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Chapter 8

General discussion

A decorative graphic at the bottom of the page consists of several concentric circles. The innermost circle is white, followed by a light yellow ring, then a slightly darker yellow ring, and finally an outermost ring of a vibrant orange color. The circles are centered horizontally and extend across most of the width of the page.

Purpose of the thesis

For an optimal development of young children, well-educated PE teachers who are using evidence-based tools and programs are prerequisite. Then, we can challenge all children at a young age to develop their skills which enables them to fulfil their own potential. For the development of children's motor skills, high quality PE lessons are nowadays more important than when I was young. During my early childhood years, it was more common to play with peers outside in a non-organized setting. We climbed in trees, played football, handball, tennis, hide and seek, or cycled around in our neighbourhood more than the children of today. The importance of the free playing for children's development was something I never realized before this PhD thesis. I'm also convinced that children still can learn and achieve the same levels of proficiency than children 30-40 years ago. However, that only occurs when children are challenged to improve their motor skills. The setting of PE offers therefore unique opportunities as 1) almost all children have weekly PE lessons, and 2) developing and improving is important in an educational setting. This thesis has focused on 1) the PE teachers' capacities of children under the age of ten who might become successful in sport, and 2) an understanding of programs that develop these capacities in young children. We formulated four main questions to achieve our two aims. These questions that lead this PhD thesis will be discussed and theoretical and practical implications will be described.

PE teachers' perceptions of children under the age of ten

In PE teachers' perceptions six capacities (i.e., motor capacity, work attitude capacity, sport learning capacity, creative capacity, interpersonal capacity, intellectual capacity) characterize children who might become successful in sport. PE teachers are assumed to identify and/ or help children to improve the six capacities in young children due to their educational background and expertise (Bailey et al., 2004; Thomas & Thomas, 1999). However, we should not forget that it is not known yet to which extent children can develop these capacities at young ages. The six capacities express the multidimensionality to become successful in sport. Of these six capacities, work attitude capacity and sport learning capacity are in PE teachers' perceptions most important. Study 2 revealed also the importance of these two capacities in coach's perceptions, regardless the type of sport. For children under the age of ten, the domain of sport is a setting in which development is more important than performance. Work attitude capacity and sport learning capacity reflects the capacity of being able to improve and are in line with the work of Abbott & Collins (2004) and Jonker et al. (2010) on effective developmental strategies. In individual-closed sport and team-open sport coaches' perspectives, motor capacity, interpersonal capacity, and intellectual capacity have a different significance. This might be explained by the (Vaeyens et al., 2008; Gagné, 2010; Taddei et al., 2012).

Assessment of the six capacities in an applied setting

An important remaining issue after study 1 and 2 was how to objectively assess the capacities which characterize under ten-year-olds who might become successful in sport. Tests that can be used in applied settings to assess and monitor capacities of young children could be of high value (Cools et al., 2009). In the domain of PE and sport it is relevant to be able to assess children's motor skills as this domain provides a crucial platform in the early childhood years (Morley et al., 2019). In study 3 we present a tool, i.e. the KTK3+ test, to measure children's motor skills in applied settings. More specifically, this test, in which we combined two existing tests, i.e. The Körperkoordinationstest für Kinder (KTK, Kiphardt & Schilling, 1974, 2007) and a hand-eye coordination test (Faber et al., 2014), measures children's locomotor skills (e.g., walking, running, hopping), balance/ stability skills (e.g. balancing, turning, dodging), and object control (e.g., throwing, catching, kicking) skills. These skills are representing children's FMS which are the building blocks for the more specific sport skills developed at later stages (Clark, 2007; Lloyd et al., 2014; Loprinzi et al., 2015; Cattuzzo et al., 2016). To gather the data, a web-application has been developed. With this application, time PE teachers must invest to objectively assess children's locomotor, stability/balance and object control skills in applied settings is minimized.

To assess work attitude capacity and sport learning capacity, with respectively three and nine underlying items, in an applied setting, we decided to develop an online tool. PE teachers score online for each child their perceptions of the current level of each item on a five-point Likert-scale. Teachers work with children daily and are expected to be well able to observe and assess these skills (Thomas & Thomas, 1999). The interpersonal capacity, with six underlying items, has been added to the questionnaire too. The intellectual capacity has three underlying items. These items (is one of the smartest students in the class, reports an above-average score on 90% of all subjects at school, has a high intelligence) can be identified in other courses at school. The creative capacity is about the original, unusual, and innovative solutions a child has for a movement problem. In sport, creativity is often linked to tactical skills and tactical performance (Memmert, 2006; Memmert & Perl, 2009). It is a multi-interpretable capacity and difficult to measure, probably also due to the didactical approach of most teachers by which children's creativity is less challenged. Although study 1 revealed its importance for the future success in sport, we have not yet been able to develop or found a tool to measure the creative capacity in an applied setting.

