

Bachelor scriptie 2014-2015

# Talent development in sportclimbing

Nikki van Bergen



Datum: 18-5-2015  
Begeleider: Dr. D. L. Mann



Faculteit der Bewegingswetenschappen,  
Vrije Universiteit Amsterdam

# Index

---

Introduction	2
Biographies of expert performers	3
Early specialization or early sampling	7
LTAD	10
Sportclimbing	16
Conclusion	24
References	24

# Introduction

---

Sportclimbing is an upcoming sport, which has become more and more popular over the last decades. What began as an outdoor activity is now changing into a competitive indoor sport. In 2007, the IFSC (International Federation of Sport Climbing) was officially recognised by the International Olympic Committee. With the growing professionalization, for coaches and staff members there is a growing demand for scientific evidence to support the athletes on performance related determinants, training methods and talent identification and development programs. However, especially on talent development and identification any empirical evidence is lacking so far. A better understanding of talent identification and development might result in a decreased dropout among youth athletes and ultimately lead to more and more healthy elite athletes. Therefore an answer to the question: 'What would be the optimal talent development guidelines for sportclimbing?' might be an important step forward in the development of the sport.

This paper consists of four key sections, which will be outlined in the next paragraphs. In many domains of sport there has been a lot of research focusing on the optimal methods for the development of talent, but this research has not yet been translated into direct research into sportclimbing. Therefore this report will summarize the existing literature and attempt to interpret the findings to further develop our understanding of talent development in sportclimbing. Since there are so many factors that influence talent development, the results of those studies remain contradictory, but some overall conclusions can be drawn. The athletic biographies of expert athletes give some insight into the different talent development pathways. In the first section those pathways will be examined by comparing the backgrounds of more and less successful athletes, including the age of onset of participation in their specific sport, participation in other sports, training volume and variability in training.

Many models of the most effective talent development pathways have been proposed. Those models can be grouped by making a distinction between early specialization and early sampling. Early specialization is marked by a high volume of domain specific training at an early age, and little involvement in play or other sports. Early sampling implies diversified involvement in a range of sports and large amounts of play at an early age, followed by specialization in one sport later in development. In the second section, those pathways are further explained and their advantages and disadvantages examined.

Many specific models for talent development are proposed, but the question of the best model remains unanswered. In the third section one of the more popular models, which is applicable to all kinds of sports, will be highlighted: the *Long Term Athlete Development Model* (LTAD). This model contains practical recommendations on the ideal contributions of training and competition throughout different stages of development, for both early specialization and early sampling sports. Furthermore it contains information about the periods in which children are most sensitive for the development of specific skills through training. In this way, an optimal overall talent development program is proposed. In the last part of this paper, this overall talent development program is translated to sportclimbing to make a suggestion on the optimal talent development guidelines in sportclimbing.

## Biographies of expert performers

---

A good point to start in the quest for the best talent-development pathway is to look retrospectively at the developmental history of elite athletes. Athletic biographies can be used to search for differences between elite athletes and non-elite athletes in their development pathways.

In sports, athlete development is usually depicted as a pyramid (Bailey et al., 2010). The different levels of the pyramid represent levels of competition, with the lowest level (recreation) at the base and the highest level (elite) at the top. The width of a level represents the number of athletes at that level. This number decreases with progressive levels of competition. The base of the pyramid is formed by mass participation and talented athletes tend to work their way up to the top of the pyramid. Gublin et al. (2013) noted that this linear model oversimplifies the developmental trajectory. It does not account for athletes who transfer from one sport to another and so would enter the pyramid at a higher level, or for athletes who descent some levels when switching from the youth to the senior competition. Anyhow, most of the talent development models known to date are of the linear kind. Therefore Gublin et al. (2013) "sought to provide a more fine-grained, sport-specific approach to examining athlete development".

Their research to a more fine-grained, sport-specific approach led Gublin et al. (2013) to propose a new model: the *Athlete Development Triangle* (ADT) (see Figure 1). The ADT is a more fine-grained variant of the development pyramid, in which not only ascending pathways

are possible, but also descending pathways, sideways transfers and entrance into the pathway at a higher level. First of all, not all athletes entered at the base of the triangle. The athletes entering at a higher level often had successful competitive experience in other sports and were able to 'switch pyramids'. The second important finding of this study is that most of the senior elite athletes had experienced some descending periods in their development. They returned at least once to a lower level of competition before ascending again. For the majority of the athletes this descent took place around the switch from the junior to the senior competition. Apparently, a switch from a higher level of junior competition to a lower level of senior competition was necessary to ultimately ascend to senior elite level. This proves that athlete development cannot be depicted as a predictable linear ascent as is proposed by most existing models of talent development.

The different trajectories in the ADT are primarily the result of individual circumstances, but they can be related to sport type as well. For example, switching pyramids and entering at a higher level might only be effective in sports with a relatively late age at which peak-performance is attained, because in sports with an early age of peak performance such as gymnastics, this switch might just come too late.

