Volume v Intensity Through Maturation

Jenny Harris

National Coach Mentor – Youth Development (Endurance)

jharris@englandathletics.org

Acknowledgements: Dave Sunderland; Norman Poole; Rob Thickpenny

Endurance Athlete Development Model (V1.2)

UNITED KINGDOM ATHLETICS

Developmental Age +/-																		
Chrono. Age	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26+
Stage of Development	Pre-Puberty			Puberty						Post-Puberty		Adulthood						
Sports Focus	Multi-Sport				Multi-Event			Endurance				MD, LD , STEEPLECHASE						
Comp. Focus – MD	100m*, 150m*, Hurdles* 600m*, 800m*, 1200m* 1500m, CC*				100m*, 200m* Long Hurdles*, 800m* 1500m*, 3K, CC*			200m, 400m, 800m, 1500m, CC			(200m), 400m, 800m, 1500m, (3k), CC	400m, 800m, 1500m, 3k, (CC)						
Comp. Focus – LD								800m, 1500m, 3k, CC			(800m), 1500m, 3k, 5k, 10k track & road, CC	(800m), 1500m, 3k, 5k, 10k track & road, Mar, CC						
Comp. Focus – SC								800m, 1500m, 3k, CC, SC			(800m), 1500m, 3k, 5k, CC, SC	1500m, 3k, 5k, (10k), CC, SC						

Development Focus	Alactic Speed & Aerobic Capacity		Alactic Speed, Aerobic & Lactic Capacity	Event Specific Endurance
	Running Mechanics & General Physical Preparation		Running Mechanics, General Prepartion & Tactics	Running Mechanics, Specific Strength, Tactics
CE	N/A		Broad range of Specific Endurance work spread across MD, LD, SC	Specific Endurance work dedicated to a specific event focus
SDE	Alactic Speed Aerobic Development	Alactic Speed Aerobic Dev Long Term Anaerobic Dev	Development of full anaerobic system	All Methods inc. Altitude Training
SPE	Athletics 365 Core Work	Gen. & Anc. Strength Core Work	Strength Endurance, General Strength, Ancillary Strength, all endurance based Extremity Conditioning, Core Work etc.	
GPE	Covered by other event groups & Athletics 365		Special Strength (inc. MJs & MTs)	Max Strength, Special Strength, all alactic generic work including Mobility & Extremity Conditioning etc
Running Drills	As part of Athletics 365		Learning technique	Perfection of technique

* = Preferred competition distances given current physical attributes

Note: These diagrams are for illustration purposes only. They can only be fully interpreted after reading the accompanying notes and audio presentations.

ENGLAND ATHLETICS

ATHLETICS NORTHERN IRELAND

scottishathletics

ENGLAND ATHLETICS

www.englandathletics.org

"If early sports training does nothing more than speed a child along to a predetermined genetic limit, it would make sense to concentrate early training on elementary skills, strategies, training education and fun rather than subject the child to arduous workouts that might lead to injury and early burnout and withdrawal from sport."

Children's Exercise Physiology by Thomas W Rowland

Athletics – Is it an Early or Late Development Sport?