Characteristics of children selected in the sport setting

Study 4 showed that players selected for the U11 of a professional youth football academy outscore the deselected players on four of the six capacities (i.e., sport learning capacity, motor capacity, creative capacity, and interpersonal capacity) found in study 1. This stresses the importance of considering these capacities in selection processes, although more research is required. Not much is known yet about the stability of the capacities and how these adjust during the early stages



of children's sport career (Murr et al., 2018). Selected and deselected players exhibited no differences in work attitude capacity and sport learning capacity. Work attitude capacity is related to discipline and resilience which have been shown important characteristics of talented football players (Holt & Dunn, 2004). It is assumed that a good work attitude capacity is prerequisite to be selected in the first step (i.e. the process of selecting the most promising players from a large pool) of the sliding population approach (Regnier et al., 1993). In coaches' perceptions, intellectual capacity does also not differ between those selected and deselected. This might be due to the items underlying this capacity (e.g., has a high intelligence, is one of the smartest students in the class) which are directly related to the general intellectual capacity. It is unsure whether coaches are aware of the players' general intellectual capacity and whether intellectual capacity in the school context differs from intellectual capacity in the sport context.

The selected players also scored higher on most of the physical and football-specific measurements. However, several studies showed that physical and football-specific skills do not follow a linear trajectory and change constantly over time, questioning the validity of performance measures in early selections (Huijgen et al., 2010; Fransen et al., 2017). Study 4 also revealed that twenty-five players with, based on their test scores, a high probability, were deselected. In current selection methods, scouts and coach's subjective perception of players current and future performance level combined with only a limited number of places available might explain their exclusion. Academies should realize that the current approach results in the deselection of many players who might become successful in the future. To improve current talent identification and talent development processes, young players should be given more time to develop (i.e., select at later ages) and academies are advised to make use of more objective measures to monitor players' development. Indeed, in case we provide all children with better programs in a challenging environment in which they can improve their skills, academies have one reason less to select at early ages.

Outcomes of intervention programs to improve children's capacities

There are enough evidence children's motor skills in general diminished over the last 40 years (e.g., Vandorpe et al., 2011; Peil.Bewegingsonderwijs.nl). However, does someone argue whether this decline in motor skills is the result of a decline in children's capacity to develop? Or do we have to admit that most children are not challenged enough nowadays to develop their motor skills? The results of study 5 reveal that if we challenge children by goal-directed learning, children improve their FMS proficiency within a four-week period. In our intervention, goal-directed learning was stimulated by goal-directed instruction, goal-directed exercises, and goal-directed individual practice. A goal-directed learning approach also offers more opportunities for an autonomy-supportive teaching style. In such a teaching style the satisfaction needs (i.e., competence, autonomy, relatedness) of each child are most important (Haerens et al., 2015). The importance of goal-directed learning

has been shown before in older children and adolescent athletes (Iivonen et al., 2011; Toering et al., 2011). Especially the seven-year-olds improved themselves. Apparently, at this age children are more into a favourable phase of goal-directed learning to improve their FMS proficiency than the six years old.

Although on average the children improved after a four-week goal-directed learning intervention, there are differences in improvement between children. Study 6 shows that there is an association between children's sport learning capacity and their FMS proficiency. More specific, on the subtest moving sideways we found that those with a higher sport learning capacity improved their score on this subtest on average more than those in the lower sport learning capacity group. Many studies showed that the environment (e.g., amount of quality PE, school environment, involvement in organized sports) (Goldfield et al., 2012; Stodden et al., 2008; Roach & Keats, 2018) influence children's improvement of motor skills. Study 6 shows that sport learning capacity can explain differences in FMS proficiency and development between 7-year-old children. There are motivational and cognitive items underlying the sport learning capacity which relevance for predicting achievement have been shown before in other school courses (Hornstra et al., 2013). Especially psychological and cognitive capacities are difficult to measure. We suggest making more use of teacher's and coach's perceptions with a validated online questionnaire. A well-educated PE teacher and/ or coach, who observe children weekly in PE classes or sport trainings, is assumed to be well able to identify and score the items underlying sport learning capacity. The purpose of these analysis should be to understand a child's current sport learning capacity to improve the developmental process.

