

## Football IntelliGym Efficacy Analysis PSV Eindhoven and AZ Alkmaar Football Academies

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### *Abstract*

The impact of cognitive training activity (the Football IntelliGym training system) on football performance has been tested within two elite football academies: PSV Eindhoven and AZ Alkmaar.

The study compared the performance of an experimental group (IntelliGym) and a control group (placebo) based on an objective football performance metrics, using the Notation Analysis System<sup>2</sup> (an objective performance analysis, developed by VU University), before and after cognitive intervention.

In all tested groups, the study has found significantly better results in performance of the experimental group compared to the control group.



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<sup>2</sup> Mariëtte J. J. van Maarseveen, Raoul R. D. Oudejans and Geert J. P. Savelsbergh (2017). Notation Analysis in Small-Sided Soccer Games. Manuscript submitted for publication.

## Method

### Participants

A total of 52 football players participated in this study, aged 14 to 17 years old. The participants were players from 4 different teams of PSV Eindhoven and AZ Alkmaar football academies (2 teams from each academy). Each team was randomly divided to the experimental group (using Football IntelliGym) and control group (placebo intervention). The experimental group consisted of 24 players. During the course of the study, 13 players were excluded from the analysis due to injuries that prevented them from participating in the pre or post performance evaluation. In addition, 6 more players were excluded from the study because they did not meet the minimum number of experimental or placebo task activities defined for the intervention (10 activity sessions).

All participants and parents provided a written informed consent prior to the study.

### Experimental Group - Cognitive Intervention

The experimental group's participants carried out a computerized cognitive training using the Football IntelliGym training system ("IntelliGym"). This system uses a video-game-like training interface which addresses a large variety of brain skills that are found to be strongly related to footballers' performance, such as anticipation, ability to find open areas, divided attention, awareness (and particularly spatial perception), long term focus and concentration, team play, working memory (needed to process trajectories that take place in hidden areas, such as behind the player), rapid adaptation to changing environment and the ability to spot evolving opportunities, pattern recognition, execution of game plan, and coping with time constraints.



Football IntelliGym – training environment sample screenshot

### **Control Group – Video Challenge**

The Control (placebo) Group was asked to perform a different computerized task: to observe video clips of real football matches and identify football-related events or actions such as passes, turnovers, headers, fouls, shots on target with regards to a specific team in that video. These events were then filled into an online form. The duration of this task was similar to an IntelliGym training session.

### **Activity Regimen**

The participants were instructed to do their IntelliGym sessions (experimental group) or the Video Challenge task (control group) 2 times a week, 30 minutes each, during a period of 10 weeks. The training sessions were scheduled to Mondays and Thursdays for both groups. Both experimental and control groups' participants were told that their respective activities are aimed at improving their football decision-making performance.

The study-related activity has been carried out by the participants on their personal computers, where such activity (for both groups) was closely monitored by the study staff via the Internet.

### **Performance Evaluation**

Football performance scores were determined based on the Notation Analysis System. Under this methodology, the players were asked to play a 4-minutes small area football game (“mini game”). Each game was played for 4 minutes and repeated 4 times. The plays were video-recorded from above (see below photo), and later analyzed by university staff members who are proficient in this notation protocol.



**Video capture of the football game settings used for performance evaluation**

The video analyses were done in a double-blind research design, that is: the evaluator did not know if the video being analyzed was taken before or after the intervention and did not know if the evaluated player was from the experimental or control group. The analysis strictly followed the Notation Analysis System, containing pre-defined criteria and scoring parameters.

The Notation Analysis evaluation system focuses on three basic elements:

- Attack with the ball
- Attack without the ball
- Defense

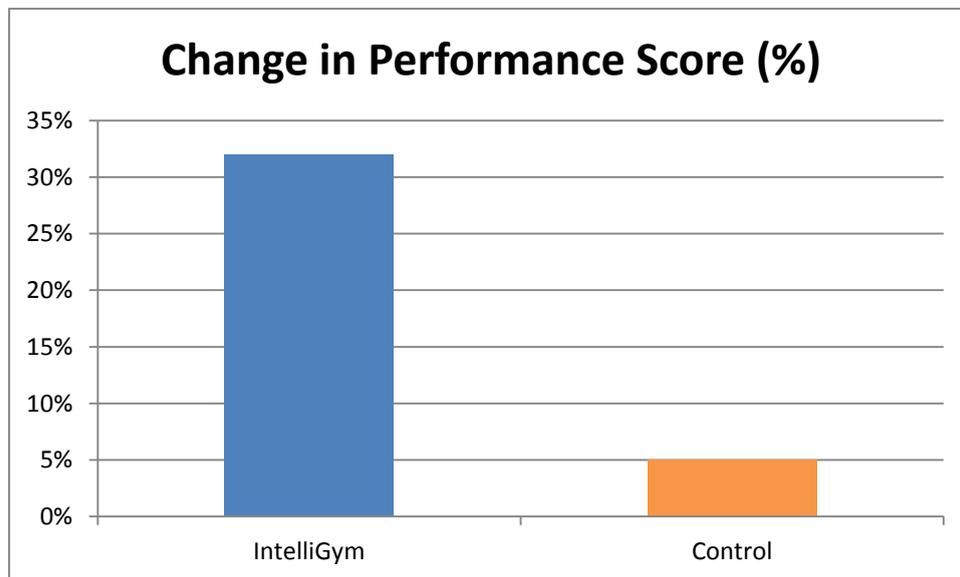
The scores are event-based, that is, players' actions are being reviewed and analyzed one at a time, and whenever a player carries out a specific pre-defined action, the respective score (as defined in the scoring system) is granted.

