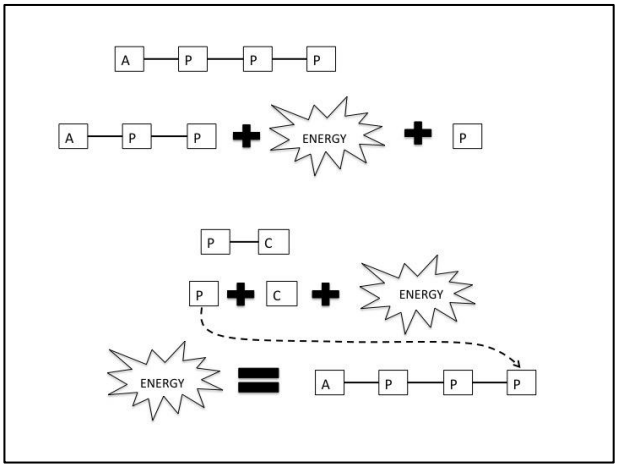
HSC CORE 2: FACTORS AFFECTING PERFORMANCE

1. HOW DOES TRAINING AFFECT PERFORMANCE?

1.1. ENERGY SYSTEMS

1.1.1. Alactacid system (ATP/PC)

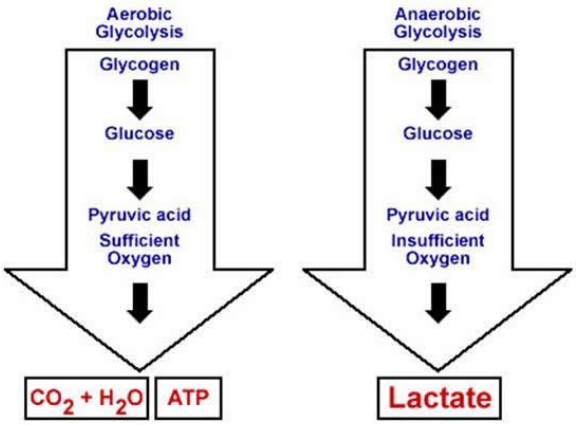


- ATP = energy stored inside muscles
- Energy rich compound serves as immediate source of energy
- Made up of adenosine and (3) phosphates
- When broken down, ATP releases heat and energy that is stored in bonds
- Broken down into adenosine di-phosphate
- Only lasts like this for 0-2 seconds because it is a **coupled reaction** (energy produced by one reaction is used to drive another reaction) with the breaking down of phosphocreatine
- *Energy From Foods:*
- Carbohydrates:
  - Broken down into glucose
  - Stored in muscles and liver as glycogen
  - Best source complex carbohydrates
  - 1 gram = 16 kilojoules of energy
- Fats:
  - Triglycerides; major energy source of fats
  - Stored in muscles and metabolized to produce glyceroland free fatty acids
  - Stored in fat cells of the muscles
  - Fatty acids can produce ATP but usually used at lower intensities at longer durations
  - 1 gram = 37 kilojoules of energy
- Protein:
  - Broken down into amino acide
  - Not used to produce ATP normal conditions
  - Only used when CHO and fat stores depleted
  - 1 gram = 17 kilojoules energy
- Energy released in breakdown of food not directly used to produce movement
- 90g ATP in our body
- Anaerobic system → replenishes ATP w/o oxygen
- We have enough ATP in our muscles for only one explosive contraction
- The breakdown of phosphocreatine (PC) creates energy that is used to join ADP and P back together to produce ATP
- 2 minutes to fully resynthesize

1.1.2. Lactic acid system

- Oxygen not available → anaerobic
- Anaerobic glycolysis:
  - Glycogen is broken down in the absence of oxygen to produce ATP
  - Glucose converted into pyvuric acid → and then into lactic acid
- Quick supply for short bursts
- Requires large amounts of glucose: 3 moles of ATP = 180g glucose

- Maximal effort causes exhaustion in 30sec
- Effort of 70-80% = 3-4 minutes
- Dominant system for events from 10sec to about 2 mins
- Excessively high levels of lactic acid can prevent the muscle fibres from contracting
- Training increases our ability to tolerate and remove lactic acid.
- The H ion is the acidic part and impair performance
- The lactate ion is a fast fuel and is actually preferred by the muscle because of its easy removal from the blood.
- Fatigue occurs when the accumulation of LA is faster than removal (lactate buffer)



- Lactate threshold: the point at which LA accumulates quickly in the blood
- Breakdown and removal can take from 30mins to 2hours
- Active recovery (cool down) is more beneficial as it promotes greater blood circulation and less pooling of LA in the muscles

1.1.3. Aerobic system

- Continuous supply of ATP
- Comes from oxygen system
- After 2-3 minutes of exercise body is able to provide oxygen to the working muscles for production of ATP
- In the presence of oxygen, muscle glycogen, fats and sometimes protein is broken down to produce pyruvic acid, ATP, CO2 and water. This is called aerobic glycolysis.
- Early stages → CHO preferred fuel (glycogen)
- 45mins – 1hr → fats fuel source when glycogen supplies exhausted
- Very efficient → 39 moles ATP from 180g glycogen.
- Total amount glycogen in body is 350g → 12hours rest, 1hr hard work
- Trained athletes → body can switch/ mix between fuels (use fats earlier and save some glycogen) → keep going longer periods.
- When glycogen runs out and moves onto fats the body tires → "hitting the wall"
- Don't have enough energy to convert fats → increases body temp and breathing rate
- Produces non-harmful CO2 and water
- Recovery dependent on length of activity
- Can take days to fully replenish glycogen stores
- Practical Examples:
  - Rowing event: 6-7 x 5 min races in 7 hours. Athletes will be using glycogen every race. After every race eat CHO in various forms – first 20 mins glycogen window.