Recommendations for future research

The six capacities of study 1 provide us with the opportunity to set up multidimensional longitudinal research from a young age. Such an approach can validate the PE teacher's perceptions and provide insight to which extent individual capacities can explain differences in development between children. Although the results of this thesis provide opportunities to identify children at a young age who might become successful, there is no guarantee that these children will have success in later stages. We need large sample sizes as the prediction accuracy is inversely related to the length of time over which the prediction is intended to span (Vaeyens et al., 2008; Baker et al., 2019). Multidimensional longitudinal research designs are time- and energy-intensive, and therefore an innovative approach is required to set up these study designs (Johnston et al., 2018). In this thesis, we developed 1) a tool to assess children's FMS proficiency (i.e., study 3) that do not place burden on professionals' time, and 2) an application with which children's development over time is easily monitored. Still, although the feasibility of this approach is high, more research is needed to determine the validity and reliability of the assessment by PE teachers' themselves in applied settings.

Creative capacity is the one capacity that probably is the most difficult to measure. It has a multi-interpretable meaning. For example, Memmert & Roth (2007) report



it as a sport-specific tactical skill whereas Bailey and Morley (2006) define it as the responding of learners to challenges and tasks with fluency, originality, and sensitivity to problems. The items underlying the creative capacity as found in study 1, seem more to express the ability to solve movement problems. From this perspective, it can be explained why in study 2 we did not find differences between team-open sport and individual-closed sports. A remaining challenge for future research is how to objectively assess and develop this capacity in young children in the setting of PE and sport.

This thesis emphasized the importance at young ages of work attitude capacity and sport learning capacity as characteristics of children who might become successful in sport. A remaining issue is to which extent these two capacities can be improved across children's development. The items underlying the capacities are related to Dweck's growth mind set theory (2006). According to Dweck, a growth mind set can be developed. In which stage of development and how work attitude capacity and sport learning capacity can be improved by children, still must be determined. Furthermore, in case these capacities can be improved, it is relevant to determine whether that improvement also results in an improvement in FMS proficiency. A high FMS proficiency, measured with the KTK, has been shown to be an important indicator of the chance of future success in sport (Brien-Smith et al., 2019).

Study 5 revealed the short-term effects of goal-directed learning on children's gross motor coordination performances. Several studies showed that relative short interventions of four to six weeks have long-term effects (Haga, 2009; Matvienko & Ahrabi-Fard, 2010). These studies used a more extensive intervention than our 4 x 8 minutes of goal-directed learning in regular PE classes. Therefore, the long-term effects of the four weeks of goal-directed learning intervention must be determined still, even as the individual differences in development between children. Although on average the six and seven years-old improved their performances in four weeks, the standard deviation shows that some improved more than others. Children's sport learning capacity might explain the differences in improvement. Study 6 revealed that children with a higher sport learning capacity have a higher FMS proficiency, even as that on the subtest moving sideways a higher sport learning capacity is associated with a larger improvement over 24 weeks. However, children develop their FMS in a diverse range of settings which we did not measure in study 6. To which extent sport learning capacity, and work attitude capacity, can explain differences in improvement between children on the short and long term is a challenge for future studies.

Recommendations for practice

It has been stated before that PE teachers could play an important role in the initial assessment of children who might become successful (Bailey & Morley, 2006; Gulbin et al., 2013). Study 1 and study 2 revealed that for this assessment, PE teachers should identify six capacities, i.e., work attitude capacity, sport learning capacity, motor capacity, creative capacity, interpersonal capacity, and intellectual capacity in young children. Regardless the type of sport, work attitude capacity

and sport learning capacity are ranked highest, suggesting that these capacities should always be considered. This understanding of children's capacities supports the use of more general sports and physical education program content in young children.

To assess children's motor capacity, it is recommended to make use of four subtests, i.e., three subtests of the KTK, walking backwards, moving sideways, and jumping sideways (Kiphardt & Schilling, 1974; 2007) and an eye hand coordination test (Faber et al., 2014). These four subtests provide a PE teacher with an objective measure of children's locomotor, stability/balance, and object control skills (Gallahue et al., 2012). The three subtests of the KTK are easy-to-administer and have been reported as a reliable measure (Iivonen et al., 2014). The application developed to administer the scores on each subtest, increases the feasibility of the assessment even more. Study 6 showed that 7-year-olds within a period of 24 weeks significantly develop their FMS performance. We recommend PE teachers, 1) to determine children's improvement rather than draw conclusions based on a single measurement, 2) use narrower benchmarks than one year, at least at the younger age groups (<10), and 3) we suggest, in line with Iivonen et al. (2015), to use raw scores to interpret children's FMS proficiency instead of norm values which are population specific and fast out-dated.

