

Research article

Testing of tactical performance in youth elite soccer

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Abstract

This is a twofold study with the goals of evaluating tactical oriented game test situations for 12-13-year old highly-talented soccer players and to analyze dynamic, intra-individual developments of the players. A cross-sectional design was carried in study 1, using game test situations to measure specific tactics and creative performance for 195 expert players. The results from five evaluation criteria show that both diagnostic instruments can be used for recording football-specific creativity and game intelligence in talented young players. They produced tactical indicators that can be described as objective and valid, exhibit a sufficient degree of differentiation and are easy to record. Study 2 uses a longitudinal design to present a dynamic performance diagnostic tool for analyzing intra-individual improvements of German Soccer Foundation talents according to football-specific creativity and game intelligence. The results with respect to divergent tactical thinking clearly show that very different change processes were observed in the German Soccer Foundation players. Finally, the practical implications for the training process are discussed on the basis of both studies.

Key words: Talent program, talent diagnostic, game test-situation, creativity, game intelligence.

Introduction

The inclusion of tactical skills as well as conditional and technical competencies in youth football training at an early stage are becoming a key topic in scientific discussions (Memmert and König, 2007; Memmert and Harvey, 2009; Memmert and Roth, 2007; Memmert and Perl, 2009a; 2009b). The talent program of the German Soccer Foundation (DFB) assigns a significant role to tactical creativity (divergent tactical thinking) and tactical game intelligence (convergent tactical thinking) at an early stage in youth football training (DFB, 2002).

Creativity was intensively studied in domains as diverse as science, literature, music, art, religion and politics (for an overview, see Sternberg and Lubart, 1999), but less in the sport context. Models, concepts, and tests of creative thinking are now a topic of current discussions (Dietrich, 2007; Runco, 2007; Memmert, 2009; 2010c). In a general and more scientific context, Sternberg and Lubart (1999, p. 3) and others (e.g. Ward, 2007) define creativity as "the ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful). In the domain of team sports like soccer, basketball, field hockey, or handball, dissociating from the so-called best solutions (tactical game intelligence or convergent tactical thinking), tactical creativity (divergent tactical thinking) is understood to be the surprising, original and flexible production of tactical response patterns

(Memmert and Roth, 2007). An unexpected no-look pass to a fellow team member (maybe not even expected by this team member) would be an example of a creative solution in basketball or soccer. According to the prevalent opinion, both characteristics are also important predictors for talent search and talent selection (Memmert, 2006b). Available research on these topics is very scarce and sadly lacking on instruments capable of measuring game-oriented creativity and tactical game intelligence.

Therefore, the first aim of this study was to evaluate talent development instruments for measuring game-oriented creativity and tactical game intelligence for a target group of 12-13-year-olds. Additionally and as a second aim of that contribution, considerations on dynamic, intra-individual developments are presented. Study 1 gives a detailed description of the two soccer-specific diagnostic instruments used with a subsequent presentation and discussion of the results including an assessment of the secondary quality factor of economics. Based on dynamic observations on development, study 2 allows a targeted approach to the following three questions:

1. Did the highly-skilled soccer players improve with regard to game-oriented creativity and tactical game intelligence? (Evaluation of soccer talents)
2. At which study base did the expert players make the best progress? (Evaluation of the study bases/coaches)
3. Which youth expert players achieved the best/worst intra-individual progress? (Identification of a possible elimination criterion)

The initial short description of the research structure of study 2 is followed by the presentation of dynamic divergent and convergent development observations as well as general results (study bases, age). Finally, both studies are summarized and suggestions of further practical implications for training procedures are made.