1.2. TYPES OF TRAINING AND TRAINING METHODS

1.2.1. Aerobic

- aims to increase cardiorespiratory efficiency (ventilation rate, cardiac output, heart rate, stroke volume)
- Continuous:
  - Sustained effort with no rest
  - At least 20 mins. 40-60 mins for improvement
  - 2 types:

1. Long Slow distance Training:

- » Start of season to create base fitness
- » 60%-80% max
- » Distance rather than speed
- » E.g. marathon: 2hr run at 70% will build base fitness = ability to provide O_2 rich blood to the muscles (stroke volume, cardiac output, Haemoglobin, VO_2 max) This will allow athlete to use less energy during the race → able to work comfortably at an increased pace = faster for longer

2. High Intensity work
   - » Demanding
   - » As the program advances the intensity increases (overload)
   - » 80-90% max
   - » E.g. 10km runner: working at 85% will help build a lactic buffer but more importantly increase the anaerobic threshold → allow the to run faster for longer

- Fartlek:
  - Combination of interval and continuous
  - Participants vary speed and terrain → shock energy systems
  - E.g. for improved performance: Soccer: 25 mins of 20seconds on 90% 30 seconds off 40%. Will improve ability to run faster for longer in a game as they have a lactic buffer. Therefore they can beat their opposition to the ball. They have a better chance at scoring, a better chance of a turnover, make less mistakes.
- Aerobic Interval Training:
  - Alternating periods of work and recovery
  - Rest period is important in differentiating aerobic from anaerobic → shorter @ 3:1 work/rest ratio
  - Short rest does not allow time for full recovery → continuously stress aerobic system but does not fatigue
  - E.g. (4 mins run @ 80% → 45 seconds walk) x 10: The athlete is working at the upper end of the aerobic zone for 2 minutes. 15 secs wont allow HR to drop that much. 10 x repeats ensure system is stressed for at least 40 mins.
- Circuit:
  - 1 station to another
  - develops aerobic capacity and potentially muscular endurance, strength, and flexibility
  - E.g. Circuit 10 stations: Improve Soccer performance: develops aerobic capacity → run faster for longer → beat opponents to the ball → more chance to score a goal.

1.2.2. Anaerobic

- Anaerobic interval training:
  - Very high intensity HR at or above 85% of max
  - Generally last between 10 sec -2 mins (ATP/PC or lactic acid)
  - Work rest ratio of 1-3
  - Athlete will be working with higher levels of lactate in the blood → improved tolerance over time
  - E.g. 6-25 sec improves alactic (ATPPC) capacity, 25-40 sec incorporates lactic power, 40-60 sec improves lactic capacity
  - E.g. Cathy Freeman:
    - » Run 400m faster than others
    - » Increased lactic tolerance and buffer
    - » Can maintain a faster pace than others
    - » Increased anaerobic threshold (LIP) → run faster for longer
    - » Lactate as a fast fuel

1.2.3. Flexibility

- Flexibility: the range through which joints and body parts are able to move
- Essential for:
  - Preventing injury
  - Rehab – stretching scar tissue
  - Coordination
  - Skill execution
  - Muscular relaxation
  - Decreased soreness
  - Increased range of motion around a joint

TRAINING	DESCRIPTION	EXAMPLE
STATIC	• Also called passive stretching • Gradual lengthening of muscle, to a point of stretch without discomfort • Very safe • w/up and cool down and rehab • hold position, not moving	Tricep stretch, lock the gate
BALLISTIC	• Bounce stretching • Repeated movements to gain extra stretch • Rhythmical (gain extra stretch) • Possible injury, tearing • Advanced athletes only • Events require explosive motion	Touching toes in bouncing motion
DYNAMIC	• Slow controlled movements • Specific body parts moved while reach and speed is slowly increased • Prepare for event • Popular for warm uowarms the muscle fibres and extends them to the degree needed in the event • Safer than ballistic → raises body temp and decreases risk of injury	Swinging of arms in circular motion
PNF	• Progressive cycle: static stretch→ isometric contraction → static stretch • Allows greatest flexibility to be attained • Essential for rehab • Knowledge and guidance necessary • Partner stretching or resistance bands	

1.2.4. Strength training

- Strength: ability of the muscles to exert force
- Absolute strength: greatest force in single maximum effort
- Purposes:
  - Building strength
  - Developing power
  - Muscular endurance
  - Injury rehab
  - General health benefits
- Repetition: number of times an exercise is repeated without rest
- Sets: number of repetitions on a particular exercise
- Resistance: number of weight being used on a load

- Repetition maximum: maximum number of repetitions that can be completed once a given resistance before the onset of fatigue
- Shoulder press: 3 sets x 10 reps (15kg), 60-90seconds rest
- Principles to consider when designing resistance programs:
  - Target specidic muscle groups
  - Progressive overload
  - Volume
  - Variety
  - Rest
  - Repetition speed
  - Repetition numbers
  - Recovery
- Types of strength training:

	Description	Advantages	Disadvantages	Example
Free weights	Uses stabilizer muscles, best for athletes	- Develops all muscle groups at the same time - Versatile so most athletes are able to incorporate into training	- can be time consuming - must have correct technique and form - beginners not suited	- rower using bars to perform shoulder press, chest press and squats.
Weight machines	Resistance provided by a stacked weights were user an adjust load	- better for beginners enhances stability and gives confidence - instructions	- can be boring	- seated row for back row muscles
Resistance Bands	Bands are anchored to a wall of the body, then stretched which creates a resistance	- cheap and portable - colour coded - most resistance is at the end of the movement - not always the best for athletes who need to develop strength through the entire muscle - good for rehab programs or warm ups	- not beneficial for whole muscle groups	Shoulder pull
Hydraulic Machines	Each effort made is confronted by an opposing force	- resistance is felt through entire muscle - effort needed for whole movement - greater resistance at high speeds	- hard	Bicep curl with resistance

- Strength training formula – free and fixed weights:

Type	Weight/resistance	Reps	Sets	Speed of lifting	Rest
Strength:	Heavy 2-6 RM	3-6	3-6	Slow	3-5 mins
Power: size but speed of	Med- heavy 6-12 RM	6-10	3-6	Fast	3-5 mins

contraction more important					
Endurance: lean tone, no bulk.	Light 15RM	20-30	3	Medium	1-2 mins
Lean body mass:	Medium	10-15	3-4	slow/medium	1-3 mins