Ages for Peak Performance in Athletics from World Statistics

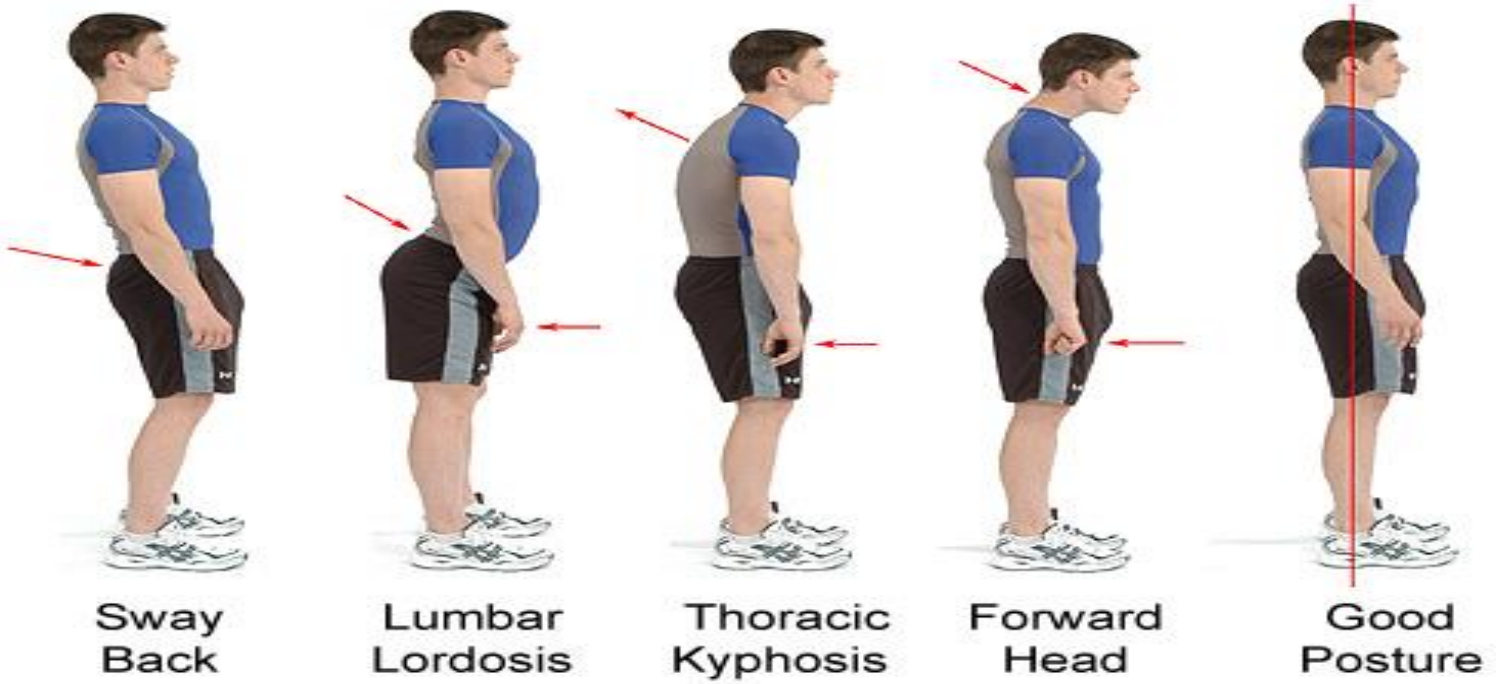
Event	Age of peak performance Men	Age of peak performance Women
100m	26	25
200m	25	25
1500m	27	29
5000m	29	30
Marathon	31	33

Maturation – Early developers may have an initial advantage

ENGLAND ATHLETICS
LCDP
LOCAL COACH
DEVELOPMENT PROGRAMME

What are the Challenges of the Current Generation?

- Relative inactivity (compared to 30 years ago) even in your athletes
- More time seated (hips flexed, knees flexed) in flexed position
- Less time walking/running (extended position)
- More time at computers, games consoles and phones (neck flexed, shoulders rounded, upper back flexed)
- ***Basically much more time in activities that don't help athleticism***



EVENT REQUIREMENTS FOR ENDURANCE

EVENT:	800m	1500m	5/10k	S/C	Mar	Walks.
MOBILITY	*	*	*	*	*	*
ENDURANCE (02)	*	*	*	*	*	*
SPEED (ALACTATE)	*	*	*	*		
SPEED ENDURANCE (LA02)	*	*	*	*		
STRENGTH	*	*		*		
STRENGTH ENDURANCE	*	*	*	*	*	*
POWER	*	(*)		(*)		
TECHNIQUE	*	*	*	*	*	*
TACTICS	*	*	*	*	*	*
PSYCHOLOGY	*	*	*	*	*	*

Percentages of 3 Main Energy Systems for each Endurance Event

Distance (m)	ATP-PC Max HR	Anaerobic-Lactate 90% - max HR	Aerobic 50-85% Max HR
800m	10%	30%	60%
1500m	8%	20%	72%
3000m	5%	15%	80%
5000m	4%	10%	86%

Not percentages for training, but showing necessity for aerobic training

Volume vs Intensity

- young people pre-puberty can benefit from endurance training but the relative intensity of exercise required for optimum benefits is higher than that recommended for adults so above 80% MHR. With HIT use sprint/speed reps at 1500m pace and faster. For VO2 development as young pre-pubertal athletes reach VO2 max within about 90 secs (2 mins for adults) appropriate VO2 rep sessions could be 6-10 x 90 secs (or maximum 2 mins) with 2 mins jog rec. VO2 speed is your 3km/5km pace.

