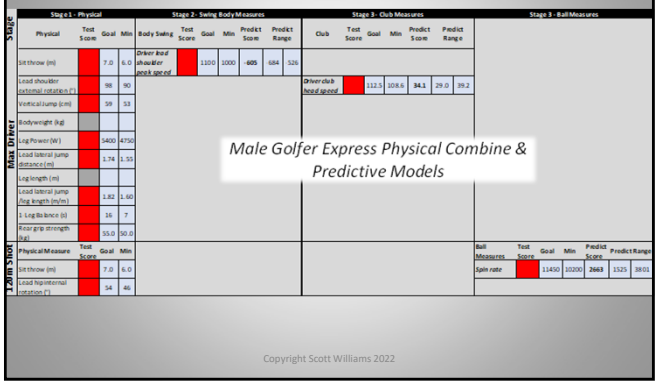
Enter Test Scores



1

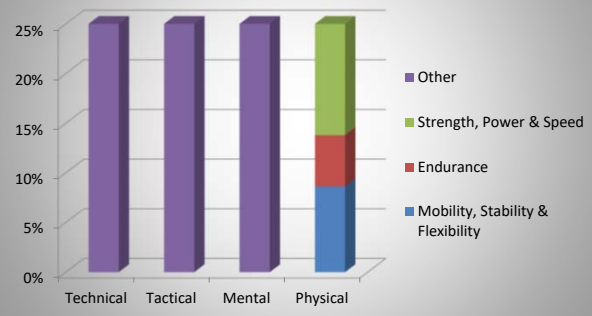
2

Fit For Golf – Contents

- How 'physical' fits in golf performance models
- Using benchmarks
- The physical-golf performance continuum
- How physical training of golfers works
- Golf injury
- Case studies

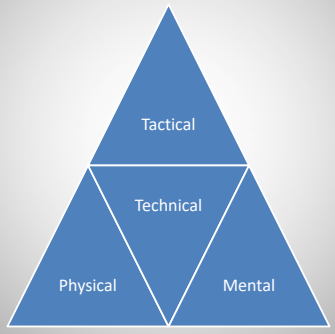
3

~2000: Classic Model For Golf Development



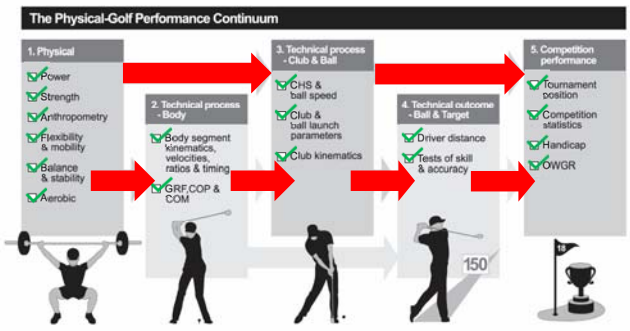
4

~2010: Integrated Model



5

~2020: Continuum
(Williams 2021)



