

USA Sport Science Summit 1998

Introduction: Written by Michael Lawrence
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A weekend in December 1998 proved to be one of the most enlightening learning experiences of my coaching career. Clinics, seminars, and workshops tend to deliver information in one of two ways: 1) coaches explaining how they do things; or, 2) academicians explaining how things ought to be done. Rarely do the theoretical and the practical meet across the same table.

The USA Swimming Sport Science Summit brought together fifteen individuals well-known for their individual expertise. Some of the names were familiar to me from research materials and books. To leave having a face to go with each name was gratifying.

What struck me most through the weekend was the rapid and thoughtful exchange of ideas. After each presentation every member of the group added new perspective from their area of expertise. New questions were posed and new solutions suggested by people familiar but not immersed in the sport. Translating this to the practical, the pool deck, was a wonderfully engaging effort.

Recognizing that children are not miniature adults is easy. Reconciling that fact with a social emphasis on competition and winning is the most difficult task in coaching. "TMTS" too much, too soon-is what we strive to avoid. In the face of the overwhelming evidence presented in a wide range of developmental disciplines it is difficult to avoid making programmatic changes. The need for some of the changes we are making in our program at Lake Forest were reinforced by the group. Based largely on discussions with the group we are making additional changes, some of which will take months and years to implement fully.

1. Unused space in a "stretch" pool has been converted to 13m lanes which we use for skill instruction for novice and younger swimmers. These lanes have also proven useful as a sprint course for older swimmers.
2. Additional opportunities for social interaction are being offered at practices/competitions and as extra-curricular activities.
3. Our philosophy of gradual introduction to competition offers more skill-oriented "rodeos" or meets and progresses to more intramural opportunities.
4. A traditional strength-training program is being reviewed with particular consideration of the long-term psychological effects of years in the weight room.
5. Gender differences and developmental issues are being actively discussed and strategies developed for addressing issues. This has been an ongoing effort for the past three years. From 1996-1999 we have seen a 17% increase in the number of boys participating on the team.

We expect to continue to establish strategies that foster the long-term development of our athletes. The information presented has been invaluable in bolstering these changes. USA Swimming is wise to continue these discussions and publish summaries for it's membership. Both clubs and LSCs will find the information helpful in creating a better sport experience for young people.

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Sport Science Summit Experts

Coaches:

- Pat Hogan, Mecklenburg Aquatic Club
- Kerry Ellett, Age Group Planning Committee Chair
- Mike Lawrence, Lake Forest Swim Club

Growth and Development:

- Crystal Branta, Michigan State University

Physiology:

- Jaci Van Heest, Univ. of Connecticut
- Tim Gibbons USOC Endurance Coordinator

Pediatrician:

- Paul Stricker, Vanderbilt University

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- Steve Langendorfer, Bowling Green State University

Sociology:

- Jay Coakley, University of Colorado - Colorado Springs

Psychology:

- Dan Gould, University of North Carolina at Greensboro
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Understanding Athletes Physical Growth and Development: What Swim Coaches Need to Know

Individuals follow a predictable pattern of physical growth but the rate at which children and youth go through this growth varies by individual.

- During the childhood phase, children (on average) grow about 2.5 in./yr. and gain about 5 pounds/year.
- Peak height velocity of growth occurs during puberty/adolescence.
- Athletes of the same chronological age can vary by as much as 5 biological years, especially during adolescence. Therefore, with two 11-year-old swimmers, one may be 10 and the other 15, biologically. Talk about competing on uneven playing fields!

Recommendation: Educate athletes regarding growth cycles and factor into your training program the variations in the timing of physical growth. Also, to ensure young athletes are growing properly, record basic growth data before, during, and after the season.

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Performance can be influenced by maturity, which is out of the athlete's control. Some young athletes, therefore, have a performance advantage over others.

- Initially, early maturers have a physical size advantage and often perform better than late maturers. These individuals experience more early success due to a physical growth advantage and not necessarily enhanced skills or abilities.
- Conversely, late maturers experience failure and frustration because they are physically "behind" their same-age (chronological) peers.
- Adolescent awkwardness due to rapid physical growth affects performance, especially for early maturers.
- Late maturers often catch up to or exceed the performance of early maturers by the mid-teen years, but only if they have stayed with the sport. Some drop out because of a lack of early performance success or, worse, are cut from the team.
- Tracking of "outstanding" kids in elementary school found that only 25% were still outstanding in later years, suggesting that early success does not predict later success.

Recommendation: Help early maturers keep success in perspective as late maturers will often catch up with them in terms of performance and success will be harder to achieve. One means of doing this is to have early maturers compete at times, against athletes with the same abilities regardless of age. Additionally, take active steps to keep late maturers involved as they often leave the sport because of low perceptions of competence due to little early success. Be creative in helping them experience some success.

Gender differences in physical growth and in the timing of the growth spurt contribute to the overall difference in the height and body shapes of females and males.

- Girls reach peak height velocity (growth spurt) between the ages of 11-13 and boys between the ages of 13-15.
- Hormonal differences in males and females cause body composition changes in adolescence, changes which are out of the athlete's control but which may impact performance (positively and negatively).
- Because males are in childhood growth longer and have a more intense growth spurt at puberty, adult males generally have a greater percentage of their height in their legs.

Recommendation: Males and females differ in the growth and development process; both when the growth spurt occurs and ensuing physical changes. It is important to take these differences into account when training adolescent males and females as well as to educate them on the developmental process. Because of the numerous and sometimes drastic changes, it is crucial to allow time for young athletes to get comfortable (physically and emotionally) with their changed bodies. Additionally, adaptation to the growth changes lags behind so expect it to take some time for the athlete to be able to take advantage of changes.

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A Physiological Perspective to Understanding Athlete Development: What Swim Coaches Need to Know

It is important for coaches to have an understanding of the biological/physiological development of the young athlete as this knowledge can and should be implemented to maximize the child's potential. There are three primary physiological performance components that undergo quantitative changes (increased size or capacity) and qualitative changes (increased efficiency) with growth and development. The components include aerobic capacity, anaerobic capacity, and muscular strength, power and endurance.