- Continuous and high intensity interval training produce increases in fitness but most effective is training that includes both. (pre puberty - more aerobic than anaerobic)

- Continuous running - the really long term changes are new capillaries and changes to the ventricles of the heart. These are major re-modelling changes and therefore take a long time to occur. This is why the aerobic system takes years to adapt. It can also result in improved economy/efficiency.

- Coaches must, particularly, appreciate the dangers of excess in both volume and intensity – whilst realising just how much can be possible with appropriate constraints and good sense.

ENGLAND ATHLETICS
LCDP
LOCAL COACH
DEVELOPMENT PROGRAMME

Factors to Take into Account

- Athlete's age
- Athlete's maturity
- Number of years training
- Different training phases of the year
- Competition distances targeted
- Number of training sessions per week (+ school/clubs)
- Mileage/kilometre weekly volume
- Athlete's strengths and weaknesses
- Event demands
- **What is the purpose of this workout?**

ENSURE

- KNOW ALL THEIR COMMITMENTS
- DIET
- GROWTH SPURTS – PHV Index
- HEALTH ISSUES – Asthma/Injuries
- TRIAD – (Disordered Eating / Amenorrhea / Osteoporosis) - Be Aware of ramifications
- TRAINING YEARS

Factors Influencing Injury Risk While Growing

- Whilst running can help stimulate increases in bone mineral density, inappropriate progression, or too little recovery between exposures can result in skeletal injuries .
- Open growth plates. (Close approx 14-15 girls/15-16 boys)
- Disproportion between long bone length and adjacent musculature/Co-ordination problems.
- Long bones more porous, so buckling fractures (incomplete fractures caused by impact) are more common.
- Over use can cause fragmentation of growing articular cartilage.

SOME CHANGES

- Females – increase in body fat (25% as opposed to 18%)
- Menarche up to a year after PHV. Absence of menarche beyond age 16 should be investigated (osteoporosis/later in life)
- Males – body fat can decrease from 16% to 12 – 14%.
- End of growth & maturation roughly 4 years after PHV.

THE COMPLETE RUNNER

- Technique
- Mobility
- Strength & Conditioning +Strength Endurance & Power
- Endurance
- Speed (+ Speed Endurance)
- Nutrition and Hydration
- Psychology – Mental Strength

TECHNIQUE/SCREENING

- **Screening** – check symmetry/good posture - biomechanics
- Shoulders
- Hips
- Knees
- Ankles

ATHLETICS 365

(Stability, Sport and Performance Movement – Joanne Elphinston)

DRILLS

- Drills – before every session? – Why?
  - Postural alignment and control
  - Improves running style, balance and co-ordination
  - Neurological – corrects and reinforces correct muscle firing patterns
  - Neurological – speed of contractions
  - Prevention of bad habits
  - Balance between left and right sides of the body
  - Dynamic control
  - Mobility
  - Transfer effect

(DVD - Running – The BK Method)

MOBILITY/FLEXIBILITY

- With PHV – stretch every day?

- Mobility drills – hurdle drills for hip mobility

CONDITIONING/STRENGTH TRAINING

- Prior to puberty – body weight circuits/med ball/resistance bands.
- . Emphasis on sets of high repetitions at low resistance
- Technique and lifting can be started early, but maximal lifts should not be performed until skeletal maturity.
- Programme design should be based on the principle of progressive resistance

ENDURANCE TRAINING

Try to think about:

- MILEAGE – Around Puberty
- HOW MANY SESSIONS - Overtraining
- TOO MUCH OF SAME TYPE OF TRAINING – Not biased
- UNFORGIVING SURFACES
- HEAVY LOADING SESSIONS
- TOO RAPID A PROGRESSION

Mileage Development?