Study 1: Evaluation of Talent Development Instruments

Overview

The cross-sectional study determined the soccer-specific creativity and game intelligence of 195 talents of the age groups born in 1991 ($n = 99$) and 1992 ($n = 96$) at seven chosen talent bases in Germany (Leutershausen, Münchweiler, Neustadt, Pfungstberg, Speyer, St. Ilgen, Steinsfurt). The selected talents are among the best youth soccer plays of Germany in this age group. In order to measure these tactical performances, game test situations

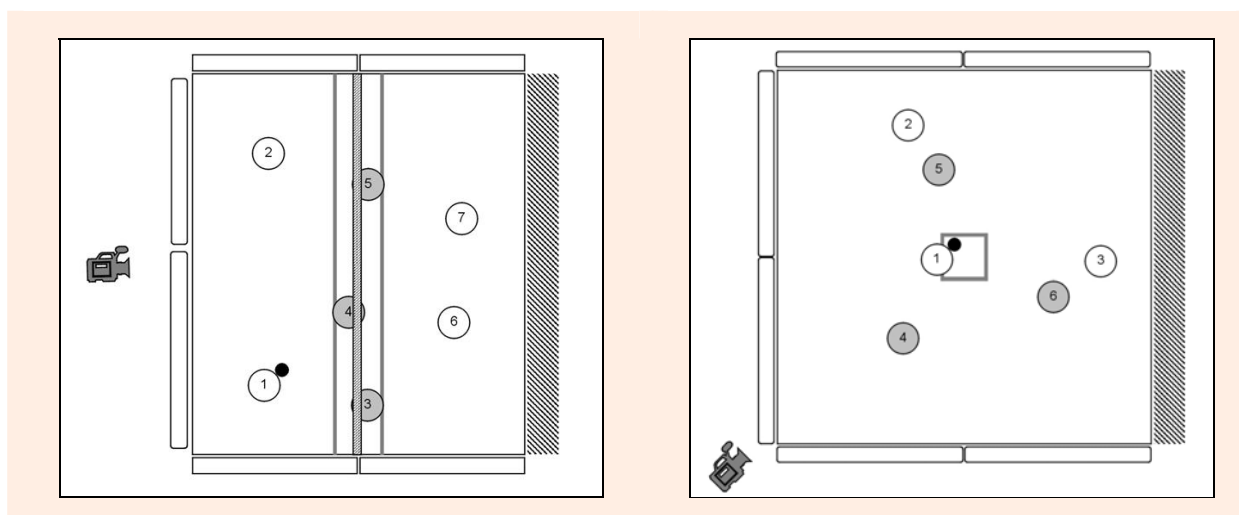


Figure 1. Diagram of the game test situation Taking advantage of openings. (left; pitch dimensions = 8 x 7 meters; width of the midsection = 1 meter; height of the line above the mid-section = 1.50 meters; distance between video camera and pitch = 8 meters) as well as offering & orienting (right; pitch dimensions = 9 x 9 meters; size of starting square = 1 x 1 meter; distance between video camera and pitch = 4 meters).

were used (e.g., Memmert, 2006b; 2007; 2010a). The objectivity, reliability and validity of these situations has been established in preliminary studies (cf. Grunz et al., 2009; Memmert & Perl, 2005; Memmert & Roth, 2007; Memmert & Perl, 2009a; 2009b), but not with highly-trained youth soccer experts.

Methods

Game test situations act as a type of compromise between standardized tactical tests and game observation methods. On the one hand, this largely preserves the high external validity typical of free observations. Game test situations are simple game forms with clearly defined game ideas, fixed numbers of players as well as defined rules and environmental conditions. The children's tactical behavior is assessed without trying to standardize the ball paths and actions of team mates and opponents. Hence, the departure point is basic constellations with clearly allocated roles in order to create recurring and consistent conditions with many repetitions for the participants. What is crucial is that the rotation of the players systematically changes the allocation of tasks and positions. After three minutes, the positions change according to a certain sequence so that each child holds an offensive position twice in the course of the game test situation.

On the other hand, we can assume a relatively high internal validity. The games are designed as "tactically one-dimensional", i.e. the requirements are typically dominated by a single tactical component respectively. Moreover, in the calculation of the performance parameters, the factors relating to other areas (e.g. condition, technology) are logically factored out. Therefore, game test situations also enable the diagnostics of individual tactical competencies. These are defined in the following in conjunction with the respective soccer-specific tasks of the survey instruments.