In study 4 we found that, in the coaches' perceptions, the selected players have better sport learning capacity, motor capacity, creative capacity, and interpersonal capacity. Therefore, we recommend football academies, and other sports, to take psycho-cognitive capacities in account in selection processes. The importance of psychological and cognitive capacities at young ages for talent identification processes are stated in other studies (Abbott & Collins, 2004; MacNamara et al., 2010). However, these capacities are difficult to measure. Coaches' perceptions could provide valuable insights and are suggested to be more used to measure characteristics as sport learning capacity and interpersonal capacity. Study 4 also revealed that 25 deselected players had, based on their test scores, a high probability of being selected. Their exclusion could not be explained by the academy except that only 16 players were needed each season. It appears that current selection processes result in a high number of 'false negatives'. Based on these findings, we recommend clubs to keep the pool of selected players larger for a longer period and/ or even better to start selections at later ages.

Study 5 showed that six- and seven-year-old children can improve their gross motor skill performance within only 32 minutes of practice during PE classes when they are challenged to improve. That, to our understanding, also undermines the use of norms based on a single measurement to interpret children's proficiency. Children were challenged by goal-directed instruction ('today is a chance to improve, remember you will be tested again'), goal-directed exercises (exercises that are related to the aim of the lesson(s)), and goal-directed individual learning (pupils have the freedom to choose which exercise(s) they want to practice). The combination of these three elements resulted in large improvements and reveals the importance to stimulate a goal-directed learning approach. In study 6 we found



that those with a higher sport learning capacity have a higher FMS proficiency and, although only on one subtest, improved more. Based on the results of study 6, we recommend PE teachers to focus on the development of sport learning capacity in young children. The items underlying sport learning capacity are in line with Dweck's (2006) growth mind set theory. It is important that from a young age, children are learned that for example working hard, doing your utmost best, trying to improve, and failure is an excellent way to improve, and are key elements of a successful developmental pathway. How to develop these capacities in young children should be part of each PE bachelor study and youth coach education program.

Conclusion

The thesis focused on 1) a better understanding of the capacities of those children who might become successful in sports under the age of ten and 2) program's that contributes to the development of these capacities in young children. Six studies were conducted that provided answers on the four main questions, i.e.,

1. What in PE teachers' perceptions are capacities of children under the age of ten who might become successful in sports?
2. How can these capacities be assessed in applied settings?
3. Are current selected children characterized by these capacities identified by PE teachers and/ or sport-specific performance skills?
4. What are the outcomes of intervention programs to develop these capacities in 6-10-year-old children?

In PE teachers' perceptions children under the age of ten who might become successful in sport are characterized by work attitude capacity, sport learning capacity, motor capacity, creative capacity, interpersonal capacity, and intellectual capacity. The importance of especially work attitude capacity and sport learning capacity, regardless the type of sport, support more general sport and physical education program content for young children.

Motor capacity can be assessed by measuring children's FMS proficiency. FMS included locomotor skills, balance/stability skills, and object control skills. These skills can be assessed in a regular 45 minutes PE class with 25 children or in a regular sport training. The use of a web application to administer the data increases the feasibility, reliability and validity. Work attitude capacity, sport learning capacity, and interpersonal capacity could be assessed with a questionnaire filled in by the PE teacher or coach. The scores on other school courses represents children's intellectual capacity. This thesis did not provide an answer how to assess children's creative capacity, leaving it as a remaining challenge for future research.

This thesis revealed that in coaches' perceptions players selected for the U11 of a football academy outperform deselected players on sport learning capacity, motor capacity, creative capacity, and interpersonal capacity. Therefore, we suggest

academies should take these capacities into account in selection processes. However, the youth academy also appears to select on physical and football-specific skills outcomes. The relevance of these outcomes is doubtful at young ages. It can also be concluded that the current selection approach results in many false negatives. A probably better solution would be not to select at such young ages and to focus on the development of especially sport learning capacity and interpersonal capacity, for example in collaboration with schools / PE teachers, which in team-open sports have a high relevance.

Challenging children to help them to improve should be a key message to teachers, coaches, and parents, who play an important role in young children's development. Children can be challenged by using a goal-directed learning approach. Stimulate children to work goal-directed result in large improvement in FMS performance within a short period of practice. Still, long-term effects of this approach must be determined. The differences in development between children might be explained by children's sport learning capacity. We found an association between children sport learning capacity and their FMS proficiency even as that those with a higher sport learning capacity developed faster on the subtest moving sideways. More research is needed to determine to which extent children can improve their sport learning capacity and whether this improvement results in a higher FMS proficiency.

In summary, this thesis provided answers on four main questions. The answers on these questions shed new light on the understanding of the underlying processes of talent identification and talent development. We believe that not only those children with capacities to become successful in sport benefit of our studies, but all children. PE teachers and sport coaches working with young children should focus on the development of the six capacities. Well-developed capacities enable children to get the most out of their own abilities and have them experience the pleasure and excitement sport can offer.



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