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SUCCESS AND FAILURE OF DRIBBLING IN FUTSAL AND FOOTBALL BASED ON REACTION TIME AND ANTICIPATION

USPEŠNOST IN NEUSPEŠNOST PREIGRAVANJA V FUTSALU IN PRI NOGOMETU NA PODLAGI REAKCIJSKEGA ČASA IN PREDVIDEVANJA

ABSTRACT

This study investigated if the dribbling performance in sports of futsal and football depends on the defender's reaction time (RT) or anticipation. Participants were futsal (n = 59) and football (n = 45) male players competing in Brazilian National and State amateur championships in 2020. One hundred and thirty dribbles (futsal, n = 77; football, n = 53) registered during official matches were selected for analysis. The beginning times of the defender's response above and below 200ms from the attacker's dribbling stimulus were used to define reaction time and anticipation, respectively. Successful dribbles are those in which the defender is not able to prevent the attacker in possession of the ball overtake him/her. On the other hand, unsuccessful dribbles are those in which the defensive player manages to prevent the attacker from overtaking him/her with possession of the ball. Results showed that reaction time and anticipation were not determining factors for successful and unsuccessful dribbling in the sport of futsal, respectively. However, reaction time results provided supporting evidence for explaining the successful dribbling in the sport of football. This finding suggests that to succeed in dribbling the attacker should try to delay the start of the defender's response.

Keywords: dribbling, futsal, football, reaction time, anticipation

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IZVLEČEK

V tej študiji smo poskušali ugotoviti, ali je uspešnost preigravanje v futsalu in pri nogometu odvisna od reakcijskega časa (RT) ali predvidevanja branilca. Udeleženci študije so bili moški igralci futsala (n = 59) in nogometa (n = 45), ki so leta 2020 tekmovali v brazilskih nacionalnih in državnih amaterskih prvenstvih. Za analizo je bilo izbranih sto trideset preigravanj (futsal, n = 77; nogomet, n = 53), registriranih med uradnimi tekmami. Za opredelitev reakcijskega časa oziroma predvidevanja sta bila uporabljena začetna časa odziva branilca nad in pod 200 ms od začetka preigravanje napadalca. Uspešna preigravanja so tisti, pri katerih branilec ne uspe preprečiti, da bi ga napadalec v posesti žoge prehitel. Po drugi strani pa so neuspešna preigravanja tista, pri katerih obrambnemu igralcu uspe preprečiti, da bi ga napadalec v posesti žoge prehitel. Rezultati so pokazali, da reakcijski čas in predvidevanje nista odločilna dejavnika za uspešno oziroma neuspešno preigravanje v futsalu. Rezultati reakcijskega časa pa so bili podporni dokaz za razlago uspešnega preigravanja pri nogometu. Ta ugotovitev nakazuje, da bi moral napadalec za uspešeno preigravanje poskušati odložiti začetek branilčevega odziva pri nogometu.

Ključne besede: futsal, predvidevanje, nogomet, reakcijski čas, preigravanje

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INTRODUCTION

In the last few years, research has been developed to understand one of the motor skills that most calls attention in both futsal and football sports: dribbling (Amaral & Garganta, 2005; Corrêa et al., 2016; Duarte et al., 2010). This motor skill consists of the player in possession of the ball overtaking the opponent, often deceiving him (Corrêa et al., 2016). Dribbling has also been viewed as an attacking player's adaptation mechanism because it is used for modifying the game dynamic (Corrêa et al., 2016). For example, when dribbling is successful, it results in a numerical advantage between players such as 2 vs. 1 or 3 vs. 2 situations; moreover, successful dribbling can increase the chances of an attacker to create goal scoring opportunities.

Previous research has sought to identify the type of dribbling (Amaral & Garganta, 2005) and the variables constraining its decision-making in futsal (Corrêa et al., 2016) and football (Duarte et al., 2010). The findings of these studies have shown that: (i) futsal players perform dribbles for protecting, passing, progression and shooting, these latter being the most and less frequent, respectively; (ii) decision on dribbling in futsal is made based on uncertainty of successfully completing a passing or shooting or the risk of the ball being recovered by the defender; (iii) critical values of interpersonal distance and relative velocity constrain the dribbling performance in sport of football.