Aerobic Capacity

- $\dot{V}O_2\text{max}$, the ability to take in, transport, and utilize oxygen, is the common parameter used to measure aerobic capacity.
- $\dot{V}O_2\text{max}$ shows significant growth from 11-13 years for females and 12-14 for males. This time frame, when significant growth can occur (sensitive period), should be maximized in the training program to develop the athlete's long term potential. The athlete is able to rapidly increase workload during this sensitive period.
- Pre-pubescent athletes show significant improvements in long duration, low intensity events and are able to enhance the utilization of their aerobic capacity.

Recommendation: Coaches should optimize aerobic training during this "sensitive period" (11-13 years for females/12-14 years for males) to maximize athlete's aerobic development. It is suggested that pre-pubescent athletes (ages 9-12/14) focus on longer distances (i.e., longer repeats and longer competitive events) for reasons related to both skill development and aerobic capacity development.

Anaerobic Capacity

- Anaerobic training involves high intensity, brief activities (repeats on long rest or 25yd. sprints or less).
- It has been found that high volume pre-pubescent anaerobic work results in insignificant long-term anaerobic improvement for young athletes (10-13 years). It may result in short-term time drops.
- However, higher aerobic work during this time results in increased performance across all distances not just longer distances.
- Increased anaerobic load early leads to potential maladaptation in young athletes...it is said to "tax their tank" and their ability to adapt.
- A gradual increase in the proportion of anaerobic work beginning at ages 12-14 for girls and 13-15 for boys maximizes development and enhances performance, BUT only if preceded by ample aerobic work.

Recommendation: Coaches need to first develop the athlete's aerobic capacity and then gradually increase anaerobic load for maximum development of anaerobic capacity.

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Muscular strength, power and endurance

- A frequently asked question is whether young athletes should be strength training. It is suggested that you can see muscular gains and adaptations but only if strength training is done under the right scenario -- with close supervision to ensure proper technique.
- Prior to puberty, the gains come from neuromuscular changes not changes in muscle size. With increases in steroid hormones (puberty), we see gains due to changes in muscle size (predominantly in males).
- As muscle size increases, so does strength. But, typically there is a year lag time between size/mass increases and maximum effects of strength gains in young athletes.
- Additionally, the translation of land-based strength, power, and endurance to pool performance can vary from half a year up to two years.
- The age of 14-15 is when peak gains occur; quantitative muscular changes can occur with proper training - "window of time where they are plastic". However, it is not until half a year up to two years later that this will be translated into an increase in strength.

Recommendations: First, keep in mind that young athletes are not miniature adults. Because of hormonal and biological differences between children and adults, children will not increase muscle size through strength training. However, neuromuscular adaptations can occur. It is only after puberty that muscle growth occurs. Keep in mind that the ability to translate muscular work to swimming velocity is the key, as our concern is helping children swim faster. Therefore, we must ensure that strength training is implemented or modified to meet this objective.

Developmental Information

Sport performance is determined by a myriad of variables. Two athletes may be the same age but not of the same ability due to intrinsic, developmental differences in: flexibility, balance and coordination, reaction time, body composition, motivation, endurance, and self-esteem, to name a few.

Growth and development

- Growth does not occur at a continuous rate but rather is greatest at puberty.
- Growth is sequential with long bone growth occurring initially, followed by growth of the trunk, and lastly increases in muscle mass.
- Psychomotor skills (development of motor skills) cannot be integrated appropriately by the central nervous system (CNS) until age six-eight.
- Significant increases in muscle mass cannot occur in the absence of significant levels of androgenic hormones; therefore, prior to puberty young athletes will not have significant gains in muscle mass regardless of the work they are doing.
- There are gender differences based on maturation. The ranges given are to be used as general guidelines.

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Early Childhood (2-5 years)

- From four-six years there is a paradoxical drop in postural and balance skills due to the young athlete being overloaded with proprioceptive (information regarding muscular dynamics and limb movement) and vestibular signals to integrate into balance control -- the athlete is initially overwhelmed.
- Total attention to balance may delay improvement if other variables are present.
- Young children have very short attention spans; can only focus on one thing for a short period of time. Instruction is best offered by show and tell.
- At this age, unstructured play is important - emphasize play, exploration, fun.
- The child does not have fully mature visual skills - imprecise eye movement, relative farsightedness, lack of visual maturity which relates to a lack of coordination.
- Sport modification is necessary (i.e., T-ball).
- There seems to be no long term advantage from practicing at this age.

Childhood (6-9 years)

- Postural and balance skills mature and become automatic by about seven. Athletes demonstrate improved fundamental skills - coordinated breathing in freestyle - and most master skills to progress on to transitional skills for organized sports.
- Young athletes still have a short attention span. Additionally, they have difficulty with integration - limited memory strategies impairs rapid decision making of complex sport skills. It is still best to provide both visual and verbal instructions.
- There is conflicting results regarding the benefits of participation in terms of being more skilled as an adult if the child starts the sport now.
- The eye is a mature spheroid shape. The young athlete has better eye movement and tracking, but CNS processing lags behind so they may judge velocity well but not direction. Because of eye changes, judging the wall moving towards them may make it difficult for swimmers to learn efficient turns until vision is more completely mature.
- Sports or activities with many variables, complex skills, and rapid decision making may still be too difficult for some athletes.

Preadolescence (10-12 years)

- In terms of motor skill development, at this age there is improvement in fundamental, transitional, and postural skills.

Adolescence (13-16 years)

- Athletes are able to use memory strategies necessary for complex skills and are also able to integrate information from many sources.
- Athletes are able to focus appropriately, use selective attention, and they demonstrate advances in decision making capabilities.
- There are striking developmental differences around age 13-15 due to maturational differences.
- There may be some deterioration in postural control during peak height velocity as the athlete struggles to adjust to his/her rapidly changing body.
- "Clumsy teenager" - temporary stage requiring adjustments in interpretation of proprioceptive components for participation.
- Remember: epiphysial (growth) plate injury is most vulnerable to injury during the period of most growth.