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1.3. PRINCIPLES OF TRAINING

1.3.1. Progressive overload

- Gains will only occur when training load is greater than normal i.e. body is stressed
- Progressively increased by no more than 10% each week as improvements in fitness occur
- Aerobic training: improve hearts ability to pump more blood to the working muscles and improve oxygen uptake
- Marathon runner: able to go faster for longer more comfortable because they are use to stress o the body
- Strength training: increased cross-sectional area of the muscle

1.3.2. Specificity

- When activity in training resembles the movements in the game
- Specific to energy systems required for event e.g. sprinting = ATP/PC system (metabolic specificity)

1.3.3. Reversibility

- Effects of training are reversible
- Detraining effect → significant losses occur after only 1-2 weeks
- Losses are slower for aerobic fitness than strength
- Flexibility lost quickly
- Greater the gains = greater the losses
- Avoid detraining CRE continuing regular training @ 70% max 3x a week

1.3.4. Variety

- using same drills and routines is boring and counterproductive
- keep athlete interested and motivates
- e.g. group or paired training sessions. Water running for recovery

1.3.5. Training thresholds

- Specific point determined by work intensity
- Aerobic threshold → 70% MHR → sufficient to cause a training affect
- Anaerobic threshold 85%+ MHR → lactic acid accumulates quickly in the blood a.k.a lactic inflexion point
- working close to the anaerobic threshold improves their tolerance to lactic acid
- Interval training to 90-95% max will also improve LIP e.g. as the athlete becomes use to training with lacyic in their system and develops a lactic buffer
- Therefore able to go faster for longer e.g. cathy freeman

1.3.6. Warm up and cool down

Warm Up:

- Increases blood flow to muscles
- Increases muscle temperature
- Reduces chance of injury
- Increases body temp
- Stimulates cardiovascular system
- 4 stages:
  - general warm up e.g. jog
  - stretching

- calisthenics
- skill rehearsal – performing skills similar to tge game

Cool Down:

- minimizes muscle stiffness and soreness
- includes aerobic work and stretching
- disperse lactic acid
- essential to all programs

1.4. PSYCHOLOGICAL ADAPTIONS IN RESPONSE TO TRAINING

1.4.1. Resting hart rate

- Definition: beats per minute at rest
- Adap: decreases
- Highly trained athletes have a RHR between 30-40bpm
- Trained athletes have a lower RHR than untrained → heart more efficient
- E.g. the heart doesn't need to work as hard, therefore less energy used (conserves energy) so you recover quicker in team sports and last longer in endurance races such as a marathon

1.4.2. Stroke volume and cardiac output

- Definition: amount of blood ejected by the left ventricle each beat/ amount of blood ejected by the heart each minute.
- Adap: both increase substantially CO up to 5x.
- *Stroke volume* – amount of blood ejected by left ventricle each beat (mL/beat)
- Increases with training because the left ventricle can fill more completely with blood, therefore a more forceful contraction and more blood and oxygen is delivered to the muscles → faster for longer

Untrained	80mL/ beat at rest	100mL/ beat at rest
Trained	100mL/ beat at rest	160mL/ beat at rest

- *Cardiac* output – amount of blood pumped by the heart per min = heart rate x stroke volume
- Increases 5x higher with training and will have a lower maximal working heart rate that the untrained athlete due to stronger intercostal muscles to increase strength and lung capacity
- E.g. Lance Armstrong – each heart beat moves double the amount of blood than untrained therefore muscle more oxygenated, produce less lactic and take longer to fatigue

1.4.3. Oxygen uptake and lung capacity

- *Oxygen uptake* – the ability of the working muscles to use the oxygen being delivered (mL/kg/min → takes individual into account)
- Increases with training by 15-20%, measured by beep test of bike ergo until exhaustion
- *Lung capacity* – amount of air that the lungs can hold
  - Vital capacity (amount expired after maximal inspiration) ↑ slightly
  - Residual volume (amount moved out of lungs) ↓ slightly with training
  - Tidal volume (air breathed in and out) is unchanged
- E.g. lungs develop in capacity, therefore bigger air intake increased by stronger intercostal muscles to increase oxygen uptake → more oxygen delivered to working muscles so marathon runner lasts longer

1.4.4. Haemaglobin level

- The substance in blood that binds the oxygen and transports it around the body (contained in red blood cells – more produced in training)
- Increases by 20% with training and increase in oxygen carrying capacity
  - Each red blood cell contains 250m haemoglobin molecules

  - Male has 14.3g of H per 100mL of blood
  - Female has 13.9g of H per 100mL of blood
- Working aerobically with oxygen for longer (altitude training) e.g. cycling to maintain performance for longer

1.4.5. *Muscle hypertrophy*

- Refers to muscle growth with an increase in the size of muscle cells (cross sectional area)
- Increases in proportion with overload – lifting beyond capability to be more powerful and stronger
- Loss of muscle size is muscle atrophy
- Cross sectional increases due to:
  - Myofibrils – the part of the muscle that contracts increases
  - Muscle fiber enlarges with stored glycogen, ATP and PC
  - Connective tissue – ligament and tendon gets bigger
- The extent depends on:
  - Fast or slow muscle type – training increases white fiber area but doesn't change from white to red
  - Stimulus – low reps with high resistance e.g. 3 sets 3-6reps
  - 3 times min training per week
  - Availability of hormones (men have more testosterone)
- E.g. marathon needs strength for gradients, sprinter explosive movements

1.4.6. *Effect on slow/fast twitch muscle fibres*

Fast twitch muscle fibres (FT)