Chart details Norman Poole's views

Age	Maximum Winter Mileage		Maximum No of Quality Sessions/wk	
	1500	800	Winter	Summer
13	10-15	10-15	2	2
14	15-25	15-25	2	2
15	20-30	20-30	2	2-3
16	30-45	25-40	3	3
17	40-50	35-45	3	3-4
18	45-60	40-55	3	4
19	55-70	45-60	3	4
20	60-75	50-65	3	4
21	65-80	50-70	3	4

Note: 1. The above recommendations refer to a non racing week and are an approx guide. They may not be advisable for every athlete – please allow coach to set mileage.

2. In the above no distinctions are drawn between male and female 800/1500 athletes.

ENGLAND ATHLETICS
LCDP
LOCAL COACH
DEVELOPMENT PROGRAMME

Age Related Training? – an idea for discussion

Age	Number of Sessions/Extra Runs	Length of Long Run
12	1/2 sessions	20 mins
13	2 sessions + 1 long run	30 mins
14	2 sessions (+ 2 extra runs)	40 mins
15	2 sessions (+ 3 extra runs)	50 mins
16	2 sessions (+ 4 extra runs)	60 mins
Sixth Form + (depends on individual)	2/3 sessions + double day training (aim for 6 hours between)	60 mins +
	N.B Coaches should use their discretion as to whether athletes are capable of this amount of training or more (particularly going through puberty) and take into account all other sport the athlete is taking part in and it would be better to consider training age and maturity	

Example Training Zone Distribution

Zone	1	2	3	4	5	6
Description	Recovery	Easy	Steady	Tempo/Extensive Aerobic Intervals (Threshold)	Intensive Aerobic Intervals (VO2)	Speed Endurance (Anaerobic Speed) (Reps)
(Approx Pace)				10Km	5km-3km	1500m/ Faster)
Perceived Exertion	Very easy	Easy	Comfortable	Uncomfortable	Very stressful	Maximal
Breathing reference	Very easy to talk	Easy to talk	Ok to talk	Hard to talk	Cannot talk	NA
Typical %HRmax	<60%	<80%	81-89%	90-95%	96%-Max	NA
Typical [La] range (mM)		<2.0	1.0-4.0	4.0-9.0	9.0-12.0	12.0-22.0

ZONE 1: RECOVERY ZONE

Recovery runs are used after races, or after a hard training session.

Example sessions:

Zone 1: Recovery

	NOVICE	IMPROVER	EXPERIENCED
ZONE 1 (RECOVERY)	20 – 30 min continuous	20 – 30 min continuous	20 – 30 min continuous

ZONE 2: EASY

Easy running is used in long runs, supplementary runs, warm-ups, cool-downs and active recoveries between higher intensity intervals. The primary benefit of easy running is that it enables you to run more distance without greatly increasing stress on your body.
Easy running also develops the capillary network, stimulation of fatty acids and aerobic enzymes.
Running faster on easy days may result in not performing as well on harder days. Simply resting between harder runs on the other hand will not allow accumulation of mileage, possibly negating further fitness benefits.

Example sessions:

Zone 2: Easy

	NOVICE	IMPROVER	EXPERIENCED
ZONE 2 (EASY)	20 – 30 min continuous	30 – 60 min continuous	30 – 120 min continuous

ZONE 3: STEADY

Steady running is executed above LT but below LTP (e.g. 81-89 % of max heart rate). At the lower end of the zone (81-85% of max heart rate), this involves medium to long workouts and at the higher end of the zone (86-89% of max heart rate), this involves medium to short workouts.

All workouts regardless of duration are generally run at a fairly constant pace. The athletes should get tired as a function of volume not the intensity of the session. Training progressions are achieved by increasing the length of time at this load and/or the average speed the runs are completed at.

Example sessions:

Zone 3: Steady

	NOVICE	IMPROVER	EXPERIENCED
ZONE 3 (STEADY)	20 – 30 min continuous	30 – 45 min continuous	30 – 60 min continuous

ZONE 4: a) TEMPO

Tempo pace is traditionally defined as the running pace at or slightly above which the blood lactate level begins to spike – that is, the LTP.
Tempo runs are traditionally run just above LTP at the lower end of the zone and are generally constant pace efforts for a relatively prolonged period of time. They typically take the form of a sustained effort with the primary purpose to increase the pace one can sustain for a prolonged period of time and increase the time one can sustain a relatively fast pace. Many coaches and runners do longer tempo runs at slower than true tempo pace. Prolonged running at this relatively hard intensity builds a good sense of maintaining a strong pace for an extended period of time. Additionally, some runners gradually build up the intensity of a longer tempo run until actually running at tempo pace for the target duration. All these practices can yield positive results.