The full Notation System scoring matrix is attached hereto as an appendix.

## Results

### On-Field Performance Analysis

The study shows a significant effect favoring the experimental group (IntelliGym-trained participants) over the control group in average performance improvement.



**t=1.55, p=0.07**

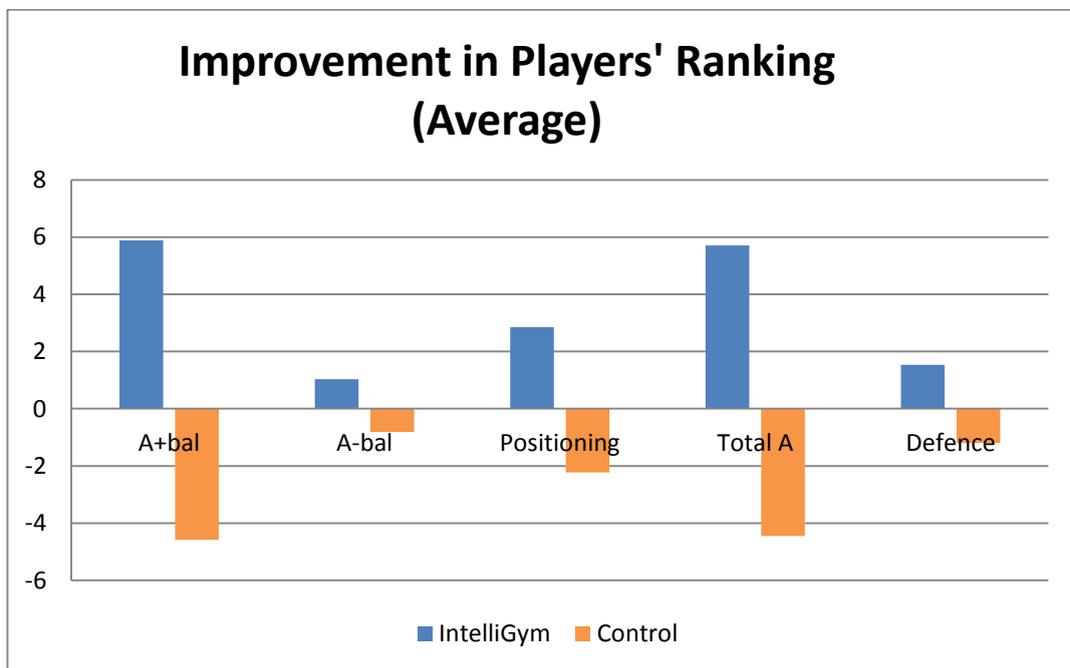
The score bars represent the improvement in percentage between the pre- and post-intervention phases across all parameters.

As seen in the above chart, while both groups improved, the overall on-field improvement of the experimental group (IntelliGym-trained players) was 27% higher than the improvement recorded by the control group.

**Players’ Ranking Score**

Another way to assess the improvement of individual players of the experimental and control groups is by way of ranking analysis. This way, the players in both groups were merged into a unified list, ordered by their performance score. Then, the ranked pre-intervention list was compared to the post-intervention list.

The following chart shows the average ranking improvement between the pre- and post- intervention, for each study group and for each score category.



**Wilcoxon, w=183, p<0.038**

As an example, IntelliGym-trained players improved their ranking by 5.9 ordinal values on average in the attack-with-ball (“A+bal”) category while the average control group player declined by 4.6 ranks in the same category.

It should be noted that in ranking analysis, by definition, every incremental climb on the list has a corresponding decline by another player. The relative sizes of the experimental and control groups dictate the constant gain/drop ratio (1.28) seen in the chart.

The chart consistently shows that in all score categories IntelliGym-trained players improved their rankings significantly compared to control group players.

## ***Conclusion***

The current study tested the impact and efficacy of cognitive training (performed using the football IntelliGym) on on-field football performance. The results showed that players who used the IntelliGym training program for at least 10 sessions, improved by nearly 30% more than players in a control (placebo) group. In addition, players who trained with the IntelliGym improved their ranking in the team, compared to the control group players. The results were statistically significant.

The study results support a promising and innovative direction: using computerized cognitive training tools for improving on-field performance of footballers.

## ***Acknowledgements***

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### Appendix: Notation Analysis in Small-Sided Soccer Games

The following tables contains the actions, outcomes, definitions and allocation of points of notation system.