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Strength development

- As the coach, you must consider the athlete's age, level of development, maturity, desire, and level of sport skill, and also assess the risks and benefits of strength training in determining if it is appropriate for athletes.
- Girls demonstrate faster increases in the sensitive period for strength which is from 13-15 years. This is after their Peak Height Velocity time (11-13 years).
- Boys tend to evidence strength gains (14-16 yr) one year after peak height velocity (13-15 yr).
- Various mechanism by which strength gains occur:
 - Motor learning
 - Improvements in motor coordination
 - Morphological and neurological (nervous system) adaptations

Considerations in Training

- Heat tolerance: younger athletes are not as tolerant of excessive heat. They generate more heat, sweat less, have slower acclimatization, and get more thermal impairment with dehydration.
- Flexibility: found to decrease with puberty in males while some improvement is seen in females.

Conclusions

- Youth sports involve a complex interaction of development, physical, physiological, cognitive and social factors.
- Developmental skills are acquired progressively and sequentially but at different rates.
- Coaches need to ensure that the activity/demands are appropriate given the athlete's level of development rather than age.

A Sociological Approach to Understanding Athlete Development: What Swim Coaches Need to Know

The athletes you coach do not participate in sports in a vacuum. They are greatly affected and influenced by the social and cultural environment in which they live and by the social development challenges they face during childhood and adolescence. To enhance your effectiveness in working with young athletes, it is important to take into account this social development as it impacts areas such as the athletes' goals, behaviors, needs, and self-concept.

Sport sociologists attempt to understand the relationship between social development and sport participation. They assume that the achievement of maturity- and an adult sense of responsibility depend on the completion of important developmental tasks during childhood and adolescence. Coaches should be aware of how the social relationships associated with sport participation are involved in the completion of these developmental tasks. For example:

Children (7-10 years old) face the challenge of learning how to get along with peers and how to deal with authority figures apart from their parents.

During these years it is important for children to learn how to stand up for themselves among their peers while at the same time understanding that their peers are different than they are. They must learn how to compromise for the sake of getting along, and how to cooperate and compete with their equals. If these social interaction skills are not learned, children may face difficulties when addressing developmental challenges during preadolescence and adolescence.

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Recommendation: As a youth coach it is important to recognize that seven-ten year olds are expressive, spontaneous, and egocentric. You should give them room to express themselves while at the same time establishing clear-cut norms about honesty and playing by the rules. As they seek to get their way you should understand that children during this stage are only beginning to develop the ability to see the world from the perspective of others. Because these children are in the process of learning acceptable means of achieving goals, coaches should take care to make clearly explained distinctions between what is acceptable and what is not.

Pre-adolescents (10-13) face the challenge of developing "best friend" relationships and gaining acceptance from peers.

A development task of pre-adolescents is figuring out how they are similar to and different from others. In attempting to understand themselves as unique individuals, they go through a stage during which close relations with same-sex "best friends" is very important. During this stage, they are very loyal to friends and greatly influenced by what friends think. Unfortunately, young adolescents can also be very exclusive in their peer groups such that those who are different are shunned or mocked. You probably see the importance of "best friends" in action on the deck quite often where being accepted and having someone to trust and confide in is of utmost importance. While this may, at times, hinder what you are attempting to do, keep in mind that it is a necessary part of social development and not an expression of disrespect on the part of the young athletes.

Recommendation: In your program, offer young individuals the opportunity to interact socially with same-sex peers on a regular basis. As was suggested by one coach, this may necessitate that when moving one athlete "up" to the next level that a peer also be moved up. Attempt to create an environment of inclusion and acceptance of differences.

Adolescents (14-17 years) face the challenge of exploring who they are and how they fit into the world in which they live.

During this stage, young people try to answer the question "who am I?" They go through processes of identity testing and identity formation - to a point that can be frustrating for the adults who know them! But adolescence is a time during which young people "try on" a variety of different identities in an attempt to discover and clarify values while exploring all the possibilities of who they might become as adults. What may seem like rebellion or acting out during this developmental stage, often may be athletes struggling to find identities that fit with their emerging sense of how they are connected to the world. We see this search for identity in the clothes they wear, the music they listen to, the activities they are involved in, the language they speak - and in the inconsistencies in their lifestyles.

Recommendation: As a coach, be tolerant and accepting of the various identities the athlete "tries on." Allow athletes to explore and test new and different identities as long as they do not put themselves in danger and as long as their actions are not in conflict with team goals or philosophy.

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Older adolescents (16-19 years old) deal with the challenge of seeking Independence and Autonomy.

A primary developmental task of adolescents is to move closer to being independent, autonomous beings -- connected to but separate from others, in control of one's life but aware of limitations and boundaries. If we view autonomy on a spectrum with dependence on one end (as a newborn is totally dependent on caregivers) to independence on the other end of the spectrum (adult), we can view adolescents as attempting to move towards independence. While complete independence and autonomy are not possible (nor is the individual ready for it), it is important that the athlete be allowed to make strides. If some autonomy is not allowed and encouraged, "swimming, or any organized sport, becomes a developmental dead end rather than a developmental opportunity" (J. Coakley). Feelings of independence and autonomy are derived, in part, from the sense that one has control over his or her life.

Recommendation: Your swim program should allow athletes a voice in their development. This voice in some decisions regarding training helps to develop independence and autonomy while at the same time making the athlete more accountable for his/her training.

A Psychological Perspective to Understanding Athlete Development: What Swim Coaches Need to Know

Another area of development that needs to be factored in relates to psychological, or cognitive, development. As with the other areas, this is an extensive area of study that we are not doing justice to when trying to condense the developmental process to a few concise points. That being said, let's try to identify and understand several elements of psychological development that may be especially important for coaches. These include the development of perceived competence, perspective-taking abilities, and motivation.