- Fast (white) will respond to sprints, short intervals and resistance training because they contract quickly but fatigue rapidly
- There are two types (FTα and FTβ):
  - FTα – immediate fibres produce high energy for a lengthy period as can draw on both aerobic and anaerobic sources (mix of ST and FT) e.g. a game player
  - FTβ – draws energy solely from anaerobic sources, therefore suited for explosive events. E.g. with an increase in ATP, the sprinter will be able to gain more power off the blocks
- Anaerobic training at high intensity causes the following adaptations in fast-twitch fibres:
  - ATP/PC supply increases and more efficiently used
  - Glycolytic enzymes increase improving cell function
  - Hypertrophy is considerable
  - Lactic acid tolerance increases → anaerobic performance sustained for longer periods

Slow Twitch muscle fibres (ST)

- Slow (red) respond most to endurance activities (smaller)
- They contract slowly and release energy gradually as required by the body and are efficient in using oxygen to generate fuel (ATP), making them resistant to fatigue but unable to produce the power of FT fibres
- Aerobic training at lower intensity causes the following adaptations to occur in muscle fibres:
  - Hypertrophy – some growth
  - Capillary supply – ↑ 15% better than CO_2 removal and O_2 delivery
  - Mitochondrial function (where ATP is produced) – ↑ number of these cells, their size and efficiency in utilising O_2 to produce ATP
  - Myoglobin function – ↑ 80%, responsible for transporting O_2 from cell membrane to mitochondria to store → last longer
  - Oxidative enzymes – activity ↑'s → energy (ATP) production efficient

- Ability to use fatty acids as an energy source (glycogen sparing/mix fuels) is enhanced as glycogen store increases and can maintain pace for longer
- E.g. marathon runner uses fat as fuel source, therefore spare some glycogen for the end of the race and more oxygen available to working muscles

2. HOW CAN PSYCHOLOGY AFFECT PERFORMANCE?

2.1. MOTIVATION – "internal state that activates, directs and sustains behaviour towards achieving a particular goal"

2.1.1. Positive and negative

Positive motivation

- When individual performance is driven by previous reinforcing behaviours
- It relies on continual self-reinforcement e.g. 'I can finish this race', reinforcement by others e.g. 'Good shooting Sophia' or 'Excellent pass, well done', recognition, praise and rewards
- This lifts your confidence and motivates you
- sustainable

Negative motivation

- Feedback for behaviour seen by coaches, parents or peers as unacceptable
- Improvement achieved through athletes avoiding this behaviour for fear of negative reactions e.g. 'pick up your game!' or 'why are you shooting so bad?'
- This decreases their confidence
- not sustainable long term

2.1.2. Intrinsic and extrinsic

Intrinsic motivation

- Occurs within the individual, self-sustaining and self-fulfilling
- The performer motivates themselves for fun, victory and satisfaction e.g. Usain bolt wants to beat his world records, 'I want to do my best.'
- flow experience where performance is maintained without conscious thinking e.g. Rafael Nadal – Aus open final

Extrinsic motivation

- Associated with external rewards or material reinforcement e.g. an athlete who wants to win money, trophies, media coverage or fame
- Can improve performance, but not a sustained form of motivation as we rely more on internal reinforcement

2.2. ANXIETY AND AROUSAL

2.2.1. Trait and state anxiety

Anxiety

- An emotion identifies by various levels of agitation that reflects a person's feelings and fears to a particular situation, and can cause discomfort physically and psychologically e.g. exams, races
- Uncontrolled contributes to poorer performances
- This may result in: unclear thinking, seizing or choking

Trait anxiety (A-trait)

- General level of stress characterised to each individual (personality trait)
- more threatened by situations and become anxious and stressed e.g. Anna Kournikova (17 double fault tennis serves)
- Can be controlled by relaxation or praise/positive motivation

State anxiety (A-state)

- More specific, referring to the emotional response to a particular situation
- Causes physical and mental distress e.g. shaking, seizing up
- E.g. Greg Norman, experienced golfer who choked under pressure making simple mistakes

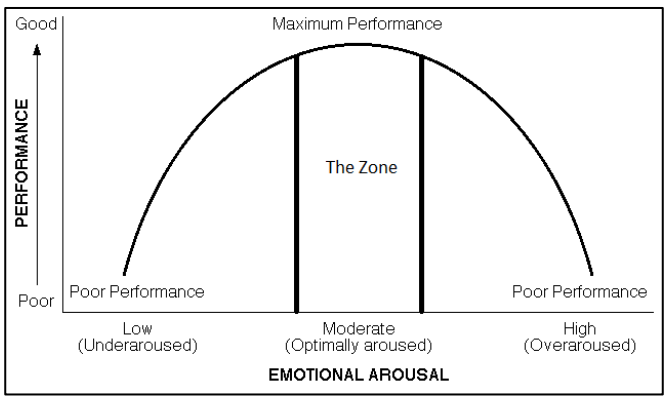
- Linford Christie choked in 100m sprint Olympic 1996 final with 2 false starts

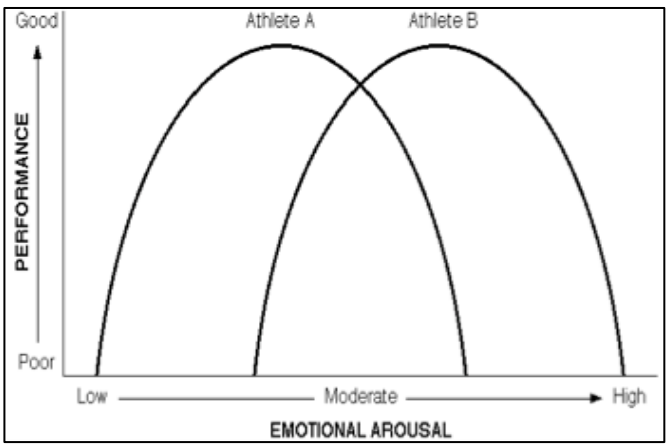
2.2.2. *Sources of stress*

- Stress is a non specific response that the body makes to demands upon it
- Stress can get the body ready for exercise producing adrenaline:
  - Increase blood supply to muscles
  - Increase glucose production to provide extra fuel
  - Increase sweat production to cool the body
  - Tightened muscles to prepare for the action
  - More oxygen to the lungs
- Stress is a personal attribute that depends on predisposition and:
  - Personal pressure to win
  - Competition pressure e.g. from opponent
  - Social pressure from family, coach, fans
  - Physical pressure e.g. physically exhausting training
- An athlete might experience:
  - Hyperstress (too much)
  - Hypostress (too little)
  - Eustress (good stress)
  - Distress (bad stress)
- To cope with stress an athlete may:
  - Practice in pressure situations e.g. 3 vs 4 in soccer to be prepared
  - Practice relaxation techniques such as breathing/ calming
  - Planning strategies to cope e.g. visualising the race and how to win (mental rehearsal)
  - Improved confidence through self talk