Role	Action	Outcome	Definition	Points
Attacker with ball				
	Shooting		The attacker shoots at goal and ...	
		Goal	... scores	12
		Blocked by defender	... the shot is blocked by a defender	6
		Saved by goalkeeper	... the shot is saved by the goalkeeper	9
		Post/crossbar	... the ball hits the post or crossbar	9
		Wide/over	... the ball goes wide or over the goal (within 1 m)	6
		Far wide/far over	... the ball goes far wide or over the goal (more than 1 m)	0
	Passing		The attacker passes the ball ...	
		Successful, towards teammate in promising position	... and a teammate in a promising position receives the ball	5
		Successful, forward	... forward to a teammate who receives the ball	2
		Successful, backward	... sideways or backward to a teammate who receives the ball	1
		Intercepted	... and a defender or goalkeeper intercepts the ball	0
		Offside	... towards a teammate in offside position	0
		Out of play	... out of play	0
	Dribbling		The attacker moves the ball, after receiving and prior to passing/shooting, (without a near defender) and ...	
		Maintain ball possession, towards promising position	... the attacker maintains ball possession and moves towards a promising position	5
		Maintain ball possession, forward	... the attacker maintains ball possession and moves forwards	2
		Maintain ball possession, to the side or backward	... the attacker maintains ball possession and moves to the side or backwards	1

	Ball possession lost	... the attackers loses ball possession	0
1:1 Duel		The attacker with ball and defender approach within 1 m, the defender is next to or in front of the attacker, and ...	
	Attacker wins and overtakes	... the attacker wins the duel and overtakes the defender	5
	Attacker retains ball possession but goes back	... the attacker maintains ball possession but does not overtake the defender	3
	Defender plays ball out of play	... the defender plays the ball out of play	2
	Defender wins ball possession and can continue directly	... the defender conquers ball possession and is able to continue to play immediately	0
	Defender wins ball possession but cannot continue directly	... the defender conquers ball possession and is not able to continue to play immediately	0
Receiving		The attacker receives the ball and ...	
	Under control	... controls it	1
	Out of control	... does not control it	0
Foul		The attackers makes a foul	0
Attacker without ball			
Running action		The attacker off the ball accelerates or moves in another direction than the flow of the game and ...	
	Defender follows, creating more space for ball carrier	... a defender follows the attacker, hereby creating more space for the ball carrier	2
	Got open on own half	... the attacker gets open on his own half of the playing field	2
	Got open on opponent's half	... the attacker gets open on the opponents' half of the playing field	4
	Wrong direction/timing	... the attacker does not get open and the defender does not follow him	0
Offside		The attacker is in offside position	0
In promising position		The attacker is in a promising position, that is, inside the penalty box and a 2 m wide line from the attacker towards the goal is open	7
Foul		The attacker off the ball makes a foul	0
Positioning		A 1 m wide line from the ball carrier to the attacker off the ball is ...	
	Open, own half, centre	... open, and the attacker off the ball is on his own half of the field and in the centre	2

	Open, own half, side	... open, and the attacker off the ball is on his own half of the field and at the side	1
	Open, opponents' half, centre	... open, and the attacker off the ball is on the opponents' half of the field and in the centre	5
	Open, opponents' half, side	... open, and the attacker off the ball is on the opponents' half of the field and at the side	3
	Marked	... marked by a defender	0
Defender			
	1:1 Duel	The defender and attacker with ball approach within 1 m, the defender is next to or in front of the attacker, and ...	
	Attacker wins and overtakes	... the attacker wins the duel and overtakes the defender	0
	Attacker retains ball possession but goes back	... the attacker maintains ball possession but does not overtake the defender	2
	Defender plays ball out of play	... the defender plays the ball out of play	2
	Defender wins ball possession and can continue directly	... the defender conquers ball possession and is able to continue to play immediately	6
	Defender wins ball possession but cannot continue directly	... the defender conquers ball possession and is not able to continue to play immediately	4
	Defensive pressure	The defender accelerates towards the attacker with ball and approaches within 2 m (and more than 1 m) and ...	
	Attacker goes forward	... the attacker with ball moves forward	0
	Attacker goes backward	... the attacker with ball moves to the side or backwards	3
	Towards 1:1 duel	... the defender approaches to within 1 m and a 1:1 duel follows	2
	Intercepting	The defender intercepts a pass and ...	
	Under control	... controls the ball	6
	No control	... does not control the ball	2
	Blocking shot	The defender blocks a shot at goal and ...	
	Defender got ball possession	... the defender gains ball possession	5
	Defender got no ball possession	... the attackers maintain ball possession	2

Offside trap	The last defender steps forward to put an attacker offside and ...	
Well executed	... the defender wins ball possession due to offside	3
Not well executed	... the timing is not correct and thus the attackers maintain ball possession	-3
Foul	The defender makes a foul ...	
Inside penalty area	... inside the penalty area	-9
Own half	... on his own half	-6
Opponent's half	... on the opponents' half	-3

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