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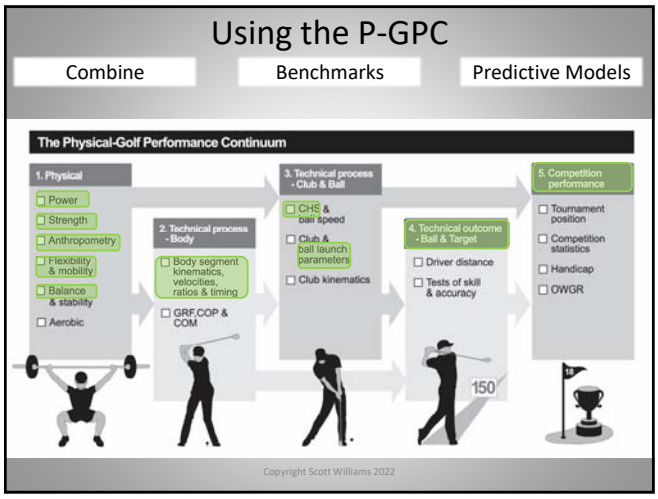
Using the P-GPC
Combine
Benchmarks
Predictive Models
The Physical-Golf Performance Continuum
1. Physical
Power
Strength
Anthropometry
Flexibility & mobility
Balance & stability
Aerobic
2. Technical process - Body
Body segment kinematics, velocities, ratios & timing
GRF,COP & COM
3. Technical process - Club & Ball
CHS & ball speed
Club & ball launch parameters
Club kinematics
4. Technical outcome - Ball & Target
Driver distance
Tests of skill & accuracy
5. Competition performance
Tournament position
Competition statistics
Handicap
OWGR
150
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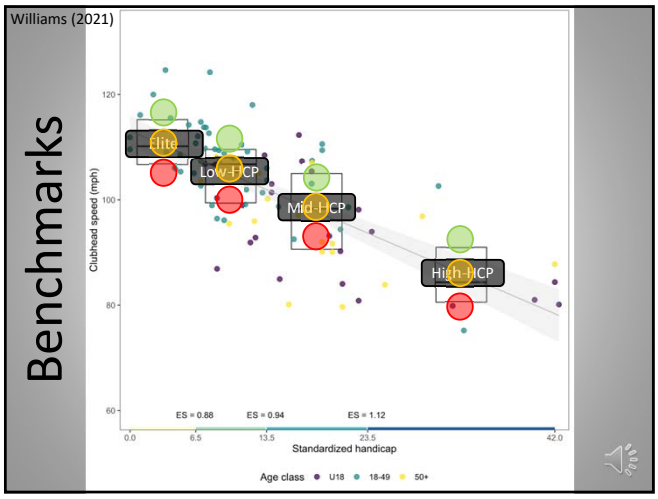
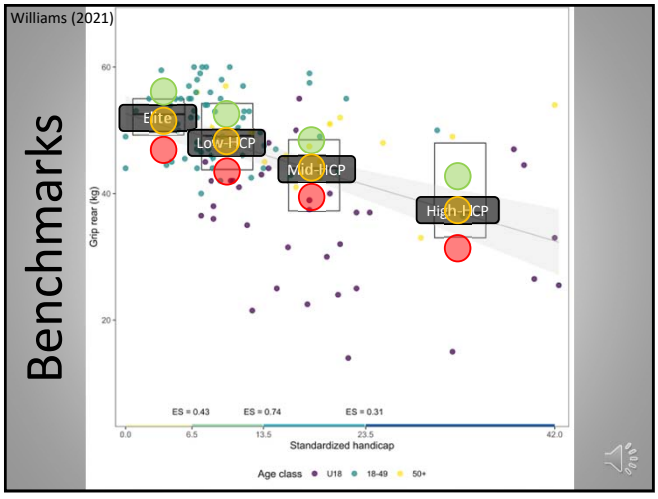
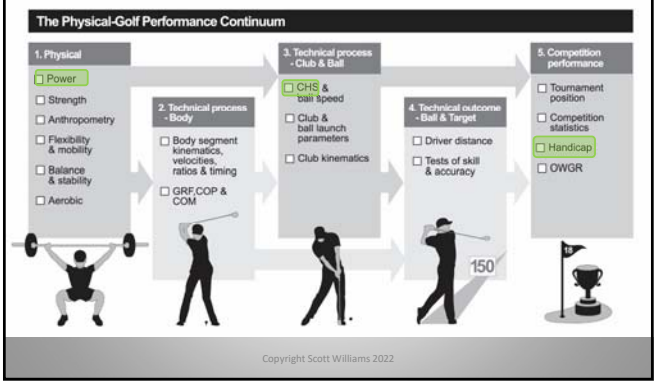

Williams (2021)
Benchmarks
Clubhead speed (mph)
Elite
Low-HCP
Mid-HCP
High-HCP
ES = 0.88
ES = 0.94
ES = 1.12
Standardized handicap
Age class U18 18-49 50+

8


Williams (2021)
Benchmarks
Grip rear (kg)
Elite
Low-HCP
Mid-HCP
High-HCP
ES = 0.43
ES = 0.74
ES = 0.31
Standardized handicap
Age class U18 18-49 50+

9

Strength of P-GPC Relationships



10

Quiz Time ☺

- Would the physical power of the golfer typically have a stronger relationship with Driver Club Head Speed or Handicap?
  - Driver Club Head Speed (Stand)
  - Handicap (Sit)

