The Footbonaut as an Innovative Diagnostic System
Differentiating Response Times in Soccer Players of Different Age-groups

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1 OBJECTIVES

The Footbonaut is a high-tech measuring instrument for the training and diagnostics of agility in soccer (Saal et al., 2013). It can be used to measure the response time and precision (goal/no goal) regarding a highly soccer specific reaction task in order to estimate agility performance. Agility is defined as "a rapid whole-body movement with change of velocity or direction in response to a stimulus" (Sheppard and Young, 2006). There are indications that suggest that agility helps to predict talent (Reilly et al., 2000). To our knowledge there exist no scientific studies targeting the application of this measuring instrument in diagnostics and training. The aim of the cross-sectional cohort study to be presented here, was to test if the response time results from tests in the Footbonaut were an appropriate trait to distinguish between age groups. We assume that professional soccer players have a shorter response time measured by the Footbonaut.

2 METHODS

Data on soccer players (n = 101, male, U14 to professionals) representing TSG 1899 Hoffenheim during the 2013-2014 season were collected. The sample was divided to seven standardized age groups. The Footbonaut (CGoal GmbH) was used to measure the response time of soccer specific reaction tasks. The Footbonaut consists of a playzone (artificial turf, 14x14 m) and is surrounded by four walls. The walls include 72 high and low positioned square panels, each equipped with light barriers and light-emitting diodes (LED). Eight ball-throwing machines are installed behind the middle panels in each wall (fig.1). The other 64 panels are used as targets. Stimuli, first at the ball-throwing machine then at the target panel, were given by the LED and an accoustic signal. Light barriers were used for time measurement.

Table 1: Settings defined for each Session in the Footbonaut.

Parameter	Value	Description
Canon Power	50 %	The speed of the ball. 50 % $\approx$ 50 km/h
Trials	32	Number of Balls per Session
Random	360°	Targets in a range of 360°
Vertical angle	2	Angle of inclination of the ball-throwing machine
Shot delay	800ms	Time difference between the stimuli

Note. Only low targets and ball-throwing machines were used.

Testing procedures included the setting from Table 1. We used uniquely randomized combinations of ball-throwing machines and target panels. Which means that the sequence was identic for each subject.

Each subject received the same instruction "play as fast and accurate as possible". There was a short practice session before the measurement. The subjects started the session in the middle of the test zone. After stimuli identification the player had to control and pass the ball into the right target panel. The athletes performed two sessions with 32 trials in a consecutive order. Means for the response time of the 32 trials in each session were calculated. The best mean was used for statistical analysis. The seven groups were compared using a Kruskal-Wallis rank sum test. For pairwise comparison we used a Wilcoxon rank sum test with a false discovery rate adjustment.

3 RESULTS

Means of the best series show that professionals have a shorter response time than others (tab.2). A Kruskal-Wallis test was conducted to evaluate differences among the seven age groups (U14 to professionals) using means of response time that resulted from a soccer specific task in the Footbo-

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Figure 1: Footbonaut with testzone, ball throwing machines (A), target panels (B) and detailed view of ball throwing machines and light barriers.

Table 2: Descriptiv statistics for the response time in the Footbonaut of soccer players different age groups.

group	n	M (SD)	95 % CI
U14	12	2.47 (0.39)	[2.22, 2.72]
U15	16	2.32 (0.17)	[2.23, 2.41]
U16	13	2.45 (0.28)	[2.28, 2.62]
U17	13	2.52 (0.20)	[2.40, 2.64]
U19	9	2.20 (0.20)	[2.05, 2.36]
U23	17	2.18 (0.30)	[2.02, 2.34]
Profis	21	2.09 (0.14)	[2.02, 2.16]

Note. CI = confidence interval

naut. We found significant differences in the best response times between the seven groups ($\chi^2(6, N = 101), = 35.82, p < .05$). Follow-up tests were conducted to evaluate pairwise differences among the seven groups, while controling the false discovery rate (Benjamini and Yekutieli, 2000). The Results of these tests indicated significant differences (tab.3) between the professionals and age groups lower than U17. No pattern was found for precision outcome.

Table 3: Pairwise comparisions of differences in response time in the Footbonaut between the age groups using Wilcoxon rank sum test. Table shows p-values.

	U14	U15	U16	U17	U19	U23
U14						
U15	.26					
U16	.78	.35				
U17	.81	.03*	.64			
U19	.12	.18	.10	.01*		
U23	.05	.05	.02*	.00*	.70	
Profis	.00*	.00*	.00*	.00*	.23	.50

Note. $^*p < 0.05$, adjustment = false discovery rate

4 DISCUSSION

The aim of the study presented here was to test if the response time measured in the Footbonaut is an appropriate trait to distinguish between age. The results show significant differences between the professionals and age groups lower than U17. We explain the result with the highly specific movement pattern and change of direction requests that the Footbonaut allows. Further research assessing the validity and reliability of the Footbonaut test procedures are necessary, especially regarding the measurement of player performance changes over time.

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