Game test situation Taking advantage of openings. Taking advantage of openings means managing tactical tasks which depend on the (individual) exploitation of

openings for the chance of a pass or a goal in confrontations with opponents. Two attacking teams A (here: players 1 and 2) and A+ (here: players 6 and 7) with two players each are located in the two outer zones (cf. Figure 1 on the left). A defending team B consisting of three players is acting in the mid-field, which it is not allowed to leave and teams A and A+ are not allowed to enter. It is the objective of the attackers to play the ball past B and underneath the upper boundary into the opposite half of the pitch. The players must stick to their respective places (to the left or the right of the action field) and are not allowed to run with the ball. They are allowed to pass the ball between the two attacking teams. Depending on ball possession, the defending team turns toward team A or A+.

Game test situation Offering & orienting: Offering & orienting is characterized by tactical tasks that depend on taking the optimal positioning on the playing field at the right time. Participants are an attacking team A and a defending team B consisting of three players each (cf. Figure 1 on the right). The objective of team A is to pass the ball as often as possible, not being allowed to run with the ball, while team B tries to prevent the passes. The defending players must keep a certain distance to the players of team A. At the beginning of the game or after team B has intercepted a pass, one attacker must be in the starting square with the ball while the other players can choose any position on the field.

In order to analyze the tactical actions shown in the two game test situations, the technical measuring instruments usually applied in standardized tests that directly survey decision times / quality cannot be used. Instead, a video of the recorded behavior is subsequently rated with regard to the concept by twelve experts. The divergent and convergent tactical behaviors in the game test situations Taking advantage of openings as well as Offering & orienting were assessed by three raters using four different scales respectively (1 to 10, cf. in depth Memmert, 2006a; 2007). These raters were trained soccer experts. The 12 performance measures for creativity and game

Table 1. Summary of all ICC coefficients (rotations 1 and 2) for the convergent and divergent tactical performances.

Game test situation	Rotation	Divergent tactical performances	Convergent tactical performances
Taking advantage of openings	1	.85	.80
Taking advantage of openings	2	.84	.85
Offering & orienting	1	.82	.83
Offering & orienting	2	.80	.77

intelligence available for each child (3 raters x 2 rotations x 2 base tactics) were summarized into one divergent and one convergent overall parameter. Each rater judged each subjects within 6 minutes per game test situation.

Results and discussion

The results of five evaluation criteria confirm the relevance of the measuring instrument for the target group, since the determined objectivity parameters were sufficiently high (cf. Table 1). The average intra-class correlation coefficient was high (ICC= 0.82). It is not surprising that the convergent performance measures achieved higher intra-class correlation coefficients (ICC = 0.86) than the divergent (ICC = 0.73). Both characteristics are differentiated virtually across the entire scale (creativity ranged from 3.29 to 8.50; game intelligence ranged from 4.04 to 8.63). As clarified by Figure 2, the available data sets also follow a normal distribution (for creativity, Kolmogorov-Smirnov-Z = 0.95, $p = 0.33$; for game intelligence, Kolmogorov-Smirnov-Z = 0.88, $p = 0.42$).

The implementation registered a smooth and – for tactical features – economical compilation and evaluation of the data. Overall, the recording of the tactical behaviors of 30 talents in both game test situations required 75 minutes. The identification of four performance measures (convergent/divergent Offering & orienting; convergent/divergent Taking advantage of openings) required a total of 120 minutes per rater for 30 children.

In terms of game intelligence there were no fundamental differences between the children at the individual talent bases. The talents at Pfingstberg achieved sig-

nificantly higher creativity values than the talents at Speyer (Scheffé-procedure: $p < 0.01$) while there were no differences in performance between the other talent bases. Subjects born in 1991 displayed significant differences to the group born in 1992 only in their convergent parameters ($F(1,193) = 13.91$; $p < 0.001$; partial $\eta^2 = 0.07$), but not in the divergent parameters ($F(1,193) = 0.52$; $p = 0.47$). These age-group-specific features coincided with findings from the field of creativity research asserting that tactical game intelligence can be improved continuously through appropriate interventions (e.g., non-specific training concept; Memmert and Roth, 2007). In the training process, however, it is already deemed a success when the creativity of youths can be upheld. The variance is negligible between divergent and convergent parameters ($r^2 = 0.03$) as well as between the performances in the two basic tactics (creativity: $r^2 = 0.01$; game intelligence: $r^2 = 0.03$).