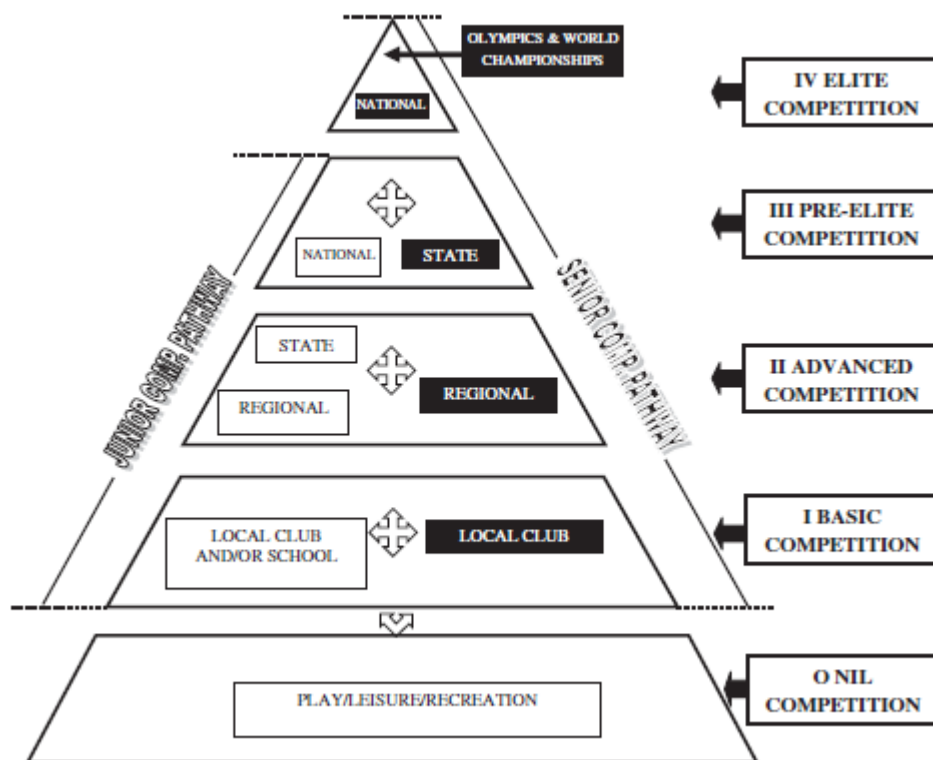


Figure 1: The Athlete Development Triangle (ADT) delineating the progressive levels of competition as well as the inter-relationships between junior and senior representative experiences. The arrows represent the possible shifts in the model between junior and senior competition (sideway transfers), between levels of competition (ascending or descending shifts) and entrance at different levels of competition. (Gulbin et al., 2013)

The finding that athlete development cannot be depicted in a linear model is consistent with the findings of Güllich et al. (2014). They analyzed athletic biographies of a large sample of German athletes across a range of Olympic Sports, focusing on age at onset, domain specificity, volume and variability in training and competition and success attained at different ages. The results showed that successful elite athletes displayed different patterns in training and competition histories. Furthermore, success in youth competition appeared to be a bad predictor of success in the elite senior competition. Although success histories were not homogeneous, two patterns of development could be distinguished. The first pattern leads to early adolescent success and is characterized by an early start of training and competition, early specialization and little or no involvement in other sports. The second pathway leads to long-term senior success and is characterized by a later age of onset of training and competition, later specialization and involvement in more other sports. Summarizing, the pathways leading to early adolescent success and long-term senior success are contradictory in many aspects.

Among senior elite athletes, the first pathway is under-represented. The rapid juvenile success leads to increased costs and risks and early depletion of individual resources, ultimately resulting in a high dropout rate. In the second pathway, the same volume of domain-specific practice is ultimately accumulated, but successful performers in this pathway differed from the performers in the first pathway in the amount of training in other sports. Most elite senior athletes participated in different sports, accumulating domain specific practice at the same time. Therefore, Güllich et al. (2014) conclude that, although domain-specific practice is critical for success, variability in training and competition in many different sports is the factor that distinguishes successful elite senior performers from non-elite senior performers.

Ford et al. (2009) performed similar research, though only in soccer players. They did not find that elite athletes practiced more sports in addition to soccer than non-elite athletes (who were successful in the youth competition but dropped out or switched to a recreational level) did, but they found a difference in the number of hours spent in playful soccer-related activities. They concluded that, when combined with an extensive number of hours in soccer practice, time spent in soccer play significantly contributes to success. To reach an elite senior level, the accumulation of sufficient practice hours is essential, but only when coupled with engagement in soccer play this leads to the actual attainment of elite status. Although there

were no differences found in the participation in other sports, these results support the importance of variability in training and competition noted by Güllich et al. (2014).

Taking the fact that time spent in outside-domain practice or domain-specific play results in more long-term success than when this time is spent in specific practice, this raises the question of-'why this would be the case'. Güllich et al. (2014) suggest that engaging in variable practice helps outstanding performers to find "the balance between availability, consumption, preservation, regeneration and new generation of individual resources" (Güllich et al. (2014), p. 394). First of all, exploring different activities might help young athletes to match their abilities to their best fitting sport. Second, athletes should find a balance between the costs and risks of time spent in their specific sport and the time demands and interests outside sport. Extensive practice might disturb this balance and consequently lead to dropout. Finally, variability in training improves individual performance while keeping physiological and psychological strain balanced with individual stress-tolerability. So the second pathway described by Güllich et al. (2014) leads to long-term athlete development because it is more resource-preserving and risk buffering. Furthermore it might assist the generation of new resources for the development of performance.

Summarizing, athletic biographies of expert performers show that development pathways are non-linear and heterogeneous. It is a process marked by ups and downs and sideway transfers between sports and between youth and senior competitions. There is not just one way to success. However, two overall pathways of athlete development could be distinguished. Those pathways give an answer to the main question of this section: How do more and less successful athletes differ regarding age of onset, participation in other sports, training volume and variability in training? First there is the pathway of rapid adolescent success, reached by an early onset age, early specialization, high intensity, specific practice and little or no involvement in other sports. This pathway is associated with early dropout and is less likely to lead to success at the senior elite level, but might be very effective in sports with an early age of peak performance. The other pathway does lead to long-term senior success and is characterized by a later age of onset, later specialization, more involvement in other sports and more play. In this second pathway, more successful athletes differ from less successful athletes or ex-elite athletes in the number of hours invested in variable training activities (e.g. other sports or domain-specific play) combined with a high amount of specific practice hours.

In the next chapter, those two pathways will be linked to two different models of talent development: the early specialization model and the early sampling model.

## Early specialization or early sampling

---

In the previous section, two different developmental pathways were differentiated from elite athlete histories. The first pathway leads to rapid adolescent success, the second to long term senior success. Both pathways are contradictory in volume of domain-specific deliberate practice, specialization and variability of training. In this section, those two pathways will be coupled with two different models of talent development: the early specialization model and the early sampling model. The advantages and disadvantages of both models and the differences between sports will be highlighted to examine both from the perspective of sportclimbing.

