. 3.):** The interaction between independent variables "repeated measurements" and "type of intervention" will have a significant effect on the aerobic capacity of athletes.

### **Task-oriented motivational climate**

**H<sub>1</sub>(4. 1.):** Athletes from the experimental group who participate in an intervention composed of small-sided games and behavioral techniques will have higher levels of task-oriented motivational climate at the end of the intervention than the athletes from the experimental group who participate an intervention based only on small-sided games.

**H<sub>1</sub>(4. 2.):** The athletes who participate in the interventions within the research will have higher levels of task-oriented motivational climate at the end of the intervention compared to the beginning of it.

**H<sub>1</sub>(4. 3.):** The interaction between independent variables "repeated measurements" and "type of intervention" will have a significant effect on the task-oriented motivational climate of athletes.

### **Ego-oriented motivational climate**

**H<sub>1</sub>(5.1.):** Athletes in the experimental group who participate in an intervention composed of small-sided games and behavioral techniques will have lower levels of the ego-oriented motivational climate



at the end of the intervention than athletes in the experimental group participating in an intervention based only on small-sided games.

**H<sub>1</sub>(5. 2.):** The athletes who participate in the interventions within the research will have lower levels of the ego-oriented motivational climate at the end of the intervention compared to the beginning of the intervention.

**H<sub>1</sub>(5. 3.):** The interaction between the independent variables "repeated measurements" and the "type of intervention" will have a significant effect on the ego-oriented motivational climate of athletes.

### ***7.7. Design***

In this research, we used an experimental, two-way mixed design. This design tests the differences between two or more independent groups while the participants are also exposed to repeated measurements (Shaughnessy et al., 2011).

### ***7.8. Variables***

**The independent variable (A)** was the method of intervention, which had two levels:

a<sub>1</sub>) participation in small-sided soccer games and 2) participation in small-sided soccer games, monitoring individual effort, public posting, goal setting, and providing positive reinforcement.

**The independent variable (B)** was the repeated measurements and had two levels:

b<sub>1</sub>) the first measurement (before intervention) and b<sub>2</sub>) the second measurement (after intervention).

**The dependent variables (Y)** of the research were total distance covered (measured on a numerical scale), total sprint distance (measured on a numerical scale), aerobic capacity (measured on a numerical scale), task-oriented motivational climate (measured on an ordinal scale of Likert type) and ego-oriented motivational climate (measured on a Likert-type ordinal scale).

### ***7.9. Research setup***

#### **7.9.1. Participants**

The participants in this research were 16 male soccer players, members of the "U Evolution" Cluj-Napoca youth team. They were aged between 12 and 14 years ( $M = 13.24$ ,  $SD = 0.68$ ), the sample being one of convenience.

### **7.9.3. Period and place**

The research occurred between August and November 2021 in the "Iuliu Hațieganu" Sports Park in Cluj-Napoca.

## ***7.10. Measurements***

The measurement of the dependent variables "total distance covered" and total sprint distance" was made through Playr Football GPS Tracker devices. The measurement of the dependent variable "estimated aerobic capacity" was carried out through the Yo-Yo Intermittent Recovery Test Level 1 (YYIRT1) (Bangsbo et al., 2008). Finally, the dependent variables "task-oriented motivational climate" and "ego-oriented motivational climate" were measured by the *Task and Ego Orientation in Sport Questionnaire* (TEOSQ) (Duda & Nicholls, 1992).

## ***7.11. Procedure***

### **7.11.1. Test approach**

In the first test session, we completed the anthropometric measurements of the athletes. The athletes also completed the questionnaires on the motivational climate and carried out the tests using the Yo-Yo Intermittent Recovery Test Level 1 (YYIRT1) (Bangsbo et al., 2008). In the second and third training sessions, we measured athletes' effort in the task of small-sided games. The athletes participated in four series of small-sided games with a duration of 5 minutes and breaks of 2 minutes and 30 seconds. During these sessions, we measured the total distance covered and the total sprint distance (Catapult Group International Ltd, 2018). Based on the results obtained in the tests, we distributed the participants into two homogeneous groups using the paired sample technique.

### **7.11.2. Experimental groups**

#### ***7.11.2.1. Experimental group 1 (Small-sided games)***

The athletes from this experimental group participated in an intervention based on small-sided games that had the following general characteristics: the duration of intervention was of 12 weeks (22 training sessions) with 2 weekly training sessions assigned to the intervention objectives. We structured the intervention in two phases, each of which had its specific objectives and characteristics, as follows:

### *Phase 1 – increasing the volume of training*

This phase took place for seven training sessions during which the athletes practiced small-sided games 4 vs. 4 with a duration of 5 minutes and duration of breaks of 2 minutes and 30 seconds. The size of the pitch was 40 meters long and 22 meters wide (110 m<sup>2</sup>/ player). To increase the volume, we used in the first training four series of small-sided games, in the following four workouts between 4 and 6 series, and in the last two workouts we used six series.