Notwithstanding these advancements in knowledge about the dribbling performance in sports of futsal and football, the identification of the key variables of its success still needs to be investigated. On this concern, Tani (2004, 2016) have proposed that the temporal organization of the relationship between the attacker and defender is the core of the dribbling success. Specifically, it has been proposed that reaction time (RT) is the variable explaining the success of dribbling, as well as anticipation is the variable explaining the failure of dribbling. Successful dribbles are those in which the defender is not able to prevent the attacker in possession of the ball overtake him/her. On the other hand, unsuccessful dribbles are those in which the defensive player manages to prevent the attacker from overtaking him/her with possession of the ball (Corrêa et al., 2016).

It is longstanding that RT has been considered as an important variable for countless performances, mainly because of the information processing mechanisms underlying the execution of motor skills, that is, stimulus identification, response selection and response programming (e.g., Henry & Rogers, 1960; Oxendine, 1968). RT refers to the time interval between the presentation of a stimulus (e.g., attacker movement) and the beginning of the

response (e.g., defender movement). The reasoning here is that the success of dribbling implies attacking player makes it difficult to organize the defender's response so that the RT is insufficient for the response to be successfully completed (Tani, 2004). For instance, an increased defender's RT implies a high probability that the response be initiated when the attacker is finishing the stimulus or even starting another one.

The RT magnitude is influenced by the stimulus characteristic (Edwards, 2010; Magill & Anderson, 2017; Schmidt et al., 2019; Spittle, 2021). When RT involves only one stimulus and one response it is considered simple. For example, in order to dribble, a player in possession of the ball could move toward the defender and suddenly change it. In this case, only one stimulus would have been provided by the attacker (change of direction), which would involve only one response from the defender as well: change of direction. RT can also be of choice by involving more than one stimulus presented simultaneously, each one requiring one specific response. For example, when approaching the defender, attacker could push the ball so that it would pass through the left side of the defender while moving through the right side (*drible da vaca*). In this case, defender would have to choose to respond to the movement of the attacker or to the ball displacement. Still, there is a phenomenon named refractory psychological period (RPP), which refers to the response delay to the second stimulus when two stimuli are presented sequentially in a short period (Schmidt et al., 2019). For example, attacker moving towards the defender could present a false stimulus such as stepping to the right side as if he/she was going to move there and, when the defender started to respond, attacker would provide the second (true) stimulus moving from suddenly to the left side. Thus, the defender would have difficulty in changing his/her initial response quickly to respond to the true stimulus. It has been predicted that simple RT is shorter than choice RT that, in turn, is shorter than RT from RPP (Edwards, 2010; Honeybourne, 2006; Magill & Anderson, 2017; Spittle, 2021).

On the other hand, the situation in which defender is not dribbled would involve his/her ability to anticipate attackers' stimuli (Tani, 2016). Anticipation involves predicting an event that is about to happen in the environment, as well as when and where it will happen (Abernethy et al., 1999; Schmidt, 1968; Silva et al., 2021; Williams et al., 2011). This is an important ability for performance in football and futsal, since the game dynamic requires that players constantly deal with possibilities for future actions (Gonçalves et al., 2015).

However, it is precisely the fact that the game is dynamic that makes anticipation not an easy task, since players usually make decisions to anticipate in a short period of time (Gould et al.,

1993; Williams et al., 2018), which can lead to errors (Silva et al., 2021). Therefore, anticipating involves identifying environmental cues even before the stimulus is presented, so that the RT is considerably reduced in advance of information processing activities (Gredin et al., 2018; North et al., 2011; Poulton, 1957; Rosenbaum, 1980; Roca et al., 2011; Tani, 2016; Williams & Davids, 1998; Williams et al., 2011; Williams & Jackson, 2019). For example, in the study by Williams and Davids (1998), football players should anticipate the dribbling direction in a 1 vs. 1 simulation. Players should imagine themselves as defenders in the penalty area and watch the attacking player on a dribbling screen. The results revealed that the players were able to accurately anticipate the dribbling direction. In a similar vein, North et al. (2011) found that skilled football players were able to anticipate the passing direction when the passing sequence was occluded.