Perceived Competence: This concept of perceived competence is extremely important as it profoundly affects participation in sport, motivation, anxiety, and sport enjoyment. Athletes' perceptions of their athletic competence and sources they use to judge self-competence go through predictable developmental changes as is highlighted in the following:

- At an early age (seven-nine years), there is a focus on outcome and effort in judging one's competence. "I won, therefore I am a good swimmer" "I tried hard, I must be a good swimmer" Winning and losing serve as an important source of competence information for young athletes.
- From about ages eight-twelve, there is a gradual decline in the importance of feedback from parents as a source of competence information, an increase in coach technical knowledge as a source of competence information, and a gradual increase in the importance of peer comparison in making competence judgments. "I beat Joe which means I'm a good swimmer".
- The older athlete (twelve-thirteen) begins to recognize that both ability and effort impact performance. Prior to this, the athlete can not distinguish between the two concepts.
- There is a progression from focusing on peer comparison to focusing on self comparison (16-18 years) as sources of competence information.
- A "task or process" goal orientation increases with age with "outcome/win" goal orientation decreases with age.

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Recommendation: We need to understand what sources children rely on to provide competence information. Because outcome is so important at a young age, our late maturing athletes are at risk of low competence as they are not experiencing much success. Additionally, note that coach feedback becomes an increasingly important source of competence information for athletes -- recognize your role in enhancing (or tearing down) the athlete's sense of self-competence. For example, as opposed to just providing critical feedback ("you missed your last turn"), also reinforce what she did correctly ("you held your streamline and kick out").

Perspective-taking: the ability to take another's perspective progresses in a predictable sequence and impacts how an individual relates to others and overall behavior in the sport environment.

- At a young age (under eight), individuals are not able to take the perspective of others and, thus, have an egocentric perspective. The young athlete's thoughts, feelings, ideas, and needs are correct (as far as they are concerned)...and everyone else thinks and feels this same way too, right?
- Gradually, children develop the ability to take others' perspective but still view their perspective as the correct view.
- The latter stage of development occurs when the individual can take and appreciate another's perspective.

Recommendation: The young athletes you are coaching will often display behavior that is selfish and doesn't take others into account. Remember that they may not yet have developed the ability to understand others feelings or points of view. As they develop, you can enhance their perspective-taking abilities by pointing out how their action affects others. This can help them progress along the developmental spectrum.

Motivation: simply defined as the direction and intensity of effort. Ideally, we want to see young athletes motivated to approach success in swimming with great intensity. But, what is it that motivates young athletes?

- Younger swimmers (seven-ten) seem more externally motivated while older swimmers are often more internally motivated.
- Around age seven-eight and older, young children begin seeing rewards as bribes ("discounting") which, under some conditions, can negatively affect motivation.
- While "discounting" increases with age, viewing extrinsic rewards (ribbons, medals, gold stars) as adding to intrinsic motivation decreases with age.

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Recommendation: Although developmentally it may seem that extrinsic rewards undermine intrinsic motivation, this is not necessarily the case. Two aspects of the rewards are particularly important as they can affect intrinsic motivation -- the controlling and informational aspects.

- If rewards are being perceived as controlling ('swim fast to get a ribbon'), it decreases intrinsic motivation because they are doing it for reasons outside of themselves.
- The informational aspect of rewards affects intrinsic motivation by influencing one's self competence. Rewards that are given contingent on specific aspects of performance (and provide information about these specific aspects of performance) should enhance intrinsic motivation as they are providing positive feedback regarding the athlete's competence.
- The key is not the reward itself but the message behind the reward. The reward must be as providing positive competence information not as controlling behavior to enhance intrinsic motivation.

Athlete Development: Phases of Learning Model

Coaches, athletes and sport scientists alike have long sought to understand how to develop excellence or talent in individuals, and swimming is no exception. Fortunately, much work has been done in the field of talent development that we may be able to learn from in understanding the development of excellence in swimmers. Of most relevance is research by Benjamin Bloom (1985) in which he studied 120 individuals who had achieved excellence in a variety of domains (art, athletics, music, academics). He wanted to assess if common pathways to achieving excellence exist and, if so, to describe these pathways.

Bloom found that successful individuals went through similar phases of development and, furthermore, that the phases he identified were very similar to a 3 phase model of learning put forth years earlier by an educational researcher (Whitehead, 1929) -- thus adding greater support to his findings. It makes sense to think about applying this model of long-term development to young swimmers. The model is presented and discussed in the following sections. As you read through this model, think about whether or not the information fits with your experiences and what you have witnessed with the development of athletes. Additionally, while some recommendations are given, you are encouraged to think about how you might apply this model within your program.

Phases of Learning Model (Bloom, 1985)		
ROMANCE	PRECISION	INTEGRATION
Fun Encouragement Exploration Freedom Develop love of sport Need immediate rewards	Technical Mastery Skill Technique Habit of Accuracy	Integration of Knowledge and Skills Individuality Insight Realization that sport is significant in one's life

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Key points

- Learning needs to occur sequentially in the three phases but the length of each phase will vary across individuals.
- Moving to the "Integration" phases before graduating from the "Precision" phase does not provide the athlete with the proper training or technical skills to succeed in the next phase.
- Learning, training, and development occurred without long pauses or delays.
- "Unless there is a long and intensive process of encouragement, nurturance, education, training, the individual will not attain extreme levels of capability in the particular fields" (Bloom).

Summary of the Romance Phase / The Early Years

- Coaches instilled a "love of sport" in the children
- Child-oriented family environment
- Child learned about a strong "work ethic"
- Child encouraged to be self disciplined and responsible
- Early success a primary factor for many of the athletes to continue in the sport

Recommendation: At an early age, it is important to have "fun" and "love of sport" instilled to sustain them through the Precision and Integration phases. Work to build this foundation in the developmental years. Additionally, it may be important to teach and expect responsible behavior; and, we need to help our young athletes experience success on a regular basis.

