

## Agility assessment in female futsal and soccer players

Cinzia Benvenuti<sup>1</sup>, Carlo Minganti<sup>1,2</sup>, Giancarlo Condello<sup>1</sup>,  
Laura Capranica<sup>1</sup>, Antonio Tessitore<sup>1</sup>

<sup>1</sup>Department of Human Movement and Sport Science, University of Rome "Foro Italico," Italy,

<sup>2</sup>Department of Experimental and Clinical Medicine, "Magna Graecia" University of Catanzaro, Italy

**Key words:** agility; futsal; soccer; field test; female players.

**Summary.** Agility is the player's capability to perform rapid whole-body movement with change of velocity or direction in response to a stimulus. The aims of this study were as follows: 1) to assess the reliability of a reactive visual stimuli agility field test (RVS-T); and 2) to evaluate differences in RVS-T and planned (PVS-T) agility performances between female soccer and futsal players.

**Material and methods.** Sixty-six female players belonging to Italian teams of regional level were recruited to the study. The experimental apparatus consisted of four lighted spherical visual stimuli connected to a computer able to randomly generate three different sequences. Differences between RVS-T and PVS-T performances were calculated to evaluate the decision-making time (DMT) of players.

**Results.** The intraclass reliability coefficient for RVS-T was 0.80. Significant ( $P < 0.05$ ) differences emerged only for RVS-T (futsal,  $17.3 \pm 0.5$  s; soccer,  $18.8 \pm 1.1$  s) and DMT (futsal,  $2.6 \pm 0.6$  s; soccer,  $4.1 \pm 1.2$  s), whereas similar performances between groups resulted for PVS-T (futsal,  $14.7 \pm 0.6$  s; soccer,  $14.6 \pm 0.6$  s).

**Conclusions.** The RVS-T proved to be a reliable tool to evaluate agility in field conditions. Futsal players showed better RVS-T and DMT performances with respect to soccer counterparts, probably due to the higher velocity of actions and faster decision-making of their sport. The lack of difference in PVS-T performances confirms the importance to evaluate agility capabilities of players in both planned and reactive conditions.

### Introduction

In the last two decades, futsal has increased its popularity and evolved into a spectacular sport, involving a massive TV audience (1). While in the past futsal players were involved in soccer competitions too, at present, they are specialized in this sport, and high-level clubs engage professional players. Consequently, the technical and tactical levels of the game have constantly improved. Conversely, because futsal requires fast movements with and without the ball and no predetermined positions, in some countries (i.e., Brazil and Spain) soccer coaches utilize this sport to enhance technical and tactical skills in their players (2). In fact compared with soccer, the technical proficiency of a futsal players is strongly influenced by the smaller ball with 30% less bounce, which forces the players to develop the ability to accurately control and move the ball quickly on the ground (3, 4). Furthermore, the reduced pitch dimensions and the frequent turnovers during futsal match-play require players fast decision-making and high sprint capabilities under pressure during attacking and defending phases (5).

According to Little and Williams (6), the high-speed actions performed during an invasion game as futsal can be categorized as requiring straight sprint components (acceleration and maximal speed) and agility (7). Although straight sprinting speed is considered an important quality in many sports, the ability to perform rapid whole-body movement with change of velocity or direction in response to a stimulus, known as agility (8), remains a fundamental component in a team sports performance. Thus, to enhance sprint and agility capabilities of their players, futsal and soccer coaches regularly include specific drills that mimic the characteristics of these sports in their training plan. However, at present, there is a lack of specific testing procedures to evaluate agility capabilities of players.

Despite acceleration, maximum speed, and agility (assessed by means of 10-m, Flying 20-m, and Zigzag tests, respectively) share common physiological and biomechanical determinants, Little and Williams (6) demonstrated that in professional soccer players, acceleration and maximal speed share only 39% of common variance with agility, which

Correspondence to C. Benvenuti, Department of Human Movement and Sport Sciences, University of Rome Foro Italico, Pza Lauro de Bosis 15, 00135 Rome, Italy  
E-mail: cinzia.benvenuti@uniroma4.it

Adresas susirašinėti: C. Benvenuti, Department of Human Movement and Sport Sciences, University of Rome "Foro Italico", Pza Lauro de Bosis 15, 00135 Rome, Italy  
El. paštas: E-mail: cinzia.benvenuti@uniroma4.it

has 50% of relative independence (9). Furthermore, Young et al. (10) reported that 6 weeks of straight and agility training determined in soccer players significant selective mode-specific improvements but a limited transfer from one mode to the other.

According to the deterministic model of agility proposed by Young et al. (11), the ability to think and make effective decisions while physically performing is considered a crucial skill for team sports players. Paradoxically, creative attacking play and high levels of scoring during matches have become more difficult despite the continuous development of fitness level and tactical know-how of players (1). Thus, the inclusion of cognitive skills to “read and react” to sport-specific cues should be an integral part of performance when evaluating the agility capabilities of players (12).