Example sessions:

Zone 4: Tempo

	NOVICE	IMPROVER	EXPERIENCED
ZONE 4 (TEMPO)	10 min run	20 min run	30 min run

ZONE 4: b) EXTENSIVE AEROBIC INTERVALS

(sometimes referred to as cruise intervals and/or threshold intervals)

These are traditionally run at the upper end of the zone and can span a wide number of sets and reps. They should have built into them sufficient rest or slow work to allow complete recovery between reps or sets. This design format ensures that there is no accumulated fatigue between sets or reps allowing maintenance of quality rather than a reduction in performance caused by fatigue. This can generally be achieved by employing a general rule of thumb of 5:1 work:rest ratio – that is for every 5 minutes of running, recovery should be around 1 minute (in practice the coach may alter this depending on time of year, training state of the athlete etc). The aim of these sessions is to get the body used to working intermittently above LTP and practice recovering after each effort. Gradually this type of training stimulates improved economy and increased fatigue resistance allowing the body to gradually increase the work it can do without accumulating progressive amounts of lactate.

Example sessions:

	NOVICE	IMPROVER	EXPERIENCED
ZONE 4 b) (EXTENSIVE AEROBIC INTERVALS)	2 x 1600m (recovery less than rep) 2-3 x 1000m (recovery less than rep)	3 x 1600m (recovery less than rep) 4-5 x 1000m (recovery less than rep)	4 x 1600m (recovery less than rep) 5-6 x 1000m (recovery less than rep)

ZONE 5: INTENSIVE AEROBIC INTERVALS

The reps and sets of these types of sessions are designed in such a way that during each interval and during the workout there will be an accumulation of blood [La] often between 5-12 mM by the end of the session. The main goal however is to maximally challenge the aerobic as opposed to the anaerobic system. To do this, the distance or time governing each rep usually needs to be a minimum of 3 minutes (as it takes around 2 minutes to reach the point where the body is operating at VO_2max – the purpose of the workout less for pre-pubertal athletes – 1 ½ minutes.) If performing shorter duration reps (e.g. 1 minute reps) then recovery must be reduced so that one is not fully recovered before the start of the next rep. Using this practice, after several intervals one may reach VO_2max in a much shorter duration thereby accumulating more time at VO_2max.

Therefore, when taking into consideration the amount of recovery taken between repeated runs the athlete should aim for equal to (if taking active recovery), or a little less (if taking complete rest – generally half the rep duration) than the rep duration. You may need to progress towards this – hence the extended recoveries also shown, as not all athletes can cope with short recoveries when starting this type of training. The athlete should be able to perform each rep at the same velocity and with the same technique throughout the session.

Example sessions:

	NOVICE	IMPROVER	EXPERIENCED
ZONE 5 (INTENSIVE AEROBIC REPS)	6 x 1 minute Rec: 1min	5 x 3 minutes Rec: 2 min	6 x 5 minutes Rec: 2 min
	10 x 200m (30 sec – 2 min rec)	8 x 400m (30 sec – 2 min rec)	10 x 400m (30 sec – 2 min rec)
		15 –20 x 200m (30 sec – 2 min rec)	20-24 x 200m (30 sec – 2 min rec)

Zone 6: Speed and Speed Endurance (Anaerobic Speed)