Summary of the Precision Phase / The Middle Years

- Environment of structured, systematic learning -- typically a 4-6 year period
- Emphasis on technical skills
- Worked with a 'master coach'
- Parents make sacrifices of time and money
- Transition from recreational swimmer to being 'a swimmer'

Recommendation: We need to ensure that the athlete is equipped with solid physical and technical skills. Additionally, during this phase we should expect a greater commitment to swimming from the athlete and their parents.

Summary of the Integration Phase / The Later Years

- Has an understanding of technical skills and information and can apply and integrate this information
- Surrounds self with others who share the same goals and commitment to the sport
- Continues to study/train with a 'master' coach and trains many hours a day

Recommendation: Coach, you are the 'master' coach we are referring to...it is important to recognize the crucial role you play in the long-term development of your athletes. It is your responsibility to 'arm' yourself with the knowledge necessary to optimally develop the athletes.

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Factoring Maturation Into Your Swim Program: Early Maturation Versus Late Maturation

What is the Maturation Process?

Children develop in sequential and predictable ways from young children into fully-grown 'adults. Yet, while individuals develop in similar ways, the timing of this maturation process can vary greatly. In fact, at any one chronological age individuals can vary by as much as five years maturationally. This means that with two swimmers who are chronologically eleven years old, one may be ten and the other fifteen biologically. The differences between ten and fifteen years of age is huge, as we all know, yet we are often training these athletes in the same way. A better approach is to consider the maturation process when working with young individuals. Keep in mind that while we are generalizing about early maturers and late maturers and approaching them as two distinct groups, there is a lot of overlap in terms of all areas of development and their swim performance.

Identifying early maturers and late maturers

One way of trying to identify the kids who are going to be early maturers and late maturers is just by eyeballing them. In childhood, early maturers tend to be taller, heavier, and have more muscle mass than their peers. Alternately, late maturers are generally very light (smaller) and lean in childhood (ectomorphic). However, the late maturer may end up being taller as adults because they are in the childhood growth phase longer. This eyeball took at kids will give you, as the coach, a general idea of the young athletes likely to be early maturers and those likely to be late maturers. Other maturational characteristics include: arm-pit hair, facial hair, voice change, and/or menstrual cycle.

Another way for coaches to identify early maturers and late maturers is to track the athlete's growth. We know that, on average, children grow 2.5 inches a year and gain about five pounds a year until they hit their growth spurt. For girls, this growth spurt occurs roughly around age twelve-thirteen and around age fourteen-fifteen for boys. Tracking basic growth parameters twice a year will provide you with information regarding when the young athletes seem to be hitting their growth spurt. As an aside, taking these growth measures will also highlight those individuals who are not growing as would be expected -- which may be an indication they are overtraining. Or, in the case of weight loss, the athletes may have some eating disturbances that need to be monitored and addressed.

Why is understanding maturation something coaches need to know?

In and of itself, being an early maturer or a late maturer is not a concern. However, the potential short-term and long-term ramifications if one ignores maturational differences are of concern.

Early maturers, who hit their growth spurt prior to their same-aged (chronological) peers, tend to have an advantage in sports, especially sports requiring speed, power, and endurance where body mass is helpful. For biological reasons, not because of greater talent or ability, they are often able to outperform their peers. In childhood, they have much early success for which they receive reinforcement and recognition and, therefore, tend to initially stay with the sport.

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Into high school we start seeing problems as the early maturer, who is used to experiencing success, gets frustrated because now all of a sudden peers are catching up with them. Others may ridicule and deride them because they are not experiencing the same outcome success and assume it is because they are not working hard, not putting forth the effort. Part of the dropout we see around age 14 is due to early maturers leaving the sport out of frustration when they are not experiencing the same success as they did when they were younger. In reality; it's the physical changes that are occurring in their peers that are allowing others to catch up with them. We need to figure out a way to help our early maturers keep success in perspective.

With late maturers, we have a different set of issues. The late maturing kids often experience early failure because they are at a biological disadvantage (they are not as physically strong or developed) that affects performance outcomes. In the water, even though they may be working as hard, they often can't keep up with their peers which is a huge source of frustration. This leads to much ridicule by their peer group. These late maturers, who are not demonstrating success relative to their peers, then don't get the coaches' attention, encouragement, or recognition that their early maturing peers are getting.

Unfortunately, in developmental sport programs, we often don't allow late maturers the time to let their physical maturity catch up and their skills to develop. Instead, these children often leave the sport early because of lack of success and extreme frustration. This seems to hit late maturing boys the hardest because they are at an extreme disadvantage. Ironically, they could have the potential to be better athletes but we have to keep them involved at the younger ages to make sure they continue with their skill development. We need to figure out how to keep late maturers interested and involved in swimming despite a lack of early success.

Strategies to deal with early maturers and late maturers

- ❑ First, we need to keep in mind that early success does not predict later success. This is nicely illustrated in a study looking at growth and development in boys (Medford Boys Growth Study) and its relation to sport abilities. Specifically, coaches were asked to rate kids in terms of their abilities in elementary school and again in junior high. They found that only 25% of the kids that were rated outstanding in elementary school were also rated as outstanding in terms of their abilities in junior high. This suggests that early talent/ability is a poor predictor of future abilities since only one-fourth of the boys that demonstrated ability in elementary school also demonstrated ability in junior high.
- ❑ Given this, while it is tempting, we need to be cautious about focusing attention and energies into only the young athletes that are showing initial talent. The success demonstrated by early maturers is due to a biological advantage and, as we know, biological maturation is genetic. Remember that late maturers, who are at an initial physical disadvantage, don't have control over biology so let's not punish them for it.
- ❑ Education!! Make the athletes and their parents aware of some of the factors involved in why they are experiencing much success (as is the case with early maturers) or limited success (late maturers). An awareness of the situation will aid in keeping both success and failure in perspective while maintaining an eye towards individual skill development. Help them focus on long-term development rather than performance today.