The RT and anticipation manifest in milliseconds (msec) differently for each sensory system (Cordo & Flanders, 1989; Edwards, 2010; Magill & Anderson, 2017; Schmidt et al., 2019; Senel & Eroglu, 2006; Spittle, 2021). For instance, Ruschel et al. (2011) showed that visual RT of amateur and professional football players were 204ms and 190ms, respectively. Although there may be influence of the context (e.g., laboratory vs. real world) or task specificity (e.g., type of sport), values around 200 msec have been accepted as a reference for inferring about information processing after (above 200 msec = RT) or before (below 200 msec = anticipation) the stimulus has been presented (Edwards, 2010; Magill & Anderson, 2017; Schmidt et al., 2019; Spittle, 2021).

Based on the foregoing, this study sought to investigate the hypotheses that the successes and failure of dribbling would be related, respectively, to the defender's RT and anticipation in futsal and football. It was expected that more successful dribbles would be observed in situations involving defender's RT than unsuccessful dribbles. On the other hand, the dribbles involving defender's anticipation would be more unsuccessful than successful.

METHODS

Participants

Regarding the sport of futsal, participants were fifty-nine voluntary players from futsal teams of two Brazilian schools (M = 15.67 years; SD = 0.46), male, who played five matches of under-16 category according to the regulations of the São Paulo Futsal Federation. Concerning the

football, forty-five football players, male, from teams that competed in the National and State Championships in 2020 in the under-17 and adult categories. Participation required written consent from the adults' players and adolescents' parents or legal guardians. The research protocol was approved by the local Institutional Review Board for the protection of human subjects procedures should follow the standards of the Helsinki Declaration of 1975.

Procedures

The matches were recorded using digital cameras (GoPro HEROS3; frequency = 120 Hz). In the futsal matches they were located above and behind the bottom line of the futsal court and the other above and in the middle of the court, which had dimensions of 17m x 26m. And, in the football matches they were positioned laterally to the football field, which had dimensions from 68m to 116m.

From these recordings, the dribbles performed by the futsal (n = 77) and football players (n = 53) were randomly selected and edited from the moment that ball carrier started the first dribbling movement until the moment that defender started the first response movement. The dribbles ranged from 59 to 775ms (futsal), and from 51 to 517ms (football). Two futsal experts and two football experts with extensive experience as athlete and coach evaluated the sequences of dribbling in slow motion (frequency = 5 Hz) or manually using the computer's forward or backward keys through KINOVEA 0.8.15 software. They considered the following items: (a) what was or what were the stimuli (true and /or false) that characterized the dribble; (b) when dribble started; and, (c) when the defender's response started. Subsequent analyses by Pearson's test revealed high reliability between evaluators for futsal [(a) $r = 0.92$, $p < 0.05$; (b) $r = 0.89$, $p < 0.05$; and (c) $r = 0.78$, $p < 0.05$, respectively] and football [(a) $r = 0.83$, $p < 0.05$; (b) $r = 0.89$, $p < 0.05$; e, (c) $r = 0.89$, $p < 0.05$, respectively].

Data analyses

The time interval between attacker and defender movements ranged from 0 to 467ms (futsal), and from 91 to 310 ms (football). Based on the 200 ms cutoff value. for the futsal anticipation dribbles (n = 38) ranged from 0 to 192 ms and RT dribbles (n = 39) ranged from 208 to 467 ms. For the football, anticipation dribbles (n = 30) ranged from 91 to 200 ms and RT dribbles (n = 23) ranged from 202 to 310 ms.

The Chi-square test was carried out for verifying if there was difference between observed and expected frequencies of successful and unsuccessful anticipation and RT dribbles. For this

purpose, the expected frequencies *(ef)* for each variable were compared to observed frequencies *(of)* using the following equation: $\chi^2 = \sum ({}_{o}f - {}_{e}f)^2 / {}_{e}f$. To obtain the tabulated Chi-square values, the number of degrees of freedom was determined using the following formula: $df = k - 1$, where k refers to the number of frequency categories observed and df are the degrees of freedom. Significant difference was considered when the observed Chi-square value was greater than the tabulated Chi-square value by considering $p < .05$ (Levin et al., 2012).