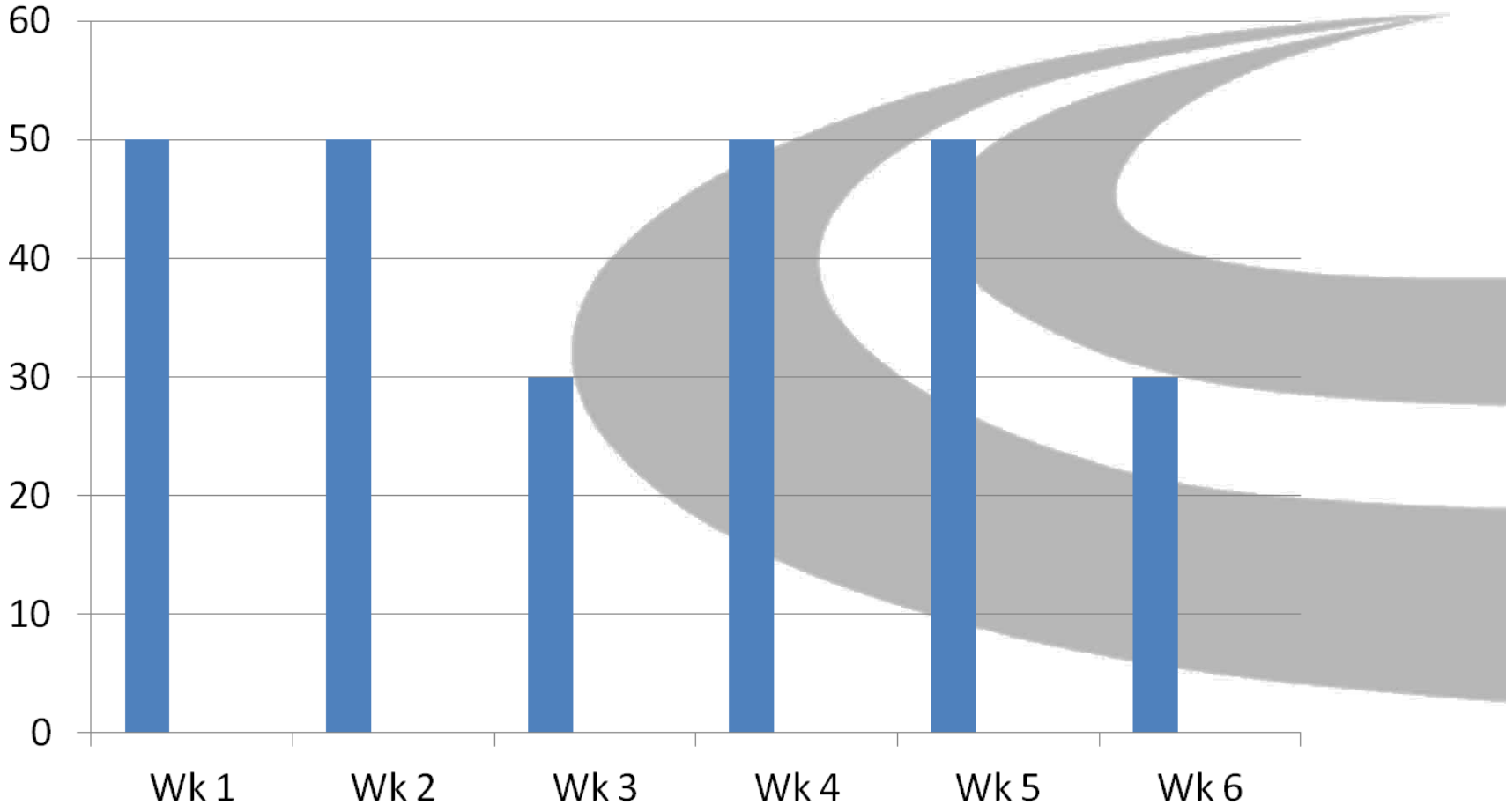
Speed endurance (Anaerobic Speed) pace training can span a wide number of reps and sets and it corresponds to roughly 1500m race pace at the lower end up to a full sprint at the top end. The benefits of Speed training are associated more with mechanics and anaerobic metabolism than with aerobic factors. As a result speed paced training usually consists of relatively short workbouts with enough recovery time to allow each subsequent run to be just as efficient as the first run of the session. Therefore a key difference between speed endurance (Anaerobic Speed) paced running and aerobic interval paced running, other than the pace of the run, is that more recovery is generally required in order to maintain speed and mechanics for the duration of the session. Determining the exact recovery time between reps and sets can be fairly subjective and may come down to coach experience and athlete status but in simple terms, recovery should be as long as it takes until the athlete is ready to perform the next workbout as well as the previous one. If unsure, a heart rate monitor can be used between reps to determine how long recoveries should be by simply waiting until heart rate drops in to at least zone 2.