### *Early specialization*

*Deliberate practice* plays a central role in the early specialization model. Deliberate practice can be defined as 'organized activities in which the principal focus is on skill development and performance enhancement' (Côté et al., 2012, p. 269). This term was introduced by Ericsson et al. (1993) as part of the deliberate practice framework. According to this framework, deliberate practice could prevent performance improvements from leveling off. The number of hours spent in deliberate practice was said to be the most important factor distinguishing elite athletes from non-elite athletes. 10.000 hours of deliberate practice would be a requirement for expert performance.

The deliberate practice framework is in line with the early specialization model, which can be coupled with the pathway that leads to early adolescent success. The early specialization model is characterized by high amounts of deliberate practice and low amounts of play in one sport and an early focus on performance, already around 6-7 years of age (Côté et al., 2009). This early focus on deliberate practice is the result of a belief that deliberate practice in one activity from a young age distinguishes experts from non-experts. Furthermore, advocates of early specialization note that deliberate practice has to start early, because some skills and movements are best developed before maturation (Côté et al., 2012). There is evidence supporting the early specialization model among elite youth soccer players and elite gymnasts (Ford et al., 2009). Apparently, early specialization is likely to result in success at young age in those sports.



### *Early sampling*

There are, however, many studies indicating that deliberate practice is not the only form of beneficial activity. Therefore Côté et al. introduced the term *deliberate play*. Deliberate play is 'a form of sporting activity that involves early developmental physical activities that are intrinsically motivating, provide immediate gratification, and are specifically designed to maximize enjoyment' (Côté et al., 2012). The early sampling model is characterized by high levels of deliberate play and low levels of deliberate practice in the early stages of development. Furthermore, athletes are encouraged to participate in a wide variety of sports in the early stages of development (Côté et al., 2009). The early sampling model can be coupled with the pathway discussed in the previous section that leads to long term success. Côté et al. (2012) note that experts normally accumulate more hours of sport specific practice than non-experts, though it was shown that this difference only occurs after adolescence. Apparently, many elite athletes participate in various sports and engage in deliberate play throughout their youth, and only finally start specializing during adolescence. This can be explained by the fact that, during the early years, general capabilities have to be developed and improved. Those general adaptations can be transferred between sports. Only at later developmental stages need improvements become more specific (Côté et al., 2012).

### *DMSP*

The early specialization and sampling models are brought together in the *Developmental Model of Sport Participation* (DMSP) (Côté et al, 2012). The DMSP describes three trajectories for sport participation: 1) recreational participation through early sampling, 2) elite performance through early sampling and 3) elite performance through early specialization. The different stages described in each trajectory of the DMSP are marked by changes in the of amount play, practice and participation in multiple sports. Every trajectory leads to different outcomes in terms of long-term performance, continued participation and personal development. Together with the DMSP, seven postulates were introduced. The postulates are hypotheses that should hold if the DMSP is true. Those postulates describe characteristics of sport programs that promote not only performance, but also participation and personal development (Côté et al, 2012). As will become clear, the early sampling model is most suitable for those goals.

The first postulate will be highlighted in this paragraph, because it provides a clear distinction between sports. It states that 'early sampling does not hinder elite sport participation in sports

in which peak performance is reached after maturation' (Côté et al, 2009, p. 11). The typical age for peak performance in those sports is in the late 20's or early 30's, which gives the athletes enough time to accumulate sufficient deliberate practice after the sampling years. However, in sports like women's gymnastics and figure skating, peak performance usually occurs before maturation. In those sports, athletes do not benefit from an early sampling approach, because a period of sampling would result in a lack of time to specialize before the age of peak performance. Therefore, a clear distinction can be made between sports with an early age of peak performance and sports with a late age of peak performance. In the former, an early specialization approach is more beneficial. In the latter, an early sampling approach is recommended, because this model generates other advantages described in the subsequent six postulates (see Table 1).

**Table 1: The seven postulates of the DMSP (Côté et al., 2012)**

---

Postulate 1	Early sampling does not hinder elite sport participation in sports in which peak performance is reached after maturation.
Postulate 2	Early sampling is linked to a longer sport career and has positive implications for long-term sport involvement.
Postulate 3	Early sampling allows participation in a range of contexts that most favorably affects positive youth development.
Postulate 4	High amounts of deliberate play during the sampling years build a solid foundation of intrinsic motivation through involvement in activities that are enjoyable and promote intrinsic regulation.
Postulate 5	A high amount of deliberate play during the sampling years establishes a range of motor and cognitive experiences that children can ultimately bring to their principal sport of interest.
Postulate 6	Around the end of primary school (about age 13), children should have the opportunity either to choose to specialize in their favorite sport or to continue in sport at a recreational level.
Postulate 7	Late adolescents (around age 16) have developed the physical, cognitive, social, emotional and motor skills needed to invest their effort into highly specialized training in one sport.

---

Summarizing, the seven postulates highlight the personal and physical benefits of early sampling and the efficiency of sport programs based on early sampling. Early sampling has

many advantages in terms of personal development, prolonged sport participation and intrinsic motivation and regulation. Early specialization on the other hand, is often associated with overuse injuries and early dropout. Therefore the advantages of early sampling outweigh early specialization. Only in sports where peak performance occurs before maturation is an early specialization approach beneficial. However, considering the costs and the risks, the decision to commit to an early specialization program should only be made after thorough considerations on the part of the athlete and their family.

## LTAD

---

So far we have seen two key athletic development pathways that can both lead to success, that is either in early adolescent success or in long term senior success. Those pathways are associated with an early specialization or an early sampling model. Those models contain information about the volume of deliberate play and deliberate practice at different ages. However, they do not contain any information about which physical aspects should be focused on during certain stages of development and are therefore too generic to design a specific talent development program. A model that does propose a specific program for talent development is the Long-Term Athlete Development (LTAD) model, proposed by Balyi. In the following section, the LTAD will be explained and the biggest advantages and disadvantages of the model will be highlighted.