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- ❑ With early maturers, who have trouble keeping early success in perspective, we may want to think about moving them "up" in competitions so they are competing on a more level playing ground and get used to experiencing defeat. They can still practice with their peers (so social development is not affected) but compete against others of a similar maturational age.
- ❑ We need to search for strategies to keep late maturers involved in skill development programs as they are the ones getting left behind. We need to be creative in structuring situations so they can experience success and see improvement. Some examples may include: post and reward personal improvement in workout times which focuses the athlete on themselves rather than peer comparison; design team competitions that emphasize skill development; because peer comparison is natural, get the athletes to compare themselves to others of the same maturational age.
- ❑ For the most part, we train early and late maturers the same. This is unfortunate because the "window of opportunity" and peak performance occur earlier for early maturing athletes. Therefore, these athletes need to train more intensely earlier in their careers to maximize their potential.
- ❑ Gender plays a role on the influence of the maturation process on performance, dropout and self-esteem. Specifically, we need to pay special attention to early maturing females and late maturing males. An early maturing female develops a woman's body at a young age and becomes very self-conscious, especially in the swimsuits she must wear that reveals all. Conversely, the late maturing male is ridiculed for being small and also becomes very self-conscious which impacts his sense of self. While nothing can be done to remedy the situation, we need to help them in the area of self-confidence and self-worth.

What Coaches Need to Know About Gender as it Impacts Training of and Interacting With Young Swimmers

In looking at development across the various disciplines, the notion of gender as a discriminating variable comes up again and again. That is, gender seems to be a factor involved in development across disciplines. However, caution is warranted: We don't want to separate males and females to such an extreme that we treat them as being on opposite ends of a spectrum. But, on the other hand, there are some gender-related differences that would be advantageous for coaches to at least be aware of. Ideally, we want to strike a balance between making young coaches sensitive enough to know gender-related differences but not so much so that they form incorrect stereotypes and over-generalize.

Given this, it seems beneficial to summarize (in no particular order) some of the more relevant gender-related differences and draw some implications or practical suggestions from this information:

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Puberty

Boys reap the benefits of testosterone that is in full throttle at this time. There is an increase in muscle development due to increased testosterone -- as testosterone is a protein anabolic that helps build up muscle by building up the protein that makes up the muscle. Concurrent with this increase in muscle mass is a decrease in percent body fat. All these changes are seemingly advantageous to the male swimmer.

For females, puberty brings about an increase in the hormone estrogen. This increased estrogen is going to aid in laying down more fat and breaking down protein. Unlike males, development during puberty for females can initially have a deleterious effect on swim performance.

Recommendation: We have to make sure that the training programs that we're giving our girls at this time are going to help maintain their muscle and offset the natural physiological changes that are occurring. Additionally, we need to remember that increased fat deposits for woman is nature's way". It is not necessarily a change in her diet, changes in her training, or lack of willpower but is part of her development as a female that, to a large degree, is out of her control.

As an aside, it has been suggested that because females tend to have less muscle mass than males during and after puberty, females may not need to taper as much in preparation for competition.

Sensitive Periods

From a physiological and growth perspective, boys and girls are different in terms of the timing of their 'sensitive periods' with girls maturing physiologically about two years ahead of boys. Remember, this sensitive period is a time when significant growth (aerobic development) can occur under the right conditions (training loads). While girls tend to mature earlier and thus have an earlier 'sensitive period', the real physiological variable is not gender but rather is the start of the growth curve. This growth spurt is really what should determine when to increase the aerobic phase. However, it is easier to understand and use this information when one knows that females tend to hit this growth phase at age 11-13 and males around age 13-15.

Because males tend to reach their growth spurt about two years after females, they are in childhood growth longer, which adds greater length to their legs. This leg length discrepancy tends to be what accounts for the height difference between males and females -- how might longer legs impact performance in the water?

Recommendation: We need to take advantage of these sensitive periods when training young athletes in order to maximize development. When entering this growth phase, which tends to happen earlier for females, coaches need to think about increasing aerobic training to maximize their capacities.

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Stress Response

There have been some interesting findings on research looking at cortisol, which is a biochemical measure of physiological and psychological stress, in male and female swimmers. For an athlete with elevated cortisol values, it would be recommended that he/she closely monitor and possibly decrease training loads. In this research, it has been found that female swimmers (elite and sub-elite post-pubescent) have high cortisol values that stay high whereas males demonstrate natural ups and downs in cortisol values. This finding occurs under similar training yardage (similar physiological stress), which suggests the need to look at differences in psychological stress. Interestingly, further analysis revealed that women coached by men had the highest cortisol all the time while the women swimmers coached by women had moderate levels like those seen in the male swimmers.

Recommendation: This interesting finding not only suggests we may need to train males and females differently but that we also need to look at the interaction of athlete gender and coach gender. Because the differences seen in cortisol values occurs only within the female population, coaches (especially male coaches) may need to monitor the athlete's physiological and psychological adaptations to the imposed training stresses by observing behavior and communicating with the athlete.

Psycho-social development

There are numerous psychosocial developmental differences between young males and females. Let's present some of these differences - - you as the coach need to assess if you perceive these characteristics to exist in your athletes and how, if at all, it should impact your interaction with the athletes or the training environment you establish.