11

And the winner is…*Stand!*

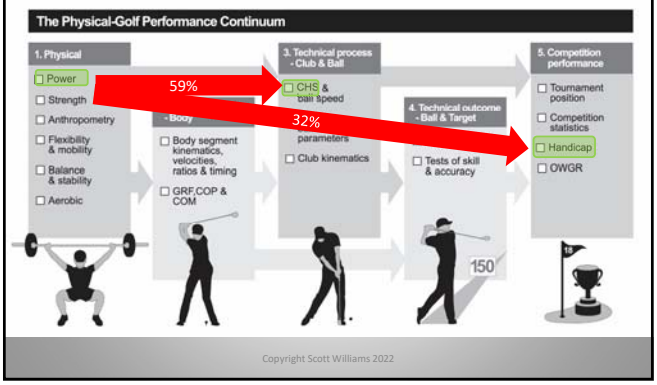
The closer measures are in the continuum the more related they are

Partly because there are less variables between them

12

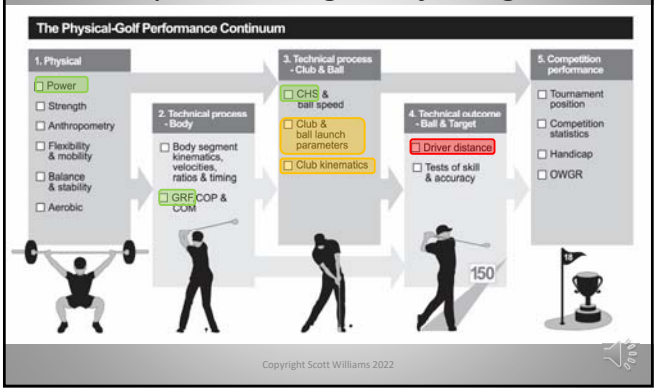
Evolved ➔ Continuum

(Williams 2021)



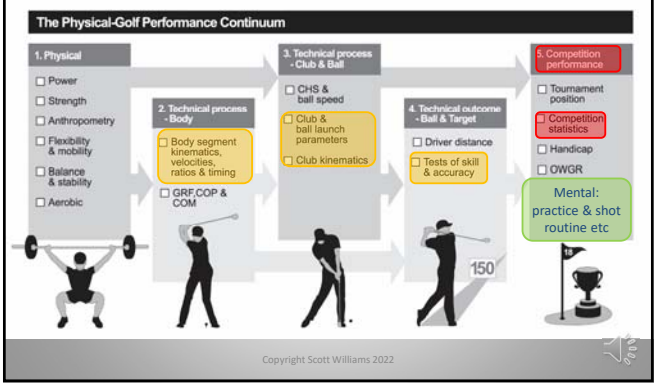
13

Using your test scores: Is your training *transferring*?



14

Trouble-shoot your performance, *efficiently!*



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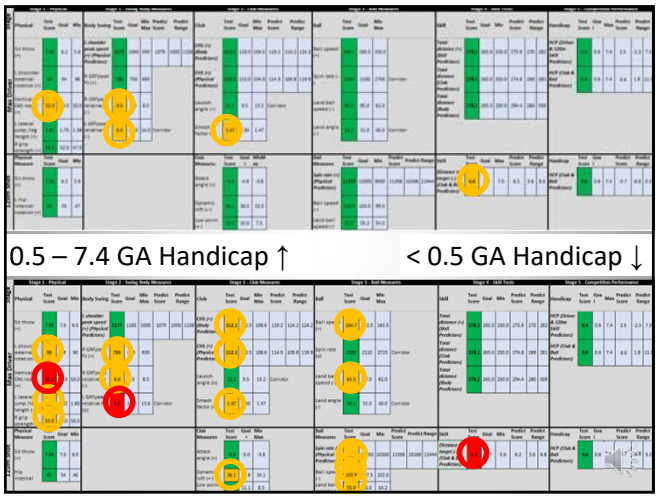
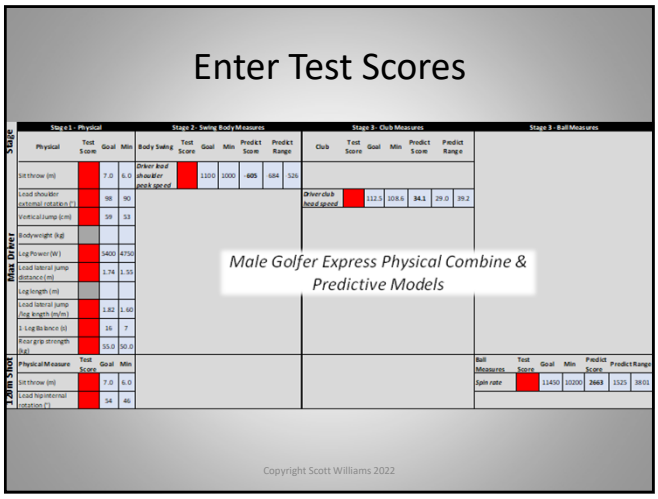