Together with the DMSPP, Côté proposed a talent development model consisting of three stages of development: the sampling years (age 6-12), the specializing years (age 13-15) and the investment years (age 16+) (Lloyd et al., 2012). Like many of the early talent development models, the problem with this model is that it is based on chronological age. Those models are widely criticized for not being able to differentiate between pupils with different rates of development. As a consequence, the LTAD was introduced. The LTAD is a training and competition model which consists of different phases, based on biological age (Robertson et al., 2005). The model is designed to promote an optimal athlete development path that does not only lead to expert performance, but also to lifelong sport participation. The LTAD consists of six stages and is applicable to both early and late specialization sports. In late specialization sports, athletes go through all six stages. In early specialization sports, the first two stages are skipped and athletes enter at the third stage (Balyi et al., 2004).

### *Biological age*

The six stages of the LTAD are based on the phases of development through which every athlete is thought to pass. Everyone passes through those developmental stages, but the timing differs between individuals. Therefore, a model based on chronological age would be too generic. Biological age should be used as the foundation for athlete development models, but biological age is very hard to determine. The LTAD uses Peak Height Velocity (PHV) as a reference for biological age. PHV is relatively easy to monitor and marks the onset of maturation. Prior to the PHV, no big differences in maturation are thought to occur between individuals, so training plans can be based on chronological age. At the onset of PHV, individual training programs are designed. Those programs are based on critical periods of trainability during the maturation process, in which accelerated adaptation takes place if the proper volume, intensity and frequency of exercises are introduced (Balyi et al., 2004). Those critical periods define the six stages of the Late specialization model of the LTAD as introduced by Balyi et al. (2004):

1. FUNdamental stage (occurs prior to PHV)
2. Learning to Train (occurs prior to PHV)
3. Training to Train (PHV occurs)
4. Training to Compete (after PHV)
5. Training to Win (after PHV)
6. Retirement

### *Windows of opportunity*

Before proceeding to a detailed description of those six stages, the concept of 'windows of opportunity' has to be explained. An important concept of the LTAD is the existence of windows of opportunity. Those are critical periods during the developmental years in which children and adolescents are more sensitive to adaptation induced by training (Lloyd et al., 2012). Balyi et al. (2004) note that all energy systems are always trainable, but during the windows of opportunity accelerated adaptations take place if the proper training is provided. Furthermore, the LTAD states that if the appropriate training is not provided during a specific window, a child will never reach their potential. So if you do not use the window of opportunity, you will never be as good as you could be (Ford et al., 2012). Therefore, the six stages of the LTAD are built around those windows of opportunity, to make sure that the athletes will reach their full potential.

It has to be noted that one of the biggest weaknesses of the current LTAD model is the lack of scientific evidence, especially on the existence of windows of opportunity. The LTAD states that when children do not engage in the appropriate training during a specific window, they may never reach their potential. However, research suggests that most components are trainable all throughout childhood and should not be restricted to specific windows during certain stages of the LTAD (Lloyd et al., 2012). There is scientific evidence that the fitness components defined in the LTAD develop more rapidly during the critical periods due to maturation (Virus et al., 1999), but there is no proof that this development is accelerated by training or that the training induced adaptations cannot occur in other periods. Therefore, the proposition that when windows of opportunity are not utilized, athletes will never be as good as they could be is unjustified (Ford et al., 2011). Ford et al. (2012) suggest the use of the term sensitive period instead of critical period. This softer term describes a period in which extra gains might be expected if the proper training is applied. When applied at another age, it is suggested that gains can still be made but a larger training volume might be needed. However, this still has to be confirmed. Ford et al. (2012) note that the original authors were referring to sensitive periods when they introduced the windows of opportunity in the LTAD. However, practitioners explained those windows as critical periods.

### *The six stages of the LTAD*

Balyi et al. (2004) gave a detailed description of the proposed six stages of athlete development, which is summarized below. Every stage is coupled to an age range. Those age ranges are based on the expected age of maturation of boys and girls. However, when applied in practice, tracking of the PHV is necessary to apply the model to individual athletes and ages might differ from the ages stated below. Furthermore, for every stage a main focus is introduced. Those are based on elements that have been proved to develop more rapidly in certain periods due to maturation (Virus et al., 1999). Balyi et al. (2004) believe that this process can even be accelerated if the proper training is provided during those periods. Therefore, Balyi et al. (2004) coupled the main focus in every stage to a 'window of opportunity'. However, as stated before, scientific evidence is lacking on this part.

#### Stage 1 - FUNdamental stage

From age 6 - 8 in females and age 6 - 9 in males the focus should be on learning all fundamental movement skills. The ABC's of athleticism (Agility, Balance, Coordination and Speed) are used to teach correct jumping, throwing and running techniques. This should be

done by using a positive and fun approach, mainly by playing games. Participation in multiple sports is essential for future performance, because this will enhance overall development of physical capacities. The first window of accelerated adaptation for speed occurs in this period.

#### Stage 2 - Learning to train

From age 8 - 11 in females and age 9 - 12 in males children are ready to learn overall sports skills that form the basis of athletic development. During this period, the focus should be on building overall sports skills. The window of opportunity for motor coordination occurs in this period, which makes it easier for children to learn those sports skills. In this phase, children should be introduced to competitions, but in very small amounts, that is a 70 : 30 training to competition ratio.

#### Stage 3 - Training to train

In the training to train stage, the aerobic base and strength are built and sport-specific skills are further developed. This phase, which occurs from age 11 - 15 in females and age 12 - 16 in males, contains windows of opportunity for both aerobic and strength training. Aerobic training should be the main focus after the onset of PHV, but speed, skill and strength should be maintained and if possible, further developed. Considering strength, the window of opportunity occurs immediately after PHV for girls and between 12 and 18 months after PHV for boys. Summarizing, the sensitive periods in this stage are both physically orientated. If an athlete misses this stage, those windows of opportunity are lost and the full potential will never be reached. This might happen due to an over emphasis on competition, in which case valuable training time is wasted. Therefore a 60:40 training to competition ratio is recommended. In this way, focus is on training, but athletes also get the opportunity to learn how to cope with physical and mental challenges in competitions and to practice technical and tactical skills.