In addition, a multivariate analysis of variance (MANOVA) was run to verify if the time interval between attacker and defender movements (anticipation and RT) and dribbling outcome (successful and unsuccessful) would interact with movement time (time between defender's starting and ending of the movement response) and interpersonal distance (distance between attacker and defender at the starting of dribbling) as two dependent variables. Finally, a Kruskal-Wallis test was conducted in order to verify if RT value would be influenced by the characteristic of the dribbling stimulus, that is, simple, choice or RPP dribbles. These tests were receded by Shapiro-Wilk's W and Bartlett's tests of normality and homogeneity of variance. For all analyses, the level of significance was set at $p < .05$, using STATISTICA® 13.0 software - Stat Soft Inc., Tulsa, USA.

RESULTS

Futsal

Table 1 shows the absolute frequencies of occurrence of the successful and unsuccessful anticipation and RT dribbles of futsal. It shows that both successful anticipation and RT dribbles were greater than their respective unsuccessful dribbles. The Chi-square tests revealed the following results: anticipation dribbles ($\chi^2 = 6.72$, $df = 1$, $p < 0.05$); RT dribbles ($\chi^2 = 0.64$, $df = 1$, $p > 0.05$).

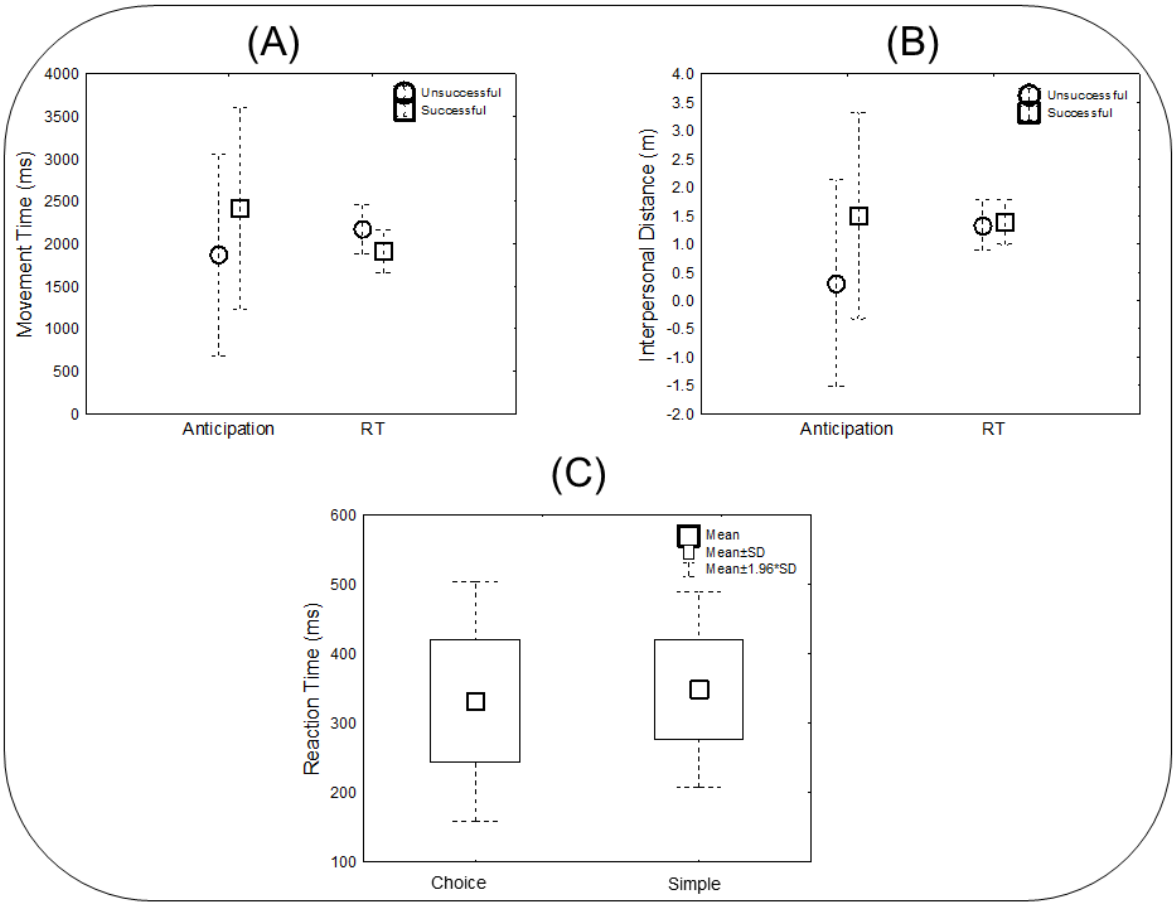
Table 1. Absolute frequencies of occurrence of the successful and unsuccessful anticipation and RT dribbles of futsal.