0.5 – 7.4 GA Handicap ↑ < 0.5 GA Handicap ↓

16

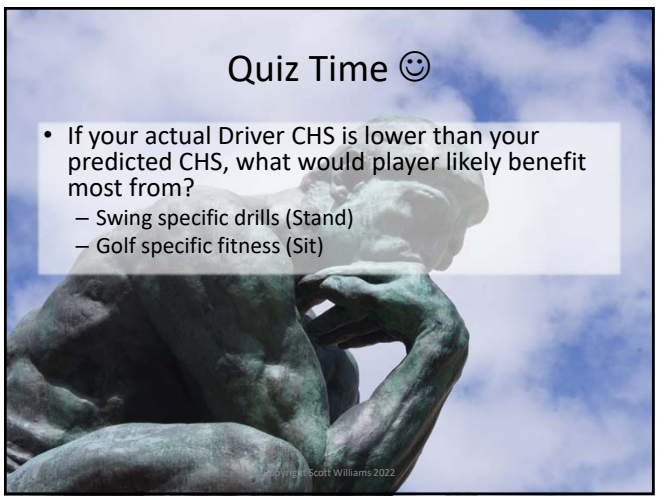
Enter Test Scores



17

Quiz Time ☺

- If your actual Driver CHS is lower than your predicted CHS, what would player likely benefit most from?
  - Swing specific drills (Stand)
  - Golf specific fitness (Sit)



18

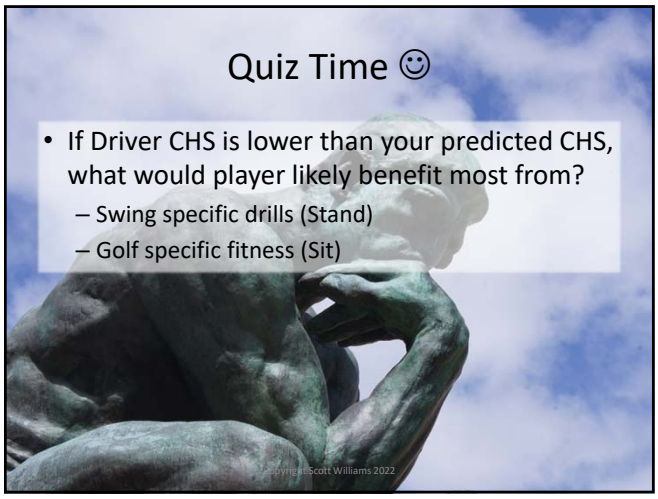
And the winner is…*Stand!*

Likely to benefit from swing specific drills

Player is 'Under-transferred'

19

Quiz Time ☺



- If Driver CHS is lower than your predicted CHS, what would player likely benefit most from?
  - Swing specific drills (Stand)
  - Golf specific fitness (Sit)

20

And the winner is…*Stand!*

Likely to benefit from swing specific drills

Player is 'Under-transferred'

21

Individualised Exercises

22

Quiz Time ☺

- What does an athlete profile tell us?
  - The strengths and weaknesses of an athlete in an area of their game (Stand)
  - Their name, age & DOB (Sit)

23

And the winner is…*Stand!*