#### Stage 4 - Training to compete

At the age of 15 - 17 in females and 16 - 18 in males, the general basic and sport-specific skills are in place and the focus shifts to performing those skills under a variety of competitive conditions. Optimal preparation to perform in competitions is the main goal in this stage. To optimize fitness, skills and performance, training and competition programs are individually tailored. Each athlete's individual strengths- and weaknesses are identified using the 'five S's': Stamina, Strength, Speed, Skill and Suppleness. Individual programs are formed in order to work on those strengths and weaknesses. The training to competitions ratio is 50 : 50.

### Stage 5 - Training to win

If the previous stages are all well established, all of the athlete's capacities should be in place around age 17 in females and age 18 in males. From this age on it is time to maximize performance. Athletes are trained to peak in major events. The training to competition ratio is 25 : 75, whereby the competition percentage also includes competition-specific training.

### Stage 6 - Retirement

When athletes decide to stop competing, there is the possibility to move into sport-related careers such as coaching, officiating, sport-administration and in the media.

### *Advantages*

It is clear that the LTAD provides a structured pathway for athletes from the beginning stage all the way to adult performance. It integrates the implications of growth and development on training to produce a program that enables athletes to reach their full potential. By implementing this program in all layers of society, not only are elite athletes provided with the best support, but also new elite athletes are formed among young children that are provided with the appropriate motor development programs (Robertson et al., 2005).

According to Balyi, the benefits of the LTAD are:

- Identification of athletes' skill levels to be achieved at each stage of development
- Identification of the stakeholder programming required at each stage of development
- Guidance in maximizing performance by taking into account optimal training windows
- Guidance in the realignment and integration of training and competition for developing athletes
- Guidance in offering programs that will result in positive experience for all participants.

### *Disadvantages*

The LTAD has served as an important first step in the introduction of the effects of growth and maturation on athlete development programs. Although it is successfully implemented in many domains of sports, it is widely criticized as well. First of all, one of the key elements of the LTAD is the monitoring of biological age by tracking the PHV. Especially when working with large groups, the measurement of biological age progression brings some methodological and practical issues (Ford et al., 2012). When biological age cannot be tracked, the LTAD

cannot be applied properly, considering that the different stages and the windows of opportunity of the model are based on biological age instead of chronological age. Even when coaches succeed in accurately monitoring biological age, the LTAD is said not to be individual enough (Ford et al., 2011). One of the most important concepts of an effective training program is individualization. The LTAD is made up of generic principles, which has to be adapted by coaches to suit the individual needs of their athletes. So the LTAD alone is far too generic to be applied to an individual athlete. Coaches need better education in how to implement the model and how to adapt it to the needs of an individual (Ford et al., 2011).

The problem of individualization is especially apparent when athletes enter the program later on when approaching adulthood. Those athletes will have missed the initial stages of the LTAD and do not get any opportunity to master the sport specific skills if the LTAD program is followed. Lloyd et al. (2012) propose the inclusion of training age as a solution to this problem. Athletes who enter the program at later ages after spending many training hours in other sports have an older training age, just like children with exceptional strength, power or aerobic capacity. Those athletes should not be restricted to the introduction of training methods, but should spend more time on mastering sport specific skills. When both biological age and training age are included, the problem of individualization is addressed (Lloyd et al., 2012).

The LTAD is also criticized for its limited approach to the holistic development of young athletes (Lloyd et al., 2012). Stamina, suppleness, speed, skill and strength are included, but other important components like power, agility and hypertrophy are not. Those factors are essential for performance as well, so Lloyd et al. (2012) recommend an inclusion in the LTAD on when and why those qualities should be trained.

Summarizing, at the moment, the LTAD is one of the best and only talent development programs based on biological age. By tracking PHV, biological age can be monitored and training programs can be individualized. This represents a significant advantage compared to athlete development programs that are based on chronological age which do not account for the individual differences in the timing of development. However, the measurement of PHV is difficult, especially for coaches working with big groups and the program might even be more individual if training age is accounted for. The six stages of the LTAD are defined by windows of opportunity. However, empirical evidence for the existence of those periods is lacking. Therefore it is suggested that the critical periods in the LTAD are replaced by



sensitive periods. In those sensitive periods, extra gains might be made if the proper training is applied, but those potential gains may not be lost if the window is missed. At a later period, the specific skills can still be developed, but a larger training volume might be needed. All together, the LTAD is an important step forward in the development of individualized development programs. However, coaches should specify the model to their domain of sport and keep on looking at the athletes critically and individually. It could be interpreted from the literature used in this study that the best training program is the program that is individually orientated and therefore it can never be replaced by a generic model like the LTAD.

## Sportclimbing

---

In the previous sections it was concluded that there are two pathways leading to success: early specialization, which is likely to result in rapid success in juvenile competition and early sampling, which might result in long-term success at senior levels. Due to the negative consequences of early specialization on long-term sport participation, the early sampling model is advised for sports with a late age of peak performance. The LTAD proposes a detailed program for athlete development in early and late specialization sports. Although criticized, this model is one of the most detailed and individually-orientated models to date, mainly because of the inclusion of biological age. Therefore, the LTAD might serve as a good guideline for a talent development program in sportclimbing. However, the model itself is way too generic to be applied without modification. Therefore, in this section, some suggestions are made on how to apply the LTAD to this specific sport.

### *Sportclimbing: early or late specialization*

First it has to become clear whether sportclimbing is an early or a late specialization sport, to decide which version of the LTAD should be applied (the four stage or the six stage version). In sportclimbing, there is a large degree of variation in the age of maturation of elite performers, making it difficult to clarify whether the sport is characterized by either an early or late age of peak performance. In the current worldrankings, the ages of the best ten women and men differ from 18 to 33, with a mean age of 24 among women and 26 among men (IFSC World ranking Lead). However, the fact that many athletes are able to compete at world level until their early thirties advocates the idea that the sport has a late age of peak performance. The wide spread in ages of peak performance might be due to a lack of knowledge about

talent development. As said before, early specialization results in rapid adolescent success, but leads to early dropout. Therefore an early specialization approach might result in very young elite athletes, even in sports with a late age of peak performance. The lack of knowledge on the downside of this approach might make countries decide to apply this pathway anyway, although it is not necessary for the athletes to peak at such a young age. Therefore, the suggestion is made that sportclimbing should be considered as a sport with a late age of peak performance. Therefore an early sampling approach is recommended, which corresponds with the six stage version of the LTAD.