DRIBLING OUTCOME	ANTICIPATION	RT	TOTAL
Successful	27*	22	49
Unsuccessful	11	17	28
TOTAL	38	39	77

(*) Significant difference

Regarding the interaction of time interval and dribbling outcome with movement time and interpersonal distance, Figure 1A shows that unsuccessful anticipation dribbles had smaller movement time than the successful ones and that unsuccessful and successful RT dribbles had similar movement time. Similar results can be observed in the Figure 1B in relation to the interpersonal distance. However, the MANOVA did not revealed interaction effect [Wilks' λ = 0.96, $F(2, 36) = 0.77$, $p = 0.47$, $\eta p^2 = 0.04$, observed power = 0.17].

Figure 1. (a) Means movement time of successful and unsuccessful early and successful dribbles, (b) means interpersonal distance of successful and unsuccessful early and successful dribbles, and (c) means reaction time of simple and successful dribbles choice.



Concerning the RT characteristics, Figure 1C shows similar values for dribbling involving that simple RT and choice RT. No dribbling involving RPP were observed. A Kruskal-Wallis test did not revealed difference among values of simple RT, choice RT and RPP-RT [H (1, N = 39) = 0.51, $p = 0.47$].

Football

Table 2 shows the absolute frequencies of occurrence of the successful and unsuccessful anticipation and RT dribbles of football. It shows that frequency of unsuccessful anticipation dribbles was greater than that of successful dribbles. Also, frequency of successful RT dribbles was greater than that of unsuccessful dribbles. The Chi-square tests revealed the following results: anticipation dribbles ($\chi^2 = 3.76$, $df = 1$, $p > 0.05$); RT dribbles ($\chi^2 = 5.26$, $df = 1$, $p < 0.05$).