The results showed that both diagnostics instruments can be applied in order to capture soccer-specific creativity and game intelligence. They supply divergent and convergent parameters that can be deemed objective and valid, that have a sufficient degree of differentiation and can be measured economically. The variance between both parameters is negligible ($r^2 = 0.03$).

Study 2: Dynamic Talent Development in Soccer

Overview

The goal this second study was to investigate the intra-individual improvements in tactical features of selected DFB talents. This pushes the focus into dynamic

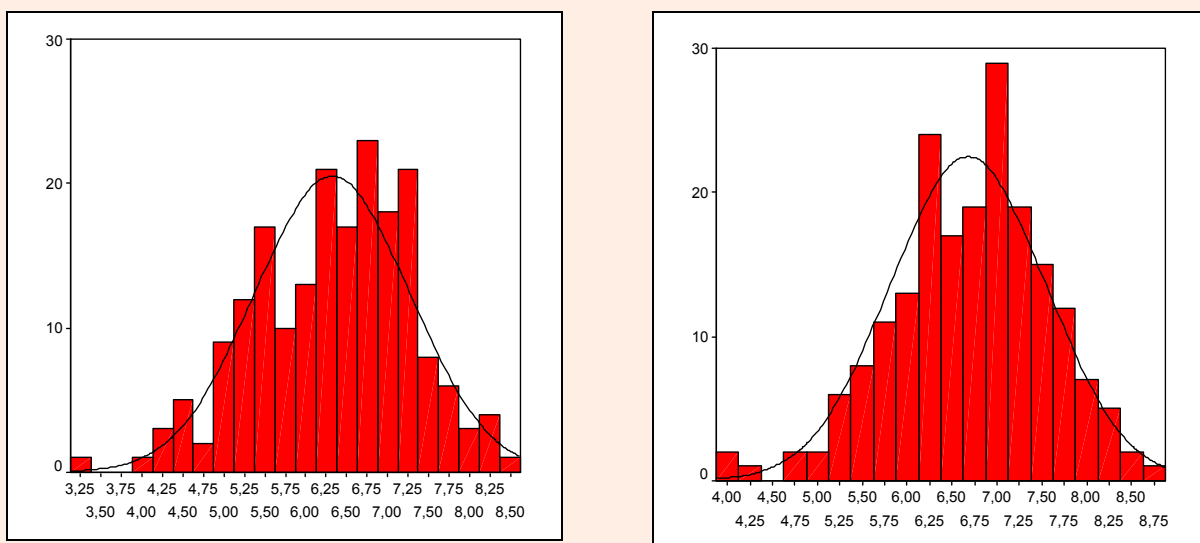


Figure 2. Diagram of the frequency distributions of the divergent (left; N = 195) and convergent (right; N = 195) performance parameters with the respective normal distributions.

performance diagnostics when analyzing the processes of change in the highly-skilled youths that are actively steered by the DFB talent promotion program, as well as the usual club training. According to the prevalent opinion, aptitude and talent manifest themselves in the positive reactions to certain training impulses within a certain period of time, where the focus is on divergent and convergent tactical thinking. Study 1 dealt with the development and evaluation of a new testing system for both of these parameters that was tested for its usefulness for the target group of 12- to 13-year-old high performing soccer talents.

Method

The study determined the soccer-specific creativity and game intelligence of 70 talents born in 1991 ($n = 36$) and 1992 ($n = 34$) at four selected talent bases in Baden-Württemberg (Leutershausen, Pfungstberg, St. Ilgen, Steinsfurt). In order to measure these parameters game test situations were used again (cf. study 1). The 12 performance measures for creativity and game intelligence available for each child (3 raters \times 2 rotations \times 2 basic tactics) were summarized into a divergent and a convergent overall parameter for the first and the second measurement point. The duration between both measurement times (t_1 , t_2) was 6 month. At each measurement times the test duration of all four game test situations was one and a half hour for each base, respectively.