### *Sportclimbing and the LTAD*

In the next paragraphs, six stages of talent development in sportclimbing are proposed. The suggestions made for those six stages are based on recommendations made by Balyi et al. (2004) in the LTAD. It is suggested that the different stages in the proposed model are explained as sensitive periods instead of critical periods. The components described in the windows of opportunity should determine the focus of the specific stages, but that does not mean other components should not be trained. If other components are not trained properly in those periods, an early specialization approach is followed, which might result in the previous mentioned negative consequences. Therefore coaches should be aware that they focus their training on the windows of opportunity, but keep on including as many other components as possible.

#### Stage 1 - FUNdamental stage (see Table 2)

From age 6 - 8 in females and age 6 - 9 in males, development of overall motor skills is accelerated (Virus et al., 1999). Therefore, Balyi et al (2004) proposed in the LTAD that the focus should be on learning all fundamental movement skills. According to the early sampling model, this should be done mainly by playing games and participation in multiple sports. Therefore, it is speculated that the amount of climbing at this age should be limited. Children should be encouraged to engage in multiple sports and activities, for example at sport clubs or just by playing outdoors a lot. Once or twice a week, they should engage in playful climbing activities to introduce them to all different climbing disciplines using a fun approach. Considering the importance of safety in climbing, it is suggested that children should learn about safety in this period as well, as an important aspect of the introduction to this sport. Furthermore, the first window of accelerated adaptation for speed, especially multi-directional speed, occurs in this period (Virus et al., 1999). Therefore, it is suggested that speed, especially

change of direction, should be developed in a playful manner (Balyi et al., 2004), for example by monkey-like climbing, jumps and other playful movements on the climbing wall. Balyi et al. (2004) state that children should not engage in competitions at this age, because that might disturb a playful, fun introduction to the sport.

**Table 2: Summary of the proposed FUNdamental stage in the translated LTAD model for sportclimbing.**

<b>FUNdamentals</b>	
Chronological age span	6 - 9 male 6 - 8 female
Naturally occurring development	Overall motor skills
Main focus	<ul style="list-style-type: none"> <li>- FUN and participation</li> <li>- General overall motor development</li> <li>- ABCs of athleticism (Agility, Balance, Coordination and speed)</li> <li>- Speed, power and endurance development through fun games</li> <li>- First introduction to rules and ethics of sports</li> </ul>
Windows of opportunity	First window of accelerated adaptation for speed, especially multi-directional speed (change of direction)
Climbing specific skills	<ul style="list-style-type: none"> <li>- Playful introduction to all the different climbing disciplines</li> <li>- Learning about safety</li> <li>- Learning to feel the centre of gravity using the ABC's of athletics</li> <li>- Develop speed in a playful manner,</li> </ul> <p style="text-align: center;"><i>The focus should be on a playful, fun introduction to climbing.</i></p>
Number of sessions per week	1-2 times per week in climbing if this is the child's sport of preference, 3-4 times in other sports or activities.
Training to competition ratio	100:0
Competition goals	-
Competition types	-

### Stage 2 – Climbing skills (see Table 3)

From age 8 - 11 in females and age 9 - 12 in males, development of motor coordination is accelerated (Virus et al., 1999). Therefore, according to the LTAD, in this stage the focus should be on building overall sport skills (Balyi et al., 2004). The window of opportunity for motor coordination occurs in this period, which makes it easier for children to learn those sports skills. Translated to climbing, it could be suggested that children can develop specific climbing skills faster during this stage. Therefore, it is speculated that the main focus in this period should be on the development of those climbing skills. This could be achieved by providing children with as many different climbing movements as possible. Suggestively, coaches should start with the basic climbing skills and introduce more complicated, specific skills toward the end of the phase, when climbing coordination is further developed.

Furthermore, the early sampling model states that children should still engage in other sports

at this age. Complementary sports, such as gymnastics might be a good addition for the development of climbing-related skills. Balyi et al. (2004) state that in this phase, children should be introduced to competitions, but in very small amounts (a 70 : 30 training to competition ratio) and with the emphasis on having fun.

**Table 3: Summary of the proposed Climbing skills stage in the translated LTAD model for sportclimbing.**

<b>Climbing skills</b>	
Chronological age span	9 - 12 male 8 - 11 female
Naturally occurring development	General climbing skill development
Progression focus	- Skill development, more specific towards the end of the phase. - Participation in complementary sports - Further endurance development by games and relays - Introduction of basic flexibility exercises - Further development of speed (especially during warm-up with agility, quickness and change of direction)
Windows of opportunity	Window of accelerated adaptation to motor coordination
Climbing specific skills	In this phase, children just have to climb a lot of everything: Both lead <sup>1</sup> and bouldering <sup>2</sup> on big overhanging walls, slabs, straight walls <sup>3</sup> on volumes or different kinds of holds <sup>4</sup> etc. The coach has to provide them with as many different movements as possible to optimally use the window of accelerated adaptation to motor coordination.
Number of sessions per week	3-4 times per week climbing or complementary sports, plus participation in other sports or activities
Training to competition ratio	70:30
Competition goals	Having fun, practice sport with many other children, have a great day
Competition types	- Club or intra-club championships - Mini leagues - Regional competitions - First introduction to national youth competition

<sup>1</sup> Lead is the best known climbing discipline: the athletes try to reach the top of a climbing wall around 15 - 20 meters in height, secured by a rope. The climber who reaches the highest point wins.

<sup>2</sup> Bouldering is the 'sprint' of sportclimbing. Athletes try to reach the top of short walls, about 4m in height. They are not secured by a rope, but big mats break their falls. This is the more powerful discipline in sportclimbing, which is used a lot by lead climbers as well to train strength and power.