2.2.3. *Optimum arousal*

- Refers to a specific level of anxiety before or during a performance
  - Anxiety – psychological state
  - Arousal – physiological process
- The degree of energy release and the intensity of readiness od the performer
- It can be measured by:
  - Heart rate
  - Respiration
  - Muscle tension
  - Skin temp
  - Brain wave activity
- Inverted u hypothesis:
  - *Limitations*: it fails to explain how and why arousal affects performance





- *Athlete A* – more difficult task using only a few muscle groups, therefore lower level of arousal e.g. golf, archery
- *Athlete B* – need a higher level of arousal e.g. a boxer or a game based sport such as rugby NZ do the haka

- *Impacted by personality factors:*
  - Self expectations of performance
  - Expectations form others e.g. coach, parents
  - Level of experience allows you to handle pressure differently
  - Level of comp (round or final)
  - Degree of difficulty of skill

2.3. PSYCHOLOGICAL STRATEGIES TO ENHANCE MOTIVATION AND MANAGE ANXIETY

2.3.1. Concentration/attention skills

- The ability to focus on the appropriate cues for the duration of the event such as key words ('breathe') to lower anxiety and narrow concentration
- Athletes must:
  - Shut out distractions (the crowd)
  - Concentrate/focus on 'here and now' (e.g. the netball shot)
- *External distractions* – weather, crowd, sledging
- *Internal distractions* – worrying about a mistake, negative self-talk, anger at umpires decisions or opponents, over analysing performance
- E.g. John McEnroe tennis player gave into booing crowd and argued with ref
- Matt Emmons Olympics 2004 shooting (1st place but in final shot wrong target → placed 8th)
  - Intense concentration: gymnastics, batting at cricket
  - High and low intervals of concentration: team sport (netball, football)
  - Sustained concentration: tennis, triathlon
- *Methods to help with concentration:*
  - Music: to calm or pump up (motivate) such as lyrics
  - Cues/key words: verbal, physical or visual such as coach cards or 'breathe'
  - Set routines: e.g. Tiger Woods in golf, rugby goal kicker, tennis bounce ball x2

2.3.2. Mental rehearsal/ visualization/ imagery

- The technique of picturing the performance or skill before executing it
- E.g. high jump, gymnastics, Hannah Campbell Pegg (luge) and mentally recreating race day and performance to perfection (Yanda Nossiter kayak)
- This elevates arousal to desired level, heightens concentration and narrows thoughts to the task at hand
- To be effective: vivid with realistic pictures, repetition, sense of the hole experience because the brain doesn't know the difference between the real and imagined

2.3.3. Relaxation techniques

- Series of techniques that seek to control the body's response to stress
- Trait anxiety must take part in some relaxation techniques to control arousal
  1. Progressive muscular relaxation – tensing and relaxing all muscle groups to decrease tension and arousal
  2. Centered breathing – release tension before a performance and keeping shoulders relaxed
  3. Meditation – narrowing ones thoughts using simple, repetitive images and sound e.g. yoga, tai chi
- E.g. Ian Thorpe uses central breathing when behind the blocks to lower arousal before the race to ensure he's focused and muscles aren't too tense

2.3.4. Goal setting

- Targets that we direct our efforts towards – behaviour or performance

- Goals set by athletes:
  - More likely to fulfil them
  - Provide motivation
  - Give focus and direction
- Short term: achieved in a limited period of time (week, month) e.g. 5 swim sessions per week
- Long term: achieved over a long period of time (yearly) e.g. make Olympics
- Behavioural: improve behavioural expectations in training and competition e.g. John McEnroe tennis player outbursts lost game (control temper)
- Performance: relate to athletes desired level of success e.g. state final, gold medal – written down (to see improvements) and so it remains a focus

3. HOW CAN NUTRITION AND RECOVERY STRATEGIES AFFECT PERFORMANCE?

3.1. NUTRITIONAL CONSIDERATIONS

- No energy = decreased performance
- Fluid is crucial as it:
  - Cools muscles and prevents dehydration
  - Assists temp regulation
  - Prevents damage to organs by diluting toxic waste
  - Aides oxygen transport to the cells

3.1.2. Pre performance

- Must be CHO
- Complex CHO (i.e. last meal) 3-4hours before
- Snack (medium GI) 1-2 hours
- CHO solutions (i.e. endura, gels, lollies) 30 mins
- Fat/ protein takes too long to digest
- Adequate fluid: 300ml 30 mins before
- Amount of food relates to type of event i.e. endurance = more
- Large amounts can cause discomfort i.e. running
- 2L fluid per day leading up to event
- 750ml 2-3 hours before
- Carbohydrate loading:
  - Loading muscles with glycogen for event 90mins+
  - Best events 8hrs before i.e. Hawaii ironman
  - Average muscle glycogen stores 100-120mmol/kg can increase by 1/3
  - Old practice: training hard with no CHO, then eat lots of CHO
  - New Belief: short term low intensity = no need (normal diet) 7-12g CHO/kg 36-72 hours before
  - Best achieved through balanced diet high in CHO and tapering 2-4days prior.
  - Can improve performance by 2-3%
  - Problems:
    1. No tapering
    2. Eating too much fibre
    3. Not eating enough food (psychological problems)
- Carb loading example meal plan:

Breakfast	• 1 glass apple juice • 6 weetbix with 1 cup milk • 2 slices unbuttered toast with jam • 1 banana
Morning snack	• 2 crumpets with honey • 750ml sports drink
Lunch	• 2 large salad and cheese rolls

	• 1 piece of fruit • 1 glass of cordial
Afternoon snack	• 200g low fat yoghurt • 1 toasted breakfast muffin with jam
Evening meal	• 2 cups cooked rice, chicken and stir fry veggies • 1 bread roll with honey • 1 cup fruit salad • 3 scoops reduced fat ice cream
Supper	• 2 slices raisin toast with jam/honey • 1 glass cordial

3.1.3. During performance

- events 90mins+ need food and fluid e.g. 90km bike race
- replace CHO and electrolytes
- electrolytes are salts and minerals important for bodily function
- exercise intensity above 75% consuming CHO will delay glycogen depletion by 30mins
- needed in long events every 30 mins (after 90) i.e. marathon
- CHO drinks + food = sick
- Fluid every 15mins 200-300ml – set timer, draw on bottle
- Aim to replace 30-70% fluid losses
- Flavoured drinks = more consumption – low CHO (4-8%)
- Dehydration = decreased performance = from 2% fluid loss
- Prevent dehydration:
  - Acclimatize to conditions
  - Light breathable clothing
  - Avoid in high heat <30 degrees and 90% humidity (zone 3)
  - Avoid fat, salt, alcohol
  - Don't run if sick
  - Recognise heat stress

3.1.4. Post performance

- Return body to pre – event state
  1. Replace glycogen stores
  2. Replace fluid and electrolytes
  3. Repair muscle protein
  4. Promote immune system
- 50-100g 20 mins after = glycogen window (faster replacing glycogen)
- 50-75g CHO every 2hrs until 500-600g consumed
- Adequate protein to rebuild and repair muscles
- Drink until body weight returns to normal
- No alcohol
- Replace electrolytes with CHO solutions

3.2. SUPPLEMENTATION

- Ergogenic aid is a technique designed to improve/increase work output
- Supplement is any addition to an athletes regular diet that aims to achieve a particular nutritional goal
- Pros:
  - Assistance to meet nutritional goals
  - Direct performance enhancement
  - Psychological boost
- Cons:
  - Cost

- Side effects
- Accidental doping

- Questions:
  - Is it legal?
  - Is it safe?
  - Does it work?

3.2.2. Vitamins/minerals

	Vitamins	Minerals
Role	Maintain normal growth, breakdown CHO, fat and protein. Body cannot make these.	Essential for bodily function – not provide energy. Aid muscle contraction, fluid balance.
Source	Fruit, vegetables, dairy, wholegrain bread, and cereal	Dairy, red meat
Example	• Vitamin A (maintains skeletal and soft tissue), Vitamin D (essential for strong bones and strong muscles), Vitamin E (important for processes of body) → all stored in the body • Vitamin B (resist infection, stress management), Vitamin C (energy production and release → water soluble (expelled easily through urine)	• Calcium, (bone growth and strength) • Potassium (nerve and muscle function) • Iron (transport of oxygen in blood) • Sodium (control blood pressure and blood volume) • Chlorine (distribution of fluid through the body) • Magnesium (bone, protein, and fatty acid formation
Link to performance	Supplementation is not needed with a balanced diet, deficiencies can exist in those athletes who restrict diets (vegetarian)	Athletes do not need to take more than RDI. Females, weight loss athletes, and endurance athletes at risk.

3.2.3. Protein

- Source: eggs, red meat, chicken, tofu, milk, protein powder, protein bars
- Needed for growth and repair of muscles
- Only need slightly more than normal to repair
- Negatives:
  - Most athletes do not benefit
  - No evidence that 2kg+ of protein per day has any benefit on strength or muscle size
  - most of Australian pop consume 150% of recommended level of protein
  - many supplements contain too many preservatives and additives
  - excess protein increase calcium excreted in urine
  - interfere with kidney function
  - may take place of nutritious foods
- Positives:
  - Strength and endurance athletes benefit in heavy training
  - Adolescents
  - Vegetarians
  - Fussy eaters

- No time
- Consuming 10-20g of protein before and after reistance training will promote training adaptions

3.2.4. Caffeine

- Central nervous system stimulant
- Diuretic (increases fluid passed through body)
- Evidence for improved performance is inconclusive
- Some power bars/ gels include caffeine
- Positives:
  - Mild doses improve: alertness, delays fatigue, concentration, clear head
  - Popular endurance events
  - Improves ability of body to convert fat stores to free fatty acids → help with glycogen sparing
  - Benefits can be felt 6 hours after intake
  - 2-3mg/ kg body weight is enough to potentially improve performance
- Negatives:
  - Can cause anxiety and jiterry unsettled feeling
  - Racing heart beat
  - Decreased visual processing ability
  - Reduced sleep quality

3.2.5. Creatine

- Sources: production by body cells, food intake from meat
- Muscle fuel derived from amino acids stored in skeletal muscle
- Short explosive events (ATP/PC)
- Supplementation popular because cant be stored in the body
- Positives:
  - Creatine storage low (vegetarians) case for limited supplementation
  - Small amounts (2-3g a day) taken with CHO and water best
  - Raise creatine by 20-30% if deficient
  - Psychological (think they will perform better so they do)
  - Muscle growth more easily achieved with creatine supplementation
- Negatives:
  - Body cant store excess creatine so supplementation has little imoacts
  - Weight increase
  - Muscle ramps
  - Kidney disease/failure
  - Non- responders in some cases
- 5 day loading period: 5g 4 times a day or 4 weeks 3g each day
- once saturated, 4 weeks to return to normal

3.3. RECOVERY STRATEGIES

3.3.1. Psychological strategies

- Cool down:
- Active recovery
- Reduces DOMS
- Reduced lactic in the blood
- Gradually lowers body temp
- Psychological benefits (feel better wwhen body returns to normal)
- Prevents blood pooling and dizziness
- Active recovery can improve the next performance by 30% when the time between performances or training sessions is short e.g. morning heat swims followed by finals
- Passive recovery;