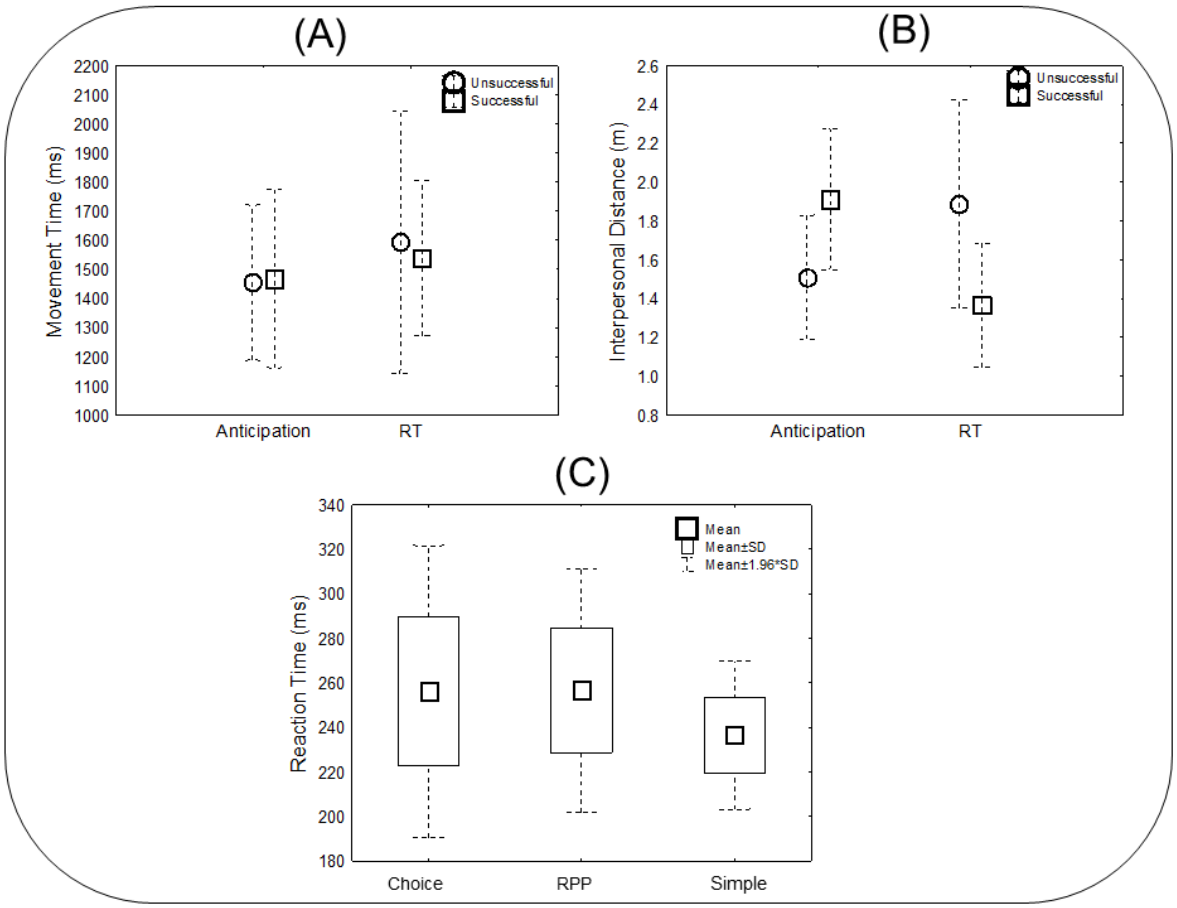
Table 2. Absolute frequencies of occurrence of the successful and unsuccessful anticipation and RT dribbles of futsal.

DRIBLING OUTCOME	ANTICIPATION	RT	TOTAL
Successful	13	17*	30
Unsuccessful	17	6	23
TOTAL	30	23	53

(*) Significant difference

Regarding the interaction of time interval and dribbling outcome with movement time and interpersonal distance, Figure 2A shows that unsuccessful and successful anticipation and RT dribbles had similar movement time. Figure 2B shows that unsuccessful anticipation dribbles had smaller interpersonal distance than the successful ones. Inversely, successful RT dribbles had smaller interpersonal distance than the unsuccessful ones. However, the MANOVA did not revealed interaction [Wilks' $\lambda = 0.89$, $F(2, 48) = 2.69$, $p = 0.07$, $\eta p^2 = 0.10$, observed power = 0.51].

Figure 2. (a) Means movement time of successful and unsuccessful early and successful dribbles, (b) means interpersonal distance of successful and unsuccessful early and successful dribbles, and (c) means reaction time of simple and successful dribbles choice.



Concerning the RT characteristic, Figure 2C shows similar values for dribbling involving that choice RT and RPP-RT, which were greater than simple RT. A Kruskal-Wallis test did not revealed difference among values of simple RT, choice RT and RPP-RT [H (2, N= 23) = 1.93, p = 0.38].

DISCUSSION

This study investigated whether successful and unsuccessful futsal and football dribbles were related to the defenders' RT and anticipation, respectively. It was expected that more successful dribbles would be observed in situation involving RT than unsuccessful dribbles. On the other hand, the dribbles involving anticipation would be more unsuccessful than successful. Regarding the successful dribbles, the foregoing expectations were partially met since the results showed that the number of successful dribbles involving RT in sport of football was

greater than that of unsuccessful dribbles. In this case, it can be thought that the football successful dribbles may have negatively affected the defender's response temporal organization to the point he was unable to respond adequately (e.g., correctly or on time) to the attacker's stimuli (Tani, 2004).