### *Phase 2 – increasing the intensity and reducing the volume of training*

This phase lasted for nine training sessions, and to increase the intensity, we used 2 vs. 2 small-sided games. Another strategy used in this phase was increasing the pitch's size. Thus, we used in the first five sessions pitches with the size of 28 meters long and 16 meters wide (112 m<sup>2</sup>/ player), and in the subsequent four sessions, we used pitches with an area of 40 meters long and 16 meters wide (160 m<sup>2</sup>/player). Finally, we used the manipulation of the exercise-rest ratio as a final strategy, by increasing it in the last workouts. The protocol was developed considering the literature recommendations (Clemente, 2016; Dost et al., 2016; Strudwick, 2016).

#### *7.11.2.2. Experimental group 2 (Small-sided games + behavioral intervention)*

Within this experimental group, the athletes participated in the same training protocol, respecting each variable and following precisely the two phases described above. However, the intervention of the athletes within this group had in its composition, in addition to the small-sided games, a component of behavioral modification composed of monitoring, goal setting, public posting, and positive reinforcement.

#### ***Behavioral monitoring***

To monitor the athletes' behavior, we used two statistics related to the physical effort: the total distance covered and the total sprint distance. The monitoring occurred during each training session and was carried out with GPS devices.

#### ***Public posting***

The results obtained by the athletes within this group were downloaded at the end of each training in the Catapult One mobile application and transferred to a table. This data was displayed publicly, near the reserve bench, in plain sight for all team members. In other studies that used public posting, the researchers displayed the results in the locker room, but due to the restrictions imposed

by the COVID-19 pandemic, the athletes who participated in our research did not use the locker room (Schonwetter et al., 2014; Smith & Ward, 2006).

### ***Goal setting***

To set goals, we used a dual approach, setting both goals at the individual level and the group level. We have selected the initial goals for each athlete within this group under the results obtained in the initial testing at the aerobic capacity test and in the small-sided games. In situations where we noticed that the goals were not suitable for some athletes, we adjusted them. We calculated the initial value of the goals at a level 10% higher than the performance from the initial measurements. Goals related to the total distance covered increased by 100 meters each time an athlete met them, and those related to the total sprint distance by a value of 10 meters when they were met. On the other hand, the objective at the group level was achieved if at least 10 of the 16 individual goals were met by the athletes.

### ***Positive reinforcement***

Following the preliminary research, we concluded with the need to use reinforcements correlated with both short-term and long-term goals, the reinforcements to be diversified and have a generalized character. To reward the desirable behavior of the athletes, we used three types of behavioral reinforcements: praise, offering the captain's armband, and token economy.

The token economy was contingent on goal setting, so for each goal achieved by the athletes, they would receive one point, and if the athletes also met the group goal, the points would double. Subsequently, athletes could exchange points for certain favorite objects or activities at a predetermined cost. These are called backup reinforcements in the literature (Miltenberger, 2015).

## ***7.12. Data analysis***

We used multiple mixed two-way ANOVA tests to analyze data. These were carried out to test the effect of the two types of intervention on each individual dependent variable: total distance covered, total sprint distance, aerobic capacity, task-oriented motivational climate, and ego-oriented motivational climate.

### 7.13. Results

#### 7.13.4.1. Total distance covered

The results (Table 41) show a significant effect of the interaction of independent variables on the dependent variable "total distance covered" ( $F(1,14) = 6,235$ ;  $p = 0.026$ ;  $\eta p^2 = 0.308$ ).

**Table 41**

*Analysis of variance for the variable "Total distance covered"*

Dependent variable	Degrees of freedom	Sum of squares	<i>F</i>	<i>p</i>	$\eta p^2$
Total distance covered	1	607477.531	23.921	0.000	0.631
Type of intervention	1	239951.281	8.459	0.011	0.377
Total distance × Type of intervention	1	158343.781	6.235	0.026	0.308

#### 7.13.4.2. Total sprint distance

For the dependent variable "total sprint covered", we can see in Table 42 that the results of the mixed two-way variance analysis also show a statistically significant interaction effect of the independent variables ( $F(1,14) = 4,781$ ;  $p = 0.046$ ;  $\eta p^2 = 0.255$ ).