- Refers to resting with no activity following exercise
- Beief: resting will allow body to recover from previous efforts by allowing (natural) metabolic removal within the muscles
- E.g. day of complete rest prior to competition
- Hydration/fluid strategy
- Avoid dehydration
- Only replace 30-70% fluid lost during activity (thik they don't need to, forget,____ during training)
- Body temp remains high after exercise → increase dehydration
- 1kg bw lost = 1L water consumed
- "fluid deficit' __. Actually 1.5L for 1kg → body still sweating and producing urine after stopping
- Drink to urine returns to normal
- What?
  - Water and CHO drinks e.g. endure and zero shots
  - Cooler temp tp reduce body temp
  - No alcohol → increases urination and dehydration
  - Also dilates blood vessels and can make injuries worse

3.3.2. Neural strategies

- Help central and peripheral nervous systems recover
- Systems fatigue due to chemicals found in muscles following heavy bouts of exercise
- Aim: relax muscles that have been fatigues and damaged from high intensity exercise
- Hydrotherapy:
- Use of eater to assist with recovery
- Provides support for movements eliminate jarring and straining
- E.g. spa, underwater massage, heated swimming pools
- Changes in blood flow
- Skin, muscles, core temp changes
- Hot water immersion:
  - 37 degrees for 15 minutes
  - Elite athletes to enhance recovery
  - Spa and water jets as a form of massage
  - No heat if injured
- Contrast water therapy:
  - Alternate immersions in hot and cold water of 60 seconds for 3-7 cycles
  - Cold 10-15 degrees, hot 37-38 degrees
  - Reduction in swelling (muscles less heavy → not fatigued)
  - Alterations in tissue temp (flushes out blood, disperses lactic)
  - Changes in blood flow distribution (no blood pooling in legs)
  - Reduction in pain (able to go faster and perform better)
  - Improvements in range of motion (muscles aren't stiff → efficient movement)
  - Refreshed and alert (mental alertness → make good decisions)
- Massage:
- Stimulation of skin and muscles by movements from self of masseur
- Increased blood flow to the muscles
- Decreased tension and soreness
- Reduces the cyhance of injury
- Increases flexibility
- Enhances immune function
- Relaxation, the other athlete feels better, promotes sleep, etc.

3.3.3. Tissue damage strategies

- Cryotherapy:
- Use of cooling to treat injury ir quicken recovery from hard and intense performances
- Cold water immersion
  - Traditionally used to treat soft tissue injuries
  - Reduce inflammation and muscle spasm
  - Decreasing HR
  - Increased BP
  - Decreased core temp
- Involves ice bath;
  - 5 min in water of 10-15 degrees
  - When the muscles are submerged in ice water exposed blood vessels will narrow
  - Force the blood away from the muscles, taking with it lactic acid and waste products
  - New blood will flow back to the area, bringing fresh enzymes
  - Allows faster recovery
  - Ice packs or ice massage moved over muscle in circular fasioh --. Reduces swelling and internal bleeding
  - 10 mins off, 10 mins on.
- Compression Garments:
  - increase rocevery from exercise
  - lower body compression found to promote venous blood flow
  - accelerated post exercise infolammatory repair and response
  - reduction in DOMS
  - increased circulation nd decrease in inflammation

3.3.4. Psychological strategies

- Athletes may experience low concentration, lack of motivation, increased anxiety levels.
- Sleep is still regarded as the most important recovery strategiey
- Relaxation strategies important for emotional recovery
  - Examples;
    - » Mind relaxing activities
    - » Progressive muscular relaxation
    - » Meditation
    - » Visualisation
    - » Centre breathing
    - » Positive self talk
- Sleep:
  - Sleep deprivation major reasons for high levels of fatigue
  - Causes a large decrease in performance
  - Decision making and focusing skills are reduced
  - Ways to improve sleep;
  - Maintain regular cycle
  - Create comfortable, quiet, temperature controlled room
  - No alcohol, coffee, large volumes of water before bed
  - Bed

4. HOW DOES THE ACQUISITION OF SKILL AFFECT PERFORMANCE?

4.1. STAGES OF SKILL ACQUISITION

4.1.1. Cognitive

- First stage of learning
- Forms a picture
- Gross errors
- Short stage
- Performance not consistent

- ROC:
  - Visual demonstration
  - Lots of feedback
  - Short clear instructions
  - motivate

4.1.2. Associative

- Practice stage
- Long stage
- Fundamentals learned
- Movement repeated to improve efficiency
- Smooth and consistent
- Fewer errors
- ROC:
  - Clear feedback
  - Correct errors
  - Video

4.1.3. Autonomous

- Automatic
- Efficient and consistent
- Few errors
- Fluent
- Instinct
- Drills with pressure
- Now able to attend to other things
- ROC:
  - Well organized sessions
  - Stimulate performance

4.2. CHARACTERISTICS OF THE LEARNER

4.2.1. Personality

- Individuals characteristic way of learning
- Certain attributes are favoured e.g. motivation, reliability
- Personalities with positive ways of behaving are more receptive, more cooperative, more helpful.