However, results also showed no differences between the amount of successful and unsuccessful RT dribbles in sport of futsal. In this case, a possible explanatory hypothesis could be related to the defender's movement time. That is, although the beginning of the defender's response had involved RT, it would be possible that the defender managed to finish it together or even before the attacker had completed the dribble. In addition, it would be reasonable to infer that even involving RT, the success of dribbling might be compromised if the attacker-defender interpersonal distance is small. This is because even starting a delayed response, the defender would be able to block the dribble due to his proximity to the attacker. However, both these explanation hypotheses were not supported by the results, as no interaction was found between movement time, interpersonal distance and dribbling outcome. By the end, it is possible to suggest that RT was not enough to delay the futsal defender's response. Nevertheless, this requires future studies. In sum, the present results suggest that the futsal successful dribbles can not be explained by RT.

Regarding the unsuccessful dribbles, contrary to our expectations the results revealed that in sport of futsal most dribbles involving anticipation were successful. And, in football they revealed no differences between successful and unsuccessful dribbles. Therefore, these results indicate that anticipation was not an adequate decision for avoiding the dribbles. It may be that the defenders relied on false stimuli emitted by the attackers to deceive them. Thus, it may be that the defenders have not been able to distinguish between the attackers' true and false stimuli. On the other hand, it is possible that the attackers took advantage of the inaccurate anticipated actions performed by the defender, and then, the attacker performed the dribble, precisely to provoke the need to the defender to correct his anticipated movements, which is very difficult to do and to recover the lost time (Tani, 2004). Similar to the goalkeepers' performances, it seems that when the anticipation is wrong it can represent an irreparable cost for the performer (Savelsbergh et al., 2005; Silva et al., 2021).

In the case of perceiving and using the wrong stimulus instead of the correct one, it could be expected differences in relation to the types of dribbling. As described above, while simple dribbling involves a single stimulus and a single response, choice and PPR dribbles involve two

or more stimuli (e.g., a wrong stimulus and a correct stimulus) and respective possible responses. However, the results did not reveal differences among of simple, choice and PPR RTs. In sports of futsal and football, the similarity between the RTs of different types of dribbling can be explained based on experience. That is, players who practice the sport and have appropriate knowledge, especially on dribbling, would be able to improve their RT of choice, being competent to recognize the skill through the initial movements and thus, minimizing the delay in their RT (Tani, 2016).

The present results do not corroborate those from studies involving anticipation in sport of football, in which players presented a higher number of anticipated actions and were more accurate in their anticipations (e.g., Bishop et al., 2013; Gredin et al., 2018; North et al., 2011; Roca et al., 2011; Ruschel et al., 2011; Ward & Williams, 2003; Williams & Davids; 1998). However, it is important to consider that these studies were carried out in artificial experimental environment, unlike that of the game context in which the information takes on another (real) meaning. In this latter, the demand for anticipation is greater because players have to constantly deal with countless possibilities for future actions (Fajen, Riley, & Turvey, 2009; Gonçalves et al., 2015; Silva et al., 2021; Williams et al., 2018). We chose this method because investigating an artificial situation might deviate from the true conditions that happen in a game. Conflicting results may be explained by these procedures, in which dribbling and not to be dribbled were analyzed during a match, and not in a simulate situation. Our findings suggest that in real conditions other factors may be important in explaining the dribble outcome. In summary, based on the results it can be said that unsuccessful dribbles in both futsal and football were not related to anticipation.

CONCLUSION

The findings of the present study allow us to conclude that the RT and the anticipation were not those determining factors, respectively, for explaining the successful and unsuccessful dribbling in the sport of futsal. In the sport of football, however, successful dribbling was related to the RT. In terms of advancing existing knowledge, our findings show that the success in dribbling is dependent on reaction time as a key variable of temporal organization of the relationship between the attacker and defender in sport of football, but not in futsal. They also show that the unsuccessful dribbling in both sports do not depend on defender's anticipation as a key capability for avoiding it. In terms of practical application, at least, this study provides

useful insight into the design of practice tasks in football by suggesting that attacking players with possession of the ball should try to delay the start of the defender's response in order to succeed in the dribbling action. Although we have been careful to ensure that the main information generated by the attackers was the main dribble stimulus, future studies need to access this from the defender's point of view through appropriate technology, for example, by accessing how and where they fix their eyes when they react and anticipate.

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The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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