**Table 42**

*Analysis of variance for the variable "Total sprint distance"*

Dependent variable	Degrees of freedom	Sum of squares	<i>F</i>	<i>p</i>	$\eta p^2$
Total sprint distance	1	21632.000	24.437	0.000	0.636
Type of intervention	1	3741.125	1.946	0.185	0.122
Total sprint × Type of intervention	1	4232.000	4.781	0.046	0.255

#### 7.13.4.3. Aerobic capacity

On the other hand, looking at Table 43 we can see that for "aerobic capacity" the interaction of independent variables was not significant ( $F(1,14) = 2,861$ ;  $p = 0.113$ ). However, the results showed a high effect size ( $\eta p^2 = 0.170$ ). Also, the main effect of the independent variable "repeated

measurements" shows that athletes have improved their performance in the post-test condition compared to the pre-test ( $F(1,14) = 47,002; p < 0.001; \eta p^2 = 0.770$ ).

**Table 43**

*Analysis of variance for the variable "Aerobic capacity"*

<b>Dependent variable</b>	<b>Degrees of freedom</b>	<b>Sum of squares</b>	<b>F</b>	<b>p</b>	<b><math>\eta p^2</math></b>
Aerobic capacity	1	115.520	47.002	0.000	0.770
Type of intervention	1	14.851	1.070	0.318	0.071
Aerobic capacity $\times$ Type of intervention	1	7.031	2.861	0.113	0.170

#### *7.13.4.4. Task-oriented motivational climate*

For the dependent variable "task-oriented motivational climate" the mixed two-way ANOVA test indicates that the results are not significant in the case of the interaction effect ( $F(1,14) = 0.014; p = 0.908; \eta p^2 = 0.001$ ), nor in the case of the main effect of the independent variable "repeated measurements" ( $F(1,14) = 1,110; p = 0.310; \eta p^2 = 0.073$ ), or of the independent variable "type of intervention" ( $F(1,14) = 0.021; p = 0.886; \eta p^2 = 0.002$ ). Table 44 shows the results of the analysis of variance for this variable.

**Table 44**

*Analysis of variance for the variable "Task-oriented motivational climate"*

<b>Dependent variable</b>	<b>Degrees of freedom</b>	<b>Sum of squares</b>	<b>F</b>	<b>p</b>	<b><math>\eta p^2</math></b>
Task-oriented	1	0.052	1.110	0.310	0.073
Type of intervention	1	0.006	0.021	0.886	0.002
Task-oriented $\times$ Type of intervention	1	0.001	0.014	0.908	0.001

#### *7.13.4.5. Ego-oriented motivational climate*

As we can see in Table 45, the results were not statistically significant for the dependent variable "ego-oriented motivational climate", nor in the case of interaction ( $F(1,14) = 0.175; p = 0.682; \eta p^2 = 0.012$ ), nor in the case of the main effect of the independent variable "repeated measurements"

( $F(1,14) = 0.013$ ;  $p = 0.911$ ;  $\eta^2 = 0.001$ ], or of the main effect of the independent variable "type of intervention" ( $F(1,14) = 0.960$ ;  $p = 0.344$ ;  $\eta^2 = 0.064$ ).

**Table 45**

*Analysis of variance for the variable "Ego-oriented motivational climate"*

<b>Dependent variable</b>	<b>Degrees of freedom</b>	<b>Sum of squares</b>	<b><i>F</i></b>	<b><i>p</i></b>	<b><math>\eta^2</math></b>
Resulting climate	1	0.008	0.013	0.911	0.001
Type of intervention	1	0.945	0.960	0.344	0.064
Resulting climate $\times$ Type of intervention	1	0.105	0.175	0.682	0.012

#### 7.14. Discussions

The first dependent variables tested were the *total distance covered* and the *total sprint distance*, measured using the Playr Catapult GPS devices. Concerning these variables, the results indicated that athletes who participated in an intervention composed of small-sided games and behavioral modification techniques had significantly greater progress than those who participated in an intervention consisting only of small-sided games at the end of the intervention compared to the beginning of it. The fact that athletes have improved both their total distance covered and the total sprint distance during small-sided games suggests a significant increase in the effort made by the athletes from the second experimental group.

In terms of the dependent variable *aerobic capacity*, there were no significantly different results between the two experimental groups in the final testing compared to the initial testing. But even though the results did not show a significant interaction effect ("group"  $\times$  "repeated measurements"), they revealed a meaningful effect size. We believe that the main reasons for the lack of significance of the effect of the interaction are the small size of the sample and the estimation of aerobic capacity based on a field test. In addition, the results showed a positive effect of the independent variable "repeated measurements", so both experimental groups significantly improved their performance in post-test measurements compared to the pre-test condition.