<sup>3</sup> Overhang, straight wall and slab are the different wall types in climbing. They are characterized by their degree of overhang, which varies from hanging (overhanging) to laying (slab). Every wall type requires different abilities. Overhanging walls require a physical and powerful climbing style. Straight walls require great finger strength and careful, static displacement of the centre of gravity. Finally slabs require absolute static climbing, great balance and pressure on the feet instead of the hands.

<sup>4</sup> Volumes and climbing holds are the bright colored 'blocs' placed on an artificial climbing wall. The holds and volumes form a route which the climber has to follow. They can differ in shape and size and therefore specify the skills needed to reach the top of a climbing route.

### Stage 3 - Training to train (see Table 4)

During this stage, PHV occurs, which causes big individual differences in maturation. Therefore, PHV should be tracked to account for those individual differences in biological age (Balyi et al., 2004). Around PHV, development of aerobic capacity and strength is accelerated (Vuru et al., 1999). Balyi et al. (2004) defined a window of opportunity for aerobic training and a window of opportunity for strength in this period. Together with strength, the development of speed is accelerated (Vuru et al., 1999). Suggestively, emphasis should be on developing endurance in climbing, for example by climbing lead routes double or by doing interval circuits. Furthermore, in order to take advantage of the windows of opportunity for strength, athletes should be introduced to strength training. It is speculated that this should mainly be done by bouldering and by performing exercises with own-body weight, but not in more strenuous exercises like campusing<sup>5</sup> in order to avoid injuries when children are still growing. Due to the sudden growth of bones, tendons, ligaments and muscles around PHV, special emphasis should be placed on flexibility (Balyi et al., 2004). It is speculated that this could be integrated in the sportclimbing program by climbing many slabs and balance boulders, because those require great flexibility. The accelerated development of speed might be optimized by doing many explosive climbing movements, like dynamic boulders and dyno's<sup>6</sup>. In the training to train stage, the aerobic base and strength are built and sport-specific skills are further developed.

Summarizing, the emphasis in this stage should be on aerobic and strength training. During this period, the 'engine has to be built' (Balyi et al., 2004). However, athletes should be introduced to the tactical and mental challenges of competitions as well (with the emphasis of having fun, not yet on winning). Therefore a 60:40 training to competition ratio is recommended. In this way, focus is on training, but athletes also get the opportunity to learn how to cope with physical and mental challenges in competitions and to practice technical and tactical skills.

---

<sup>5</sup> Campus is a specific training form for strength in climbing. The basic exercise is to work yourself up without feet, on a wooden board with small planks attached above each other, separated by a fixed interval.

<sup>6</sup> A dyno is a climbing movement where the athlete is required to jump from one hold to another.

Table 4: Summary of the proposed Training to train stage in the translated LTAD model for sportclimbing.

<b>Training to train</b>	
Chronological age span	12 - 16 male 11 - 15 female
Naturally occurring development	Aerobic and strength development Further develop specific climbing skills
Progression focus	<ul style="list-style-type: none"> <li>- Emphasis on aerobic conditioning</li> <li>- Speed and strength should be further developed</li> <li>- Refinement of specific technical skills</li> </ul> <p><i>Due to differences in maturation, fitness and technical training should be individualized in this stage.</i></p> <ul style="list-style-type: none"> <li>- Special emphasis on flexibility, due to the sudden growth of bones, tendons, ligaments and muscles</li> <li>- FUNDamentals of tactical preparation</li> <li>- Introduction to mental preparation</li> </ul>
Windows of opportunity	Second window for speed. PHV: Window of opportunity for aerobic development at onset of PHV. Window of opportunity for strength: girls directly after PHV, boys 1,5 years later.
Climbing specific skills	<ul style="list-style-type: none"> <li>- Developing endurance</li> <li>- Using windows of opportunity for strength and speed to develop power, especially by doing many dynamic boulders and dyno's</li> <li>- Introduction to strength training, mainly in bouldering and exercises with own-body weight (avoid the campus board until after maturation)</li> <li>- Climbing many slabs and balancy boulders or routes for flexibility and feeling of the changed body</li> <li>- Introduction to onsight <sup>7</sup>training and simulations to introduce the athletes to the mental / tactical part of climbing.</li> </ul>
Number of sessions per week	3-5 times per week climbing
Training to competition ratio	60:40 (includes competition-specific training, like onsight training or simulations)
Competition goals	Climbers compete to win and to do their best, but the major focus is on training and learning the basics of competing: Practice of technical and tactical skills and learning how to cope with physical and mental challenges presented during competition.
Competition types	<ul style="list-style-type: none"> <li>- Club championships</li> <li>- Regional competitions</li> <li>- National youth competitions</li> <li>- First introduction to international youth competitions</li> </ul>

#### Stage 4 - Training to compete (see Table 5)

At the age of 15 - 17 in females and 16 - 18 in males, the sport-specific skills and conditioning are in place if the proper training is provided in the previous stages (Balyi et al., 2004). At this point, the focus can shift to performing those skills under a variety of competitive conditions. To optimize skills, condition and performance in competitions,

---

<sup>7</sup> Onsight is a specific form of climbing used in competitions. The athletes have to climb a route without prior knowledge, which means they are not allowed to try the route before, to get verbal information about the route from someone who has tried it, or to see another person climbing the route.

training and competition programs have to be individually tailored (Balyi et al., 2004). This can be achieved by identifying each athlete's individual strengths- and weaknesses to work on in individual training programs. It is suggested that at this point, an athlete should start specializing in a specific discipline, such as lead or bouldering, based on the addressed strengths and weaknesses. Furthermore, special attention should be paid to tactical and mental preparation, as part of the optimization of performance in competitions. Especially in sportclimbing, the mental part is considered crucial. During a competition, athletes have got only one chance to give their best performance. This has to be done in a completely new situation, by climbing a route they have never practiced before. This aspect is suggested to place extremely high mental demands on the competitors. Therefore, it is speculated that the mental and tactical preparation should receive extra attention. This could be done by doing a lot of onsight climbing and competition simulations in many different routes and climbing gyms. The training to competitions ratio is 50 : 50 (Balyi et al., 2004).