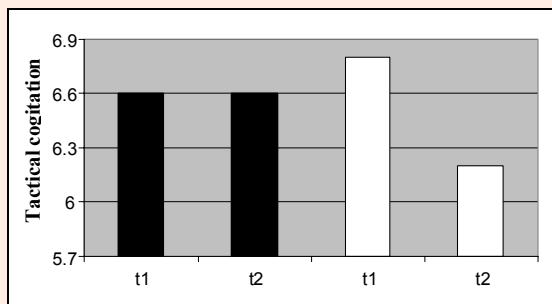


Figure 3. Diagram of the divergent (black) and convergent (white) tactical performance parameters as an average across all DFB bases (each $N = 70$).

Results and discussion

The data can be attested sufficient objectivity, since all intra-class correlation coefficients were above the critical value of 0.80. The consistency coefficient in the game-test situation is 0.74. It therefore lay in a similar area to measurements of general creativity (see Hocevar and Bachelor, 1989). The intra-individual change developments of the DFB talents can only be demonstrated after the completion of the general and differential evaluation steps that are required in order to be able to interpret the individual dynamic improvements and deteriorations appropriately.

General and differential result patterns: the results across all bases showed that none of the talents deteriorated in terms of creativity. The main effect time was not

significant (cf. Figure 3).

It is unreasonable to expect significant increases over a survey period of only half a year. However, at the selected talent bases, some descriptive divergent change tendencies existed, but they were not significant. There were no significant reciprocity between time and group, where the different starting levels of the four talent groups must be considered.

Since a significant deterioration in performance of game intelligence was observed (main effect time: $F(1,68) = 27.51$; $p < 0.001$, partial $\eta^2 = 0.29$) too little time may have been spent on tactical training in the home clubs or at some bases (cf. Figure 3). However, these results must be put into perspective, since a significant interaction effect was observed ($F(3,65) = 4.85$; $p < 0.001$, partial $\eta^2 = 0.18$). There were no changes at the talent bases of Pfungstberg and St. Ilgen while there were significant deteriorations at the other two bases.

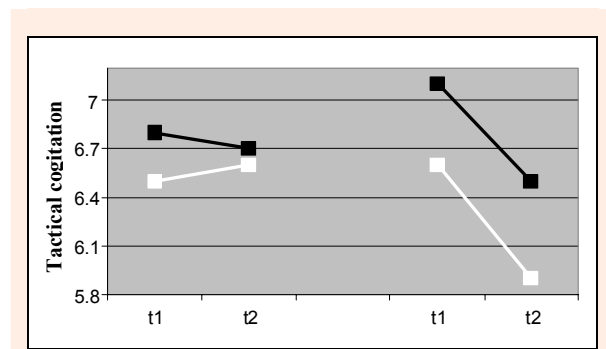


Figure 4. Diagram of the age-specific differences (age-group 1991: black; age-group 1992: white) with regard to the divergent (left) and convergent performance parameters (right).

It is possible that the age of the youths must be considered when interpreting the intra-individual changes of the DFB talents. Development of creativity is independent of the talents' year of birth (cf. Figure 4 on the left). There is a slight tendency for younger players to have become more creative. As demonstrated by Figure 3 (right), the deterioration of tactical game intelligence is independent of the talents' year of birth (interaction effect: $F(1,67) = 0.81$; $p = 0.37$). In connection with the general confirmation of a drop in performance, this result is not surprising, since there were similar training contents in both age groups and since the youths were supervised by the same coaches. In terms of tactical game intelligence, the older players are still ahead of the younger ones (main effect age: $F(1,67) = 13.19$; $p < 0.001$, partial $\eta^2 = 0.16$).