Example sessions:

	NOVICE	IMPROVER	EXPERIENCED
ZONE 6 (SPEED ENDURANCE or ANAEROBIC SPEED)			
For 800m type –	4 x 200m Rec: 5 minutes	3 x 500m. Rec: 6 minutes	2 x 600m Rec: 12 minutes
For 10 Km type -	Not applicable	6 x 800m Rec: 3 mins	1600m/1200m/800m/400m Rec: 5 mins/4mins/3 mins

BLOCK TRAINING

Mileage ratio hard – easy week 1:1, 2:1 – aiming for 3:1? – depends on individual



Improving Fitness

- Suggested training required to improve fitness = 3-4 x week – 30-60 mins of exercise above 80% max heart rate (so easy pace or faster) research by CHERC – aiming for 40-60mins.

- Obviously if higher intensity will need a drop in overall duration.

ENDURANCE

- Endurance – The biomechanics of the activity needs to be carefully considered to minimize the transfer of “poor mechanics”. Easy running uses slightly different mechanical patterning to say track sessions.

- The process of growing uses considerable energy – possibility of over training.

SPEED

- Need to develop speed with young athletes. Running at maximum speed elicits force that is roughly 7 times more than that produced through steady running.

NUTRITION

- More miles/growing = more fuel
- Balanced diet
- Supplements for bone health:-

  Calcium – 800 – 1500mg

  Magnesium – 300mg

  Vitamin D3 – 1000 iu (found in eggs/oily fish)

MENTAL STRENGTH

- Need to build trust with your athlete to see them through a period of sometimes up to 2 years when they can see their performances plateau or even decline when they go through puberty.

- They will come through.

PLANNING AND PREPARATION

- PLAN THE YEAR – but be prepared to make changes
- PLAN THE LONG TERM FUTURE
- NO SHORT CUTS
- BUILD IN THE PROGRESSIONS – Technique, volume, number of sessions, physical preparation, intensities, miles per run
- PATIENCE

CONCLUSION

- Train in all the different zones (ref Physiology Presentation) – recovery running, easy, steady, tempo, VO2 reps, high intensity reps (especially before puberty), speed.
- Think of an individual athlete's long term development
- Paramount – how much should we be stressing a growing body? Overuse injuries on a developing skeleton. Are children less trainable around the age of puberty?
- Conclusion – both continuous and Interval based training programmes have been shown to enhance peak VO2 but those studies which incorporated both interval and continuous running have been the most consistently successful.

ENDURANCE 2012 OLYMPIANS' ATHLETIC BACKGROUND

- Lynsey Sharp- U11 – 800m only
- Lisa Dobriskey – U15 – 800m/1500m
- Hannah England – U15 – 800m/1500m
- Laura Weightman – U15 - 800m/1500m
- Jo Pavey – U15 – 1500m/3K (injured for best part of 6 years)
- Julia Bleasdale – U20 – 800m/1500m
- Barbara Parker – U17 – 800m/1500m
- Eilish McColgan- U13 – 800m/1500m
- Freya Murray (Ross) – U17 – 1500m/3K
- Claire Hallissey – U20 – 1500m/3K

ENGLAND ATHLETICS
LCDP
LOCAL COACH
DEVELOPMENT PROGRAMME

2012 OLYMPIANS' ATHLETIC BACKGROUND

- Michael Rimmer – U15 – 1500m/800m
- Andrew Osagie – U17 – 800m
- Gareth Warburton – U23 – 400m
- Ross Murray – U13 – 800m/1500m
- Andy Baddley – U15 – 1500m
- Nick McCormick – U17 – 1500m
- Stuart Stokes – U20 – S/C
- Lee Merrien – U23 – 800m/1500m
- Scott Overall – U17 – 1500m
- Chris Thompson – U15 – 3K
- Mo Farah – U13 – 1500m

- **4 out of 21 started competing at U13 and 10 out of 21 at U17 +**
- Lord Coe (if not working hard by 15 – might as well forget it) and David Rudisha – multi eventer in 2004 aged 15.

ENGLAND ATHLETICS
LCDP
LOCAL COACH
DEVELOPMENT PROGRAMME

Thank you!

U-COACH
GARETH SANDFORD: DEVELOPING HIGH INTENSITY ENDURANCE