- Perceived Competence: in general, males tend to have higher perceptions of athletic competence than girls meaning they view themselves as more competent or able as athletes. And, we know that one's perception of competence influences such things as participation, enjoyment, and motivation.
- Extra steps may need to be taken to develop, bolster, and reinforce young girls' perceptions of competence; to help them recognize and appreciate their abilities as swimmers.
- Goal Orientation: findings are fairly consistent in showing that females are more task oriented and males are more oriented towards winning -- A win or outcome orientation suggests one focuses on comparing performance with and beating others whereas with a task goal orientation one is focused on comparing one's performance to personal standards and personal improvement. A task orientation has been tied to positive achievement related behaviors that we want to see in our young athletes.
- Given that only one athlete can "win" (which aren't very good odds), we may need to encourage boys to also compare performance relative to themselves as it greatly increases their chances of experiencing success and is much more within their control.
- Social/Affiliation needs: girls seems to have greater needs for affiliation and are more motivated to participate for social reasons whereas boys tend to be more motivated by competitive factors.
- If social factors are indeed important to your female athletes, it would be essential to make sure this need is being met; to incorporate time for social interaction in the training environment.

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Strategies for Coaches to Deal With Athletes Who Are Negatively Impacted By Their Growth Spurt

(This section is primarily for female athletes)

As we discussed, maturation or natural growth and development tends to have a negative impact on females whereas it tends to be advantageous for males. With our female athletes, we often see an increase in percentage of body fat and a relative decrease, but not necessarily absolute decrease, in muscle mass. Following are a few practical strategies for dealing with this common challenge:

- Coaches need to be proactive by educating the athletes early on about why their performances may falter or plateau; prepare them for the growth and development and natural changes that will occur. If maturation brings about detriments in performance, help the athlete recognize why these performance decrements are occurring.
- In line with being proactive, make an effort, along the way, to teach kids coping skills to deal with adversity. They will then be better prepared to deal with this adversity.
- Be careful in not letting the highs get too high or the lows too low -- keep it in perspective. It is crucial to not make a big deal out of success, and encourage parents not to as well.
- In some cases, having a female coach can help as she can relate better to the female athletes.
- Don't give up on the females as they are struggling with development; focus on having them give an honest effort in what they do.
- It seems that having a strong aerobic base and by having taken advantage of their window of opportunity for aerobic development is beneficial when trying to deal with their maturation and the ensuing changes.
- It may be beneficial to focus on training to think about decreasing the number of competitions until the athlete adjusts to her body and gets fit. It doesn't make sense to have the athlete 'beat her head against the wall', struggle with confidence, and experience failure and frustration.
- Coaches will typically have to help athletes make changes to their stroke technique to adjust to their bodies.
- Provide the young females with examples of athletes who have also experienced major body changes and have worked through them; find a role model or older athlete who had similar struggles and can talk to the younger athletes about how they coped.

Readiness for Competition and the Young Swimmer

Across sports, kids seem to be competing at younger and younger ages. Children as young as three, four, and five are competing in sports such as gymnastics, swimming, and baseball. As an extreme example, there is a competitive event called a "baby decathlon" in which infants compete against each other. Young children used to "play" with friends after school and on weekends, for a variety of reasons they now are enrolled in organized, competitive athletic programs. Should we be concerned? Can a child be too young for athletic competition?

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When is a young swimmer ready to compete?

While this is a seemingly simple question, it is actually quite complex with no easy answer. In addressing this question about readiness, first, we need to define what we mean by "competition". Then, we need to assess readiness across disciplines -- from a biological, sociological, psychological, and physiological perspective -- because, for example, a young athlete may be physiologically ready for the demands of competition but not psychologically ready. Only after readiness across disciplines has been examined can we try to answer this question with each of our young athletes.

What do we mean by competition? Restructuring competition to make it developmentally appropriate.

When assessing readiness for competition, we tend to define competition strictly as organized swim meets where the participants compete against each other in specific events according to specific rules; a so called "adult model" of competition. A more fitting way of looking at competition involves broadening our definition of competition to include models that are developmentally appropriate. A young athlete may not be socially, psychologically, technicality, or physiologically ready for the "adult model" of competition but would be ready for and benefit from more developmentally appropriate types of competition. So, we need to think not so much about whether the young athlete is ready for competition and instead think about what type of competition the young athlete is ready for. In the following section, a few ideas or suggestions of competitions more appropriate for developmental athletes are presented.

Keep in mind that at the developmental level, the important element is skill; it therefore makes sense to structure events that emphasize skill. In addition, evaluating performance based strictly on time is an injustice to our late maturing athletes that are at a biological disadvantage relative to their early maturing peers. Be creative in using different evaluation criteria or rewards that recognize areas we want to emphasize i.e., stroke, technique, individual improvement. Following are varied examples of appropriate competitions for developmental athletes:

- Technique meets
- Skill recitals
- Do-overs instead of DQs
- Alter events based on physical abilities, i.e., allow 5 butterfly strokes then 5 butterfly kicks
- Race strategy competitions
- Intra-squad and inter-squad meets
- Relay only meets
- Single age events
- Compete by height
- Buddy meets: pair younger swimmers with older swimmers
- Fewest stroke / stroke rate competitions
- Swim and score: kids score teammates stroke

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By creating developmental progressions for competition that are not part of our traditional rules and competitions, we are setting up a more sound and appropriate program for entry level swimmers to develop a firm foundation; a foundation that includes proper skill development and the development of self-esteem. Finally, creating a sound developmental program will instill in children a love of swimming.

Understanding Readiness

As previously mentioned, because the question of readiness for competition is complex, the answer is also going to be complex. While we can not provide definitive answers regarding when precisely a child is ready for competition, we can 1) identify criteria or specific aspects of development that need to be met for the young athlete to be "ready" for swim competition (of the adult model); 2) discuss reasons why all young athletes are not developmentally ready for competition. Readiness issues regarding the areas of psychological and social development are discussed below. However, coaches must rely on their best judgement and knowledge of the swimmer to determine physical readiness for appropriate levels of competition.