Talent specific intra-individual differences: At the center of the study was a dynamic performance diagnostic tool for analyzing intra-individual improvements of selected DFB talents. Although the study period only comprised six months, more than half the DFB talents ($n = 39$) improved with respect to their tactical creativity (cf. Figure 5 on the left). Twelve subjects improved by more than 5% and 20 by more than 10% with regard to divergent thinking. Three players of the age group born in 1992 and two players born in 1991 even improved their

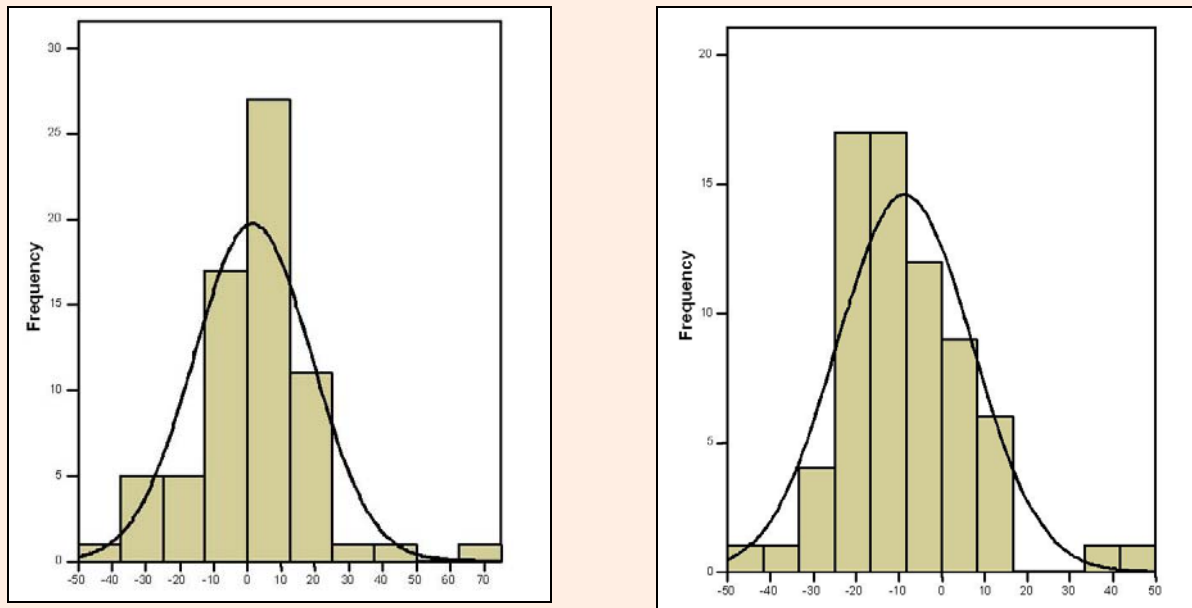


Figure 5. Diagram of the intra-individual changes of the DFB talents (in percent) with regard to the divergent (left) and convergent tactical performance parameters (right).

creative performance by more than 20%. This suggests a large potential for intra-individual improvements according divergent tactical behavior. After all, 16 talents (23%) displayed an increase in convergent tactical thinking (cf. Figure 5 on the right). Two of the younger talents even improved by more than 20%.

Which talents achieved the lowest intra-individual progress? Fourteen subjects weakened significantly with regard to divergent tactical thinking (>10%). The development of nine players declined by more than 20%. Game intelligence deteriorated for 36 talents and for 12 talents by more than 20%. In combination with other results at the talent bases (e.g. speed), an exclusion criterion can be considered in these cases. The results of individual talents at the bases can also be viewed in relation to the result patterns of all players of the respective age group. For instance, the creativity parameters of two players from the group of younger talents ($n = 10$) at the talent base Steinsfurt are better than 95% of all DFB talents, while the intra-individual (percentage) divergent performance parameter of one player is worse than 85% of all talents.

General Discussion

The result patterns of study 1 demonstrated that the diagnostics instruments can be applied in order to capture soccer-specific creativity and game intelligence. They supplied divergent and convergent parameters that can be deemed objective and valid, that have a sufficient degree of differentiation and can be not economically consuming. Therefore, the presented game test situations are another tool of testing tactical behavior next to the still established measurements of game performance (Griffin and Richard, 2003; Gréhaigne et al., 2005; Oslin et al., 1998; Richard et al., 2000; Richard et al., 2002; Richard et al., 1999; for a overview, see Memmert and Harvey, 2010).

At the center of the longitudinal performance diagnostics of study 2 are the development processes of the youths that are actively steered by the DFB talent promotion program. Aptitude and talent manifested themselves in the positive reactions to certain training impulses. Surprisingly, a general drop of the convergent performance values was detected, which turned out to be different for the particular training base camps. This can be explained by a different implementation through the coaches in the camps, even though the DFB provides consistent guidelines. Furthermore, tactic training might be included to a lesser extent than the training of motor skills. However, as Memmert and Roth (2007) showed, the development of divergent tactical performance does not necessarily have to be affected by that fact.

Although interesting differential talent-base-specific and age-group-specific result patterns were discussed along with more general aspects, the present project should not be interpreted as a treatment study or an intervention or evaluation study of the DFB concept or of the DFB bases. In addition, several factors that can hardly be controlled for – by any study – remain unconsidered in the period of half a year. Among these are the influence of continuous training at the home club (quantity/quality), playing during leisure time, as well as participation in rounds or selection games. These are confounded among each other as well as with the weekly training units at the bases.

The central aim of our second study was to examine the individual talents' intra-individual development of creativity and game intelligence. The results with respect to divergent tactical thinking clearly showed that very different change processes were observed in the DFB players. Accordingly, some youths reacted very positively to the training impulses in the training units at the club and at the bases. Why do some talents develop faster than others with regard to divergent thinking? The causes for

these large intra-individual variations remain reserved for future studies such as standardized treatment studies for instance. Possible reasons for the variations in the intra-individual development of creativity and game intelligence of individual talents could be related to different genetic potential, differing training intensities and above all, differences with regard to teaching quality. In addition, ecological and situational quantitative and qualitative analysis of training processes would be the best method in the future to closer link convergent and divergent tactical development of the players with the given interventions and the players' engagement in them.

Conclusion

Summarizing the result patterns for convergent thinking, it is evident that the targeted and guided tactical gathering of experience in soccer-specific situations is still neglected in many training units. For this reason, current books on tactics for school sports (Memmert, 2010b) as well as for children's, youth and high performance soccer at the club level place much more emphasis on individual and group-tactical requirements in soccer (cf. Memmert, 2006a; Thumfart, 2006; Uhing, 2006), in which the players can learn, relearn and vary soccer-specific skills in addition to convergent and (also) divergent tactical thinking. For instance, Memmert (2006a) conducted an extensive analysis of expert knowledge of qualified soccer coaches with important game situations from league games chosen by coaches. The video sequences obtained in this way served as the basis for the (qualitative) identification of group-tactical categories that play a significant role in high-performance soccer. The group tactics identified in this way were used as the starting point for constructing game and training forms used in the training of amateur and professional teams.

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References

- DFB. (2002) Trainingstipps für die Stars von morgen. [Training advices for the heroes of tomorrow] *DFB-Talentförderung [DFB talent education]*. Münster: Philippka-Sportverlag. (In German).
- Dietrich, A. (2007) Who's afraid of a cognitive neuroscience of creativity? *Methods* **42**, 22-27.
- Gréhaigne, J.F., Richard, J-F. and Griffin, L.L. (2005) *Teaching and learning team sports and games*. New York: RoutledgeFalmer.
- Griffin, L.L. and Richard, J-F. (2003) Using authentic assessment to improve students' net/wall game play. *Teaching Elementary Physical Education March*, 23-27.
- Grunz, A., Memmert, D. and Perl, J. (2009) Analysis and simulation of actions in games by means of special self-organizing maps. *International Journal of Computer Science in Sport* **8**, 22-36.
- Hocevar, D. and Bachelor, P.A. (1989) Taxonomy and critique of measurements used in the study of creativity. In: *Handbook of creativity*. Eds: Glover, J., Rowing, R.R. and Reynold, L.R. New York: Willey. 53-75.
- Memmert, D. (2006a). *Optimales Taktiktraining im Leistungsfußball [Optimal tactical training in professional soccer]*. Balingen: Spitta Verlag. (In German).
- Memmert, D. (2006b) Developing creative thinking in a gifted sport enrichment program and the crucial role of attention processes. *High Ability Studies* **17**, 101-115.
- Memmert, D. (2007) Can creativity be improved by an attention-broadening training program? – An exploratory study focusing on team sports. *Creativity Research Journal* **19**, 281-292.
- Memmert, D. (2009) noticing unexpected objects improves the creation of creative solutions—inattentive blindness influences divergent thinking negatively. *Creativity Research Journal* **21**, 1-3.
- Memmert, D. (2010a) Game test situations: assessment of game creativity in ecological valid situations. *International Journal of Sport & Exercise Psychology*. (In press).
- Memmert, D. (2010b) Development of creativity in the scope of the TGfU approach. In: *Teaching Games for Understanding. Theory, Research and Practice*. Eds: Butler, J.I. and Griffin, L.L. 2nd edition. Champaign: Human Kinetics. (In press).
- Memmert, D. (2010c). Sports and creativity. In: *Encyclopedia of Creativity*. Eds: Runco, M. and Pritzker, S. 2nd edition. Burlington: Elsevier Academic Press. (In press).
- Memmert, D. and Harvey, S. (2010) Identification of non-specific tactical problems in invasion games. *Physical Education and Sport Pedagogy*. (In press).
- Memmert, D. and König, S. (2007) Teaching Games at Elementary Schools. *International Journal of Physical Education* **44**, 54-67.
- Memmert, D. and Perl, J. (2005) Game intelligence analysis by means of a combination of variance-analysis and neural networks. *International Journal of Computer Science in Sport* **4**, 29-38.
- Memmert, D. and Perl, J. (2009a) Analysis and simulation of creativity learning by means of artificial neural networks. *Human Movement Science* **28**, 263-282.
- Memmert, D. and Perl, J. (2009b) Game creativity analysis by means of neural networks. *Journal of Sport Science* **27**, 139-149.
- Memmert, D. and Roth, K. (2007) The effects of non-specific and specific concepts on tactical creativity in team ball sports. *Journal of Sport Science* **25**, 1423-1432.
- Oslin, J.L., Mitchell, S.A. and Griffin, L.L. (1998) The Game Performance Assessment Instrument (GPAI): Development and Preliminary Validation. *Journal of Teaching in Physical Education* **17**, 231-243.
- Richard, J-F., Godbout, P. and Gréhaigne, J.F. (2000) Students' precision and interobserver reliability of performance assessment in team sports. *Research Quarterly for Exercise and Sport* **71(1)**, 85-91.
- Richard, J-F., Godbout, P., Griffin, L.L. (2002) Assessing game performance; an introduction to the Team Sport Assessment Procedure (TSAP). *Physical and Health Education Journal* **68(1)**, 12-18.
- Richard, J-F., Godbout, P., Tousignant, M. and Gréhaigne, J.F. (1999) The try – out of team sport performance assessment procedure in elementary school and junior high school physical education classes. *Journal of teaching in Physical Education* **18**, 336-356.
- Runco, M.A. (2007) *Creativity – Theories and Themes: Research, Development, and Practice*. Burlington: Elsevier Academic Press.
- Sternberg, R.J. and Lubart, T.I. (1999) The concept of creativity: Prospects and paradigms. In: *Handbook of creativity*. Ed: Sternberg, R.J. Cambridge: Cambridge University Press. 3-15.
- Thumfart, M. (2006) *Optimales Taktiktraining im Kinder-Fußball [Optimal tactical training in children soccer]*. Balingen: Spitta Verlag. (In German).
- Uhing, U. (2006). *Optimales Taktiktraining im Jugend-Fußball [Optimal tactical training in youth soccer]*. Balingen: Spitta Verlag. (In German).
- Ward, T.B. (2007) Creative cognition as a window on creativity. *Methods* **42**, 28-37.

Key points

- With game test situations it is possible to assess tactical performance as game intelligence and creativity objective, valid, with a sufficient degree of differentiation, and economically.
- The results with respect to game intelligence and creativity show that very different change processes were observed in the German Soccer Foundation players depend on the bases (trainers).
- Current literature on tactics for school sports as well as for children's, youth and high performance soccer at the club level should place much more emphasis on individual and group-tactical requirements in soccer.

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