**Table 5: Summary of the proposed Training to compete stage in the translated LTAD model for sportclimbing.**

<b>Training to compete</b>	
Chronological age span	16 - 18 male 15 - 17 female
Naturally occurring development	- Optimize physical preparation and individual skills - Competitive preparation
Progression focus	- Individual conditioning - Individualization of technical / tactical skills - Basic tactical preparation - Basic mental preparation
Windows of opportunity	Last part of the second window of opportunity for strength at the beginning of the phase
Climbing specific skills	- Address individual strengths and weaknesses and start working on this in training - A larger emphasis is placed on the mental game, which is considered crucial in climbing - Start strength development through campus training - Start specializing in a specific discipline (bouldering or lead)
Number of sessions per week	5 – 7 times per week climbing
Training to competition ratio	50:50
Competition goals	Climbers compete to win and to do their best, but the major focus is on applying the basics of competing, learning about weaknesses and strengths and to learn how to cope with pressure and defeat.
Competition types	- National youth competitions - International youth competitions - National senior competitions - First introduction to international senior competition

### Stage 5 - Training to win (see Table 6)

From age 17 in females and age 18 in males on, it is time to maximize performance. Athletes are trained to peak in major events (Balyi et al., 2004). All aspects of training are completely individualized. It is suggested that focus points should be determined for every individual athlete, based on strengths and weaknesses. Those focus points should cover all components that influence performance (such as tactical preparation, mental preparation, physical components and skills). Specified to climbing, the individual maximization of performance might mean that climbers should focus solely on one discipline at this stage. However, it is suggested from experience that the other disciplines could be very useful for training specific aspects (see Table 6). The training to competition ratio is 25 : 75, whereby the competition percentage also includes competition-specific training (Baly et al., 2004).

**Table 6: Summary of the proposed Training to win stage in the translated LTAD model for sportclimbing.**

<b>Training to win</b>	
Chronological age span	18+ male 17+ female
Naturally occurring development	Maximize all components individually to peak in major competitions.
Progression focus	<ul style="list-style-type: none"> <li>- Advanced tactical preparation</li> <li>- Advanced mental preparation</li> <li>- Improve all physical components</li> <li>- Work on strengths and weaknesses</li> </ul> <p><i>All aspects of training are completely individualized in this stage</i></p> <ul style="list-style-type: none"> <li>- Further develop knowledge and experience</li> </ul>
Windows of opportunity	None, all the fitness components should be in place now. Athletes are trained to peak for competitions
Climbing specific skills	<ul style="list-style-type: none"> <li>- Focus on one discipline (that does not mean that the other disciplines should not be trained anymore! For example, bouldering is a very useful strength training exercise for lead climbers and lead training is very useful to become physically fit for bouldering)</li> <li>- Choose focus points for every individual athlete based on strengths and weaknesses on all components that influence performance.</li> </ul>
Number of sessions per week	6 – 8 times per week climbing
Training to competition ratio	25:75
Competition goals	Win
Competition types	<ul style="list-style-type: none"> <li>- National senior competition</li> <li>- International senior competition</li> </ul>



# Conclusion

---

It is concluded that sportclimbing should be categorized as a late specialization sport and therefore an early sampling model is recommended. A pathway leading to success in late specialization sports is marked by large amounts of play and participation in other sports during childhood, followed by late specialization. This is likely to result in longer sport careers and success at senior elite level instead of success in the youth competition and early dropout, which might be the case when an early specialization approach is followed. The LTAD offers some useful guidelines for talent development programs in late specialization sports. However, the model is far too generic and should be translated to climbing specifically to be of maximal benefit. Due to the lack of research on talent development in sportclimbing, this translation can only be suggested, which was done in the last section of this paper. This might be a first step in developing a structured talent development program for sportclimbing. However, clearly more research is needed to address its effectiveness.

# References

---

- Balyi, I. & Hamilton, A. (2004). Long-Term Athlete Development: Trainability in Childhood and Adolescence. Windows of Opportunity, Optimal Trainability. Victoria: National Coaching Institute British Columbia & Advanced Training and Performance Ltd.
- Côté, J., Lidor, R. & Hackfort D. (2009). ISSP position stand: To sample or to specialize? Seven postulates about youth sport activities that lead to continued participation and elite performance. *International Journal of Sport and Exercise Psychology*, 7(1), 7-17.
- Côté, J., Murphy-Mills, J. & Abernethy, B. (2012). The development of skill in sport. In Hodges, N. & Williams, M.A., *Skill Acquisition in Sport: Research, Theory and Practice* (269-286). Abingdon: Routledge.
- Ford, P.R., Collins, D., Bailey, R., MacNamara A., Pearce, G. & Toms, M. (2012). Participant development in sport and physical activity: The impact of biological maturation. *European Journal of Sport Science*, 12(6), 515-526.

- Ford, P.R., De Ste Croix, M., Lloyd, R., Meyers, R., Moosavi, M., Oliver, J., Till, K. & Williams, C. (2011). The Long-Term Athlete Development model: Physiological evidence and application. *Journal of Sports Sciences*, 29(4), 389-402.
- Ford, P.R., Ward, P., Hodges, N.J. & Williams, A.M. (2009). The role of deliberate practice and play in career progression in sport: the early engagement hypothesis. *High Ability Studies*, 20(1), 65-75.
- Gulbin, J., Weissensteiner, J., Oldenziel, K. & Gagné, F. (2013). Patterns of performance development in elite athletes. *European Journal of Sport Science*, 13(6), 605-614.
- Güllich, A. & Emrich, E. (2014). Considering long-term sustainability in the development of world class success. *European Journal of Sport Science*, 14(1), 383-397.
- Lloyd, R.S. & Oliver, J.L. (2012). The Youth Physical Development Model: A New Approach to Long-Term Athletic Development. *Strength and conditioning journal*, 34(3), 61-72.
- Robertson, S. & Way, R. (2005). Long-term athlete development, *Coaches report*, 11(3), 6-12.
- Viru, A., Loko, J., Haroo, M., Volver, A., Laaneots, L., & Viru, M. (1999). Critical periods in the development of performance capacity during childhood and adolescence. *Physical Education and Sport Pedagogy*, 4(1), 75-119.