- As discussed in the psychological development section, the young athlete's perspective-taking ability develops sequentially and is important to understand because it impacts the young athlete's behavior in sport. In regards to this perspective-taking ability, in order to "compete" athletes need to be able to see the world from perspectives that go beyond their own personal perspective and see relationships that don't involve them directly. That is, they need to possess the cognitive abilities to take multiple perspectives or multiple roles. For the competition to be meaningful, the young athlete must be able to conceptualize the competition from an opponent's perspective and engage in social comparison. It would not necessarily be harmful for the young athlete to compete without this perspective taking ability but the athlete's motivation and satisfaction would have to be derived elsewhere. "Imposing a competitive reward structure on the sport activities of children who do not possess these social-cognitive skills is at best senseless and futile" (J. Coakley). Furthermore, as discussed earlier, research has identified sequential stages of development in terms of role taking abilities (Selman, 1976). And, it is not until around age twelve that individuals develop the ability to engage in formal reasoning and to put oneself in numerous roles. In sum, it seems that prior to age twelve (roughly) young children do not possess the social cognitive abilities to understand and experience the competitive process.
- Another cognitive skill that impacts an athlete's readiness for competition involves how she explains performance outcomes, also termed "causal attributions". This cognitive skill is important not only because it illuminates aspects of performance that can be addressed in training but also because it impacts the athlete's perceptions of competence (a developmental skill discussed earlier). For example, an athlete can attribute a loss to an unstable factor, such as lack of effort, and still feel competent in her abilities. Conversely, an athlete may attribute a loss to lack of ability, a stable factor, which will negatively impact his perceptions of self-competence. It has been found that prior to around age twelve, children are not able to distinguish between effort and ability in explaining successes and failures. These young athletes, therefore, do not have the attributional abilities to accurately assess competence based on competitive performances. "These developmental shifts in causal reasoning influence not only how children of different ages will assess their competence based on performance outcomes but also how they will respond emotionally to those outcomes, what their future performance aspirations and success expectancies will be, and how they will approve or disapprove of other children based on those children's outcomes." (Passer, 1987).

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- In trying to determine a young athlete's readiness for competition, we also need to assess if the athlete has the coping skills to deal with the demands and challenges inherent in the competitive environment. Some of these demands and challenges may include dealing with success and failure, managing time and energy at the competition, getting DQ'd, and performing in front of others. A young athlete who is found in tears after a race may not have the coping skills to deal with competition and is therefore not "ready" for competition. Coaches need to monitor how the young athlete copes with various situations in practice to determine if she has the coping skills to deal with the increased demands and challenges of competition. Use "teachable moments" in practice to help the athlete acquire coping skills.
- There is a developmental need for social comparison beginning around five-six years of age. Yet, the above comments suggest that young athletes may not be ready for competition (adult model) until eleven-twelve years. We need to think about how we can fulfill this need for social comparison without adding additional stress/pressure that the athletes may not be ready for. We need to be creative in structuring opportunities for "healthy comparison".

Now, back to our original question "can a child be too young for competition?" The answer would be "yes" if we are strictly referring to competition as competition of the adult model (i.e., organized swim meet) because, as has been discussed, young athletes often do not have the psychological, social, and physical skills necessary for the competitive environment. However, if we structure competition to make it developmentally appropriate for these young athletes, they can benefit from the experience and develop the skills to prepare themselves for competition.

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Recommended Readings

Title	Author	I.S.B.N. Number
Peer Power: Preadolescent Culture and Identity	Adler and Adler	0813524601
The Child and Adolescent Athlete	Bar-Or, Oded	0-86542-904-9
Developing Talent in Young People	Bloom, Benjamin	034531509X
From Childhood to Champion Athlete	Bompa, Tudor	0-9697557-1-6
Serious Training for Serious Athletes From Childhood to Champion Athlete	Bompa, Tudor	0-9697557-1-6
Theory and Methodology of Training	Bompa, Tudor	0-7872337-1-4
Youth Sports & Self Esteem	Burnett, Darrell	0-940279-80-0
Intensive Participation in Sports	Cahill & Pearl (editors)	0-88011-698-6
Child Health, Nutrition, & Physical Activity	Cheung & Richmond (editors)	0873227743
Straight Talk About Children and Sport	Coaching Assoc. of Canada	0-88962-630-8
Sports and Society	Coakley, Jay	0-8151-2027-3
Talented Teenagers, The Roots of Success and Failure	Csikzentmihalyi, Mihalyi	0521574633
Sports Training Principles	Dick, Frank	0-7136-4149-5
Children and Sports Training	Drabik, Jozef	0-940149-03-6
Discipline Without Tears	Dreikurs, Rudolf	0-452-26898-2
With the Boys: Little League Baseball and Preadolescent Culture	Fine, Gary A.	out of print
Sports for Children	Humphrey, James	0-398-06168-8
Worldwide Trends in Youth Sport	Knop, Engstrom, Skirstad & Weiss	0-87322-729-8
No Contest	Kohn, Alfie	0-395-63125-4
Punished by Rewards	Kohn, Alfie	0-395-71090-1
Science of Sports Training: How to Plan and Control Training for Peak Performance	Kurz, Thomas	0-9401149-01-X
Coaching Children in Sport	Lee, Martin	0-419-18250-0
Swimming Even Faster	Maglischo, Ernie	1559340363
Sports Without Pressure	Margenau, Eric	0-89876-165-4
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The Cheers and Tears: A Healthy Alternative to the Dark side of Youth Sports Today	Murphy, Shane	0-7879-4037-2
Psyching for Sport	Orlick, Terry	0-88011-273-5
Exercise and Children's Health	Rowland, Thomas W.	0873228103
Little Girls in Pretty Boxes: The Making and Breaking of Elite Gymnasts and Figure Skaters	Ryan, Jane	0446672505
Children and Youth in Sport	Smoll & Smith	0-697-22490-2
Positive Coaching	Thompson, Jim	1-886346-00-3
Sport for Children and Youths	Weiss & Gould	0-87322-009-9
Coaching the Young Swimmer	Wilke & Madsen	1-878602-54-3
Training for Sport and Activity	Willmore & Costill	0-697-06778-5
Good Sports	Wolff, Rick	0-440-50435-X
Sports and Fitness Success from 6 to 16	Yessis, Michael	1-57028-108-4