In the literature (13–15), the terms planned and reactive agility have been introduced to describe the agility tests in which the participants are aware of the exact movement pattern required before the start or have to react in response to given stimuli during the test, respectively. Considering that in team sports players are challenged to unknown match-play situations, agility tests that separate the cognitive skills from the motor elements of performance could be counterproductive when producing misleading interpretations (13). To this scope, the development of field tests combining cognitive task with soccer specific movement patterns and technical actions is strongly needed.

Thus, the aims of the present study were as follows: 1) to verify whether a new field reactive visual stimuli agility test (RVS-T) based on the successive sprints reacting to unexpected visual stimuli protocol is a reliable tool to evaluate this capability of players (i.e., Study 1); and 2) to evaluate differences, if any, in RVS-T and planned (PVS-T) agility performances in futsal and soccer players (i.e., Study 2).

### Material and methods

**Participants.** Thirty female athletes (age,  $23 \pm 6$  years; body mass,  $59.5 \pm 7.1$  kg; height,  $166 \pm 5$  cm) practicing futsal and soccer volunteered were enrolled into the Study 1 aimed to examine the reliability of the RVE-T. Another sample of 18 female futsal (age,  $22.9 \pm 2.8$  years; body mass,  $56.2 \pm 5.9$  kg; height,  $163 \pm 3.6$  cm) and 18 female soccer (age,  $20.9 \pm 3.1$  years; body mass,  $55.2 \pm 5.5$  kg; height,  $162 \pm 7.5$  cm) players were recruited for the Study 2 aimed to test sport-related differences in RVS-T and PVS-T performances. Criteria of inclusion were as follows: 1) at least 7 years of previous training (three 2-hour training sessions and a match weekly); 2) their participation in the highest Italian regional level championships. Written and oral information



Fig. 1. The experimental apparatus of the agility test positioned on the pitch

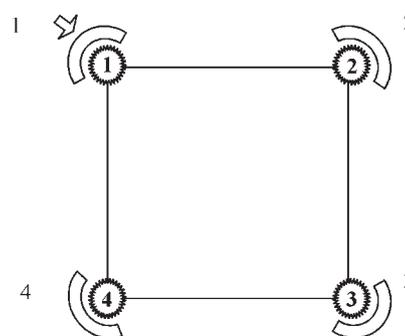


Fig. 2. Schematic representation of the position of the four spheres

of the potential risks and benefits associated with participation were provided to the subjects before giving their written consent to participate.

**The field reactive visual stimuli agility test (RVS-T).** The experimental apparatus (Fig. 1) consisted of four lighted spherical visual stimuli (J&S, Rome, Italy) placed at the corners of a  $7.5 \times 7.5$  m pitch and numbered from 1 to 4 (Fig. 2). The spheres (Fig. 3 A and B) were connected by means of a telemetric system (Fig. 4 A and B) to a computer able randomly generate three different sequences (A, 321241; B, 231421; C, 342123) for a total of 51 m covered in each trial.

Unaware of the sequence, the players started behind the sphere 1 and had to run as fast as possible behind to the lighted spheres to switch off touching them with her foot (Fig. 5). To avoid rest periods due to the delays between visual stimuli, lights went on with a 2-second anticipation following diagonal runs and a 1-second anticipation following side runs. To calculate the total time (seconds), the players had to run and switch off the lighted semispheres in the sequence presented.



A



B

Fig. 3. The spheres with the light turned on (A) and off (B)



A



B

Fig. 4. The telemetric system of the experimental apparatus: the transmitter (A) and the receiving (B) modules



Fig. 5. The foot-sphere contact

*Study 1. Reliability of the RVS-T.* To examine the reliability of the RVS-T, participants were administered the three sequences in a random order, during three experimental sessions with a three-day rest in between. Before the experimental sessions, a single test was used to familiarize the subjects with the protocol. Warm-up procedures were standardized, and to avoid that subjects could learn the sequences, they were not permitted to attend the trials of others athletes.

*Study 2. Agility performances of female futsal and soccer players.* To test differences between female futsal and soccer players in reactive and planned agility performances, a random sequence of two RVS-T trials was administered adopting the same procedures of Study 1. Then the sequence rela-

tive to the fastest performance was selected for the planned condition (PVS-T), which was scheduled after 15-min rest during which the athletes were required to learn it. The time to perform each test was registered, and the difference between the best RVS-T and the PVS-T was calculated to determine the decision-making time (DMT).

**Statistical analysis.** The statistical package SPSS (17.0) was used for the analysis. Data were presented as mean values and standard deviations; statistical significance was set at an alpha level of  $P < 0.05$ . The Kolmogorov test was applied to test the normal distribution of the data. To verify significant differences between trials and experimental sessions of the RVS-T, an ANOVA for repeated measures was applied. To examine the test reliability of RVS-T, intraclass correlation coefficient (ICC) was used.