4.2.2. Hereditary

- Fast/ slow twitch fibres
- Body type
- Gender
- Height
- Conceptual ability

4.2.3. Confidence

- Belief in ones own ability
- Coaches do not develop confidence = athletes learn slower
- Hard skills too early = failure = decreased confidence

4.2.4. Prior experience

- Previously learned a similar movement or skill, learn new movement more quickly
- Transfer learning

4.2.5. Ability

- Ease to learn and perform a movement
- Range of factors: acuity, perception, reaction time, intelligence

4.3. THE LEARNING ENVIRONMENT

4.3.1. Nature of the skill

- Observable characteristics of the skill
- Open and closed skills
- Open:
  - Unstable, unpredictable environment
  - Impacted by weather, other players, tactics
  - Adapt by modifying technique
  - Learning more difficult
- Closed:
  - Stable, predictable environment
  - Learning is easier
  - Skills can be well planned in advance
- Gross and Fine motor skils:
- Precision of hand movement
- Fine:
  - small muscle groups
  - Require greater control in movement
    - » Darts
    - » Putting in golf
    - » Serving in table tennis
- Gross:
  - Large muscle groups
    - » Walking
    - » Running
    - » Swimming
- Discrete, serial, continuous skills
- Discrete:
  - Clearly defined beginning and end e.g. throwing a ball
- Continuous skills:
  - No distinct beginning and end
  - Skills are repetitive and appear ongoing. E.g. swimming.
- Serial skills:
  - Involve a sequence of smaller movements that are assembled to make a total skill e.g. a place kick in football.
- Self and externally paced
- Self paced
  - Performer decides the timing and the speed of execution
- Externally paced:
  - Factors external to the performer set the time for execution of movement.

4.3.2. Performance elements (decision making, strategic and tactical development)

- We can develop performance elements through the use of technical equipment, coaching boards, game like drills, small and modified games.
- Decision making skills:
- Decision making practice to improve skills → clear decisions when performing
- Done under pressure to improve reaction time
- Achieved best through:
  - Observation:
    - » Boards and demonstrations to highlight why and when certain decisions need to be made
    - » Observation of skilled players

- Questioning:
  - » Improved by highlighting options anc having players work through game like scenarios
- Whole part whole approach:
  - » All players taught overall plan
  - » Learn specific roles
  - » Practiced again in full
- Variation:
  - » Must happen when rehearsing strategies
  - » Lots of different plays
- Creativity:
  - » All players should be involved n decision making and strategic development
  - » Foster positive and productive decision making environment.
  - » Ask for advice

- Strategic and tactical development:
- Strategic understanding: refers to the way we play, where we should be at a particular time
- Tactical awareness: utilizing ways of gaining an advantage over an opponent
- Both mature gradually through drills and mini games
- Less tactical sports → individual sports → specific and technical in training
- Tactical games training must reflect game like situation
- Benefits:
  - Player understand complete requirement of skills
  - Allows practice for decision making under pressure
  - Enhances confidence
  - Improves team coordination

4.3.3. Practice method (massed, distributed, whole, part)

- Massed and distributed practice:
- Massed:
  - Continuous practice session with brief rest periods or when rest intervals are shorter than practice intervals
  - Involves long periods of instruction and skill development
  - Massed practice works best when performers are highly motivated, frest, unable to attend a number of sessions.
- Distributed:
  - Session that has periods of work and relief
  - Works best when:
    - » Learner is in early stage of learbubg
    - » If the skill causes fatigue or discomfort
    - » Performer lacks interest or is unmotivated.
- Whole and part practice:
- Whole:
  - Applied when a skill is practiced in its entirety
- Part:
  - Applied when a skill is broken into smaller components and each small sub skill is practiced separately.
  - Best used for new and complex skills
- Many coaches use a combination of methods e.g. whole, part, whole.

4.3.4. Feedback (internal, external, concurrent, delayed, knowledge of results, knowledge of performance)

- "the information provided to the learner about the nature or result of their performance"
- needed at each stage of acquisition
- works best if immedieate and positive and reinforce corret execution.
- Ability to:
  - Reinforce correct or desired response
  - Motivate performer
  - Correct action
- Relied on
- Sometimes can be confusing e.g. applause from crowd but poor execution
- Internal and external feedback:
- Internal:
  - During performance
  - Comes from within
  - Received through body's proprioceptive mechanisms → how it feels
- External:
  - Comment from coach
  - Applause
  - Score
  - Video replays
  - Race results
- Concurrent and delayed feedback
- Concurrent:
  - Received during performance of the skill.
  - Relayed through the body by the senses
- Delayed:
  - Received after the skill has been executed
  - Feedback is not received until the ball enters or misses the basket.
- Knowledge of results:
  - Information anout the outcome of a movement
  - Always external
  - Quantitative
  - "what"
- Knowledge of performance
  - Actual execution of a skill
  - An be internal or external
  - "how"

4.4. ASSESSMENT OF SKILL AND PERFORMANCE

4.4.1. Characteristics of skilled performers

- Kinaesthetic sense:
  - Information gained from within the body concerning body position and limb awareness
  - Able to feel movement as they perform it
  - Alert to error and can make corrections and modifications while performing the movement
- Anticipation:
  - Better able to predict what might happen next- and being able to respond
  - Skilled performers are better able to predict what may occur in games
- Technique:
  - Procedure applied to particular tasks

- Advantages of a good technique:
  - » Economical
  - » Reduced chance of injury
  - » Better chance of holding up under pressure
- Consistency
  - Athlete can perform same skill repeatedly without error

4.4.2. *Objective and subjective performance measures*

- Subjective: personal judgement f how well the skill was performed
- Based on personal feelings and can be impacted by mood
- Objective: based on facts and occurs without bias
- Independent from the observer
- Same result for the same performances
- How to make observations more objective:
  - Use checklists
  - Measurement systems
  - Established criteria
  - Rating scales

4.4.3. *Validity and reliability of tests*

- Validity: the honesty of a test
- Degree to which a test measures what it is designed to measure
- To enhance validity:
  - Judgements about test items e.g. if known good jumpers score better than poor jumpers
  - Ensuring test items contain the component being validated e.g. a sprinting test would need a running component
  - Accuracy in prediction: the test is more valid if can predict future performances
  - Reliability: is the ability of a test and test results to be repeated
  - A test can be reliable but invalid but cannot be valid if it is not reliable.

4.4.4. *Personal versus prescribed judging criteria*

- Standards or qualities that are used for judging
- Personal:
  - Pre conceived ideas that an individual brings to judge a performance
  - Relies on feelings and emotions, expectations and possible bias to measure performance
- Prescribed criteria:
  - Established by a sports organization and form the basis of assessment
  - The more rigorous the criteria and more competent the judges the more objective is the appraisals