We also expected the results to reveal differences between groups for the two types of motivational climates. However, the results did not reveal any significant differences between the

groups. Possible reasons for the lack of significance of the results may be related to the use of questionnaires or the stability of the motivational climate, learned over the years and further strengthened by coaches and parents.

A strong point of this intervention was the implications it could have within the theory of sports training. On the other hand, the proposed intervention program can be difficult to implement in youth soccer at present due to the necessary resources. However, GPS sensors are being used more and more frequently in professional teams, they are becoming accessible, and we expect that these devices will be used more often also in the case of young athletes (Rana & Mittal, 2021).

### ***7.15. Limits and future directions***

Among the main limits identified in this research were: the use of a sample of convenience, the low number of study participants or the use of indirect measurements for aerobic capacity and for the two types of motivational climate. Future studies should overcome these limitations by using tools with a high degree of objectivity and by replicating the study under various conditions and with a higher number of participants.

### ***7.16. Conclusions***

The conclusions of this research were the following:

- For the dependent variable "total distance covered" the interaction effect was significant, and this suggests the more pronounced effect of the combined intervention compared to the intervention consisting of small-sided games;
- Similarly, the variable "sprint distance" indicated a significant interaction effect ("repeated measurements" × "type of intervention"), suggesting the higher efficiency of the combined intervention compared to the single intervention;
- Analysis of the variable "aerobic capacity" on the other hand, did not reveal a significant interaction effect of independent variables. However, analysis of the effect size revealed meaningful values of the results. We believe that the lack of significance of the interaction can be explained by the low number of study participants or by the estimation of this variable using an indirect measurement of aerobic capacity.



- Also, even if there were no differences between the groups, the results indicate a significant increase in aerobic capacity, both in the experimental group "small-sided games" and in the experimental group "small-sided games + behavioral intervention" at the end of the intervention;
- On the other hand, in the case of the variable "task-oriented motivational climate", the results did not show significant differences between the experimental conditions;
- In addition, even for the "ego-oriented motivational climate", the results were not significant. We consider that the lack of significance in the case of the two types of motivational climate can be attributed to the use of questionnaires and the stable nature of motivation reinforced by other relevant people in the lives of young athletes;
- The interventions tested have the advantage of bringing a plus to the practice of using small-sided games with high intensity to develop aerobic capacity;
- However, more studies are needed to explore and confirm the results achieved and further investigate the complex link between motivation, effort, and effort capacity in the context of small-sided games;
- Among the limits of this research, we identified the use of a sample of convenience, the low volume of the sample, the use of indirect measurements of the motivational climate and aerobic capacity, or the use of a comparison group that participated in an alternative intervention. Future research should replicate this study under various conditions and try to exceed the identified limits.

### **Own contributions and the limits of the work**

A first contribution of this work was the writing of a novel systematic review on the use of goal setting to improve athletes' performance. The writing of this review also allowed us to achieve an effective goal setting protocol due to the deepening of the theme and the choice of experimental designs suitable for the field.

Another novelty element refers to the dual approach used with the help of the two types of experimental design, investigating the effects of interventions both at the individual level (single-subject experimental design) and at the group level (experiment). In addition, in terms of data analysis, we used various methods such as visual data inspection (Barker et al., 2011), thematic analysis (Neuendorf, 2016), and mixed two-way variance analysis (Field, 2013).

We believe that we have contributed to the development of the literature also by conducting a questionnaire and a semi-structured interview to investigate the social validity of the intervention.

The use of GPS devices to monitor athletes' physical exertion is becoming increasingly present in sports training (Malone et al., 2017). However, our research was the first to use these devices as part of a behavioral intervention to increase the intensity of small-sided games.

We appreciate that the main limitation of this Ph.D. thesis was represented by the low number of participants in the experimental studies we carried out. The main reason for the low number of participants was related to the limited number of GPS devices available. Our intervention involved behavioral monitoring during each training, and to achieve this desideratum, we needed a GPS device for each athlete.

An important limitation of this work was represented by the age differences of the athletes who participated in the two investigations. These differences were caused by the epidemiological measures taking place, which appeared in response to the COVID-19 pandemic. The sports teams have shown reluctance to participate in the intervention, and our protocol has been adapted to comply exactly with the epidemiological measures established by the health authorities. Other limits were related to using convenience samples, assessing motivation by subjective measurements (questionnaire), or evaluating aerobic capacity by indirect measures (field test). It is also worth mentioning the inherent limitations imposed by the experimental designs used.

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