To verify significant sport-related differences in RVS-T, PVS-T, and DMT, a two-way (sport, futsal vs. soccer) ANOVA was applied. To provide meaningful analysis for significant comparisons from small groups, the Cohen's effect sizes (ES) were also calculated. An ES of  $\leq 0.2$  was considered trivial, from 0.3 to 0.6 small,  $< 1.2$  moderate, and  $> 1.2$  large.

## Results

The results of the Study 1 are represented in Fig. 6. No significant difference was found for trials and experimental sessions (first session: sequence A =  $20.33 \pm 1.35$  s, sequence B =  $20.0 \pm 0.96$  s, sequence C =  $19.94 \pm 1.11$  s; second session: sequence A =  $19.77 \pm 0.89$  s, sequence B =  $19.83 \pm 1.56$  s, sequence C =  $19.87 \pm 1.19$  s; third session: sequence A =  $19.52 \pm 0.82$  s, sequence B =  $19.51 \pm 0.84$  s, sequence C =  $19.49 \pm 1.23$  s). The mean ICC was 0.80.

The results of the Study 2 are presented in Table and Fig. 7. A significant sport-related effect emerged for RVS-T ( $P = 0.001$ ; ES = 0.62) and DMT ( $P = 0.001$ ; ES = 0.77). Furthermore, no significant difference was found in the PVS-T condition.

## Discussion

To our knowledge, this is the first agility test that combines cognitive tasks with soccer specific movement patterns (i.e., change of directions) and a technical action (i.e., to kick). While in the past most of the agility tests pertaining changes of direction referred to planned conditions, currently a greater interest exists for developing field tests that can effectively evaluate agility under reactive conditions. The novelty of this approach is a reactive agility test protocol, which requires changes of directions and kick actions that mimic futsal (16). Conversely, the limitation of this test is the use of a lighting sphere (either "off" or "on"), which does not resemble the specificity of match-play stimuli (i.e., movements

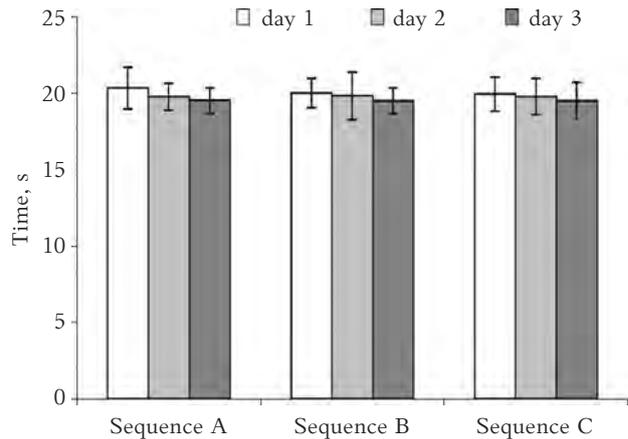


Fig. 6. Means  $\pm$  standard deviations of total time (s) for the three sequences (A, B, and C) in the three experimental sessions (day 1, 2, and 3)

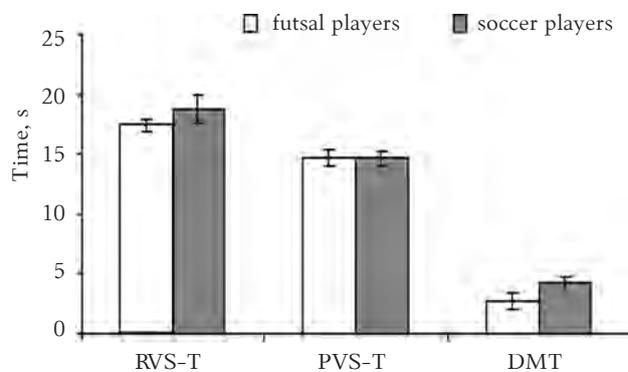


Fig. 7. Means  $\pm$  standard deviations of total time (s) for the reactive (RVS-T), planned (PVS-T) agility performances, and the decision-making time (DMT)

\* $P < 0.05$ , significant differences between futsal and soccer players.

Table. Means  $\pm$  standard deviations and  $P$  values for reactive (RVS-T) and planned (PVS-T) agility performances, and decision-making time (DMT) of futsal and soccer players

Performance	Futsal players	Soccer players	$P$
RVS-T	$17.32 \pm 0.51$ s	$18.78 \pm 1.19$ s	0.001
PVS-T	$14.69 \pm 0.67$ s	$14.60 \pm 0.63$ s	NS
DMT	$2.63 \pm 0.67$ s	$4.14 \pm 0.56$ s	0.001

of the ball, opponents, and teammates) (17), which might reduce the ability of skilled players to respond picking up anticipatory information compared with less-skilled players (8, 13, 15). Nonetheless, the present experimental approach has an added value allowing the evaluation of planned and reactive agility in field conditions.

The lack of differences between test-retest trials and the high ICC values (i.e., 0.80) of the Study 1 demonstrated that the RVS-T is a reliable tool to evaluate the reactive agility of futsal and soccer play-

ers. The reliability of a test depends on a number of factors, such as the number of subjects, the number of performed trials, the subject's skills, and motivation to do well (18). Actually, the high skill level of the futsal and soccer players who compete at the highest Italian regional levels and their high motivation to perform at their best the three trials during the three testing sessions could have contributed to the high reliability of the findings (19). Thus, future research is strongly needed to verify whether this test could be applied also to athletes of different levels.

Regarding the differences between soccer and futsal female players in their reactive and planned agility performances (i.e., Study 2), the current results indicated two interesting aspects. First, the futsal players were significantly faster than their soccer counterparts in reactive agility and in decision-making times, indicating a sport-specific effect. Despite the apparent similarity between these two sports, in futsal the reduced pitch dimension and temporal duration of the actions, the higher number of game situations that the players have to learn, memorize, and select, and their concurrent participation in

both attacking and defensive actions of match-play probably sustain the development of high cognitive and coordinative skills in players (5). Second, the lack of significant sport-related differences emerging in the planned agility performances confirms that the inclusion of reactive tasks is fundamental when constructing test aimed to evaluate this capability in athletes (12–15). Therefore, the planned conditions could be used only to assess conditional aspects of players.

### Conclusions

The results of this study provide important practical applications for team sports coaches. The response to open (reactive) and closed (planned) tasks demonstrated that both these two conditions could be used to evaluate the effects of specific futsal and soccer training programs.

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## Uždaru patalpų futbolo bei lauko futbolo žaidėjų judrumo įvertinimas

Cinzia Benvenuti<sup>1</sup>, Carlo Minganti<sup>1,2</sup>, Giancarlo Condello<sup>1</sup>,  
Laura Capranica<sup>1</sup>, Antonio Tessitore<sup>1</sup>

<sup>1</sup>Romos „Foro Italico“ universiteto Žmogaus judėjimo ir Sporto mokslų katedra, Italija,

<sup>2</sup>Kantazaro „Magna Graecia“ universiteto Eksperimentinės ir klinikinės medicinos katedra, Italija

**Raktažodžiai:** judrumas, uždaru patalpų futbolas, futbolas, lauko tyrimai, moterys žaidėjos.

**Santrauka.** Judrumas yra žaidėjo galimybė atlikti greitą kūno judesį keičiant greitį arba kryptį atsakant į tam tikrą stimulą. Tyrimo tikslas: 1) įvertinti reakciją į vizualinį stimulą judrumo lauko teste (RVS-T); 2) įvertinti skirtumus tarp RVS-T ir planuoto (PVS-T) judrumo atlikimo moterims futbolininkėms bei uždaru patalpų futbolo žaidėjų grupių.

**Tiriamųjų kontingentas ir tyrimo metodai.** Iširtos 66 moterys, žaidžiančios Italijos regioninėse futbolo komandose. Eksperimentinę įrangą sudarė keturi sferiniai šviestuvai vizualiniam stimului formuoti kompiuteriu, kuris atsiktiniu būdu pateikdavo šviestuvams impulsus trimis skirtingomis sekomis. Apskaičiuotas skirtumas tarp RVS-T ir PVS-T atlikimo siekiant įvertinti žaidėjo sprendimų priėmimo laiką (DMT).

**Rezultatai.** Reikšmingumas grupės viduje koeficientui RVS-T buvo 0,8. Patikimi skirtumai buvo, kai RVS-T (uždaru patalpų futbolas – 17,3±0,5 sek.; futbolininkės – 18,8±1,1 sek.) ir DMT (uždaru patalpų futbolas – 2,6±0,6 sek.; futbolininkės – 4,1±1,2 sek.), tuo tarpu PVS-T buvo panašus tarp grupių (uždaru patalpų futbolas – 14,7±0,6 sek.; futbolininkės – 14,6±0,6 sek.).

**Išvados.** RVS-T testas yra patikima priemonė asmens judrumą lauko sąlygomis įvertinti. Uždaru patalpų futbolo žaidėjai parodė geresnį RVS-T ir DMT atlikimą lyginant su lauko futbolininkėmis, galimai dėl didesnio greičio savo veiksmuose bei greitesnio sprendimų priėmimo. Skirtumo nebuvimas, atliekant PVS-T, patvirtina, kaip svarbu įvertinti sportininko judrumo galimybes abiem atvejais – planuojant ir realiomis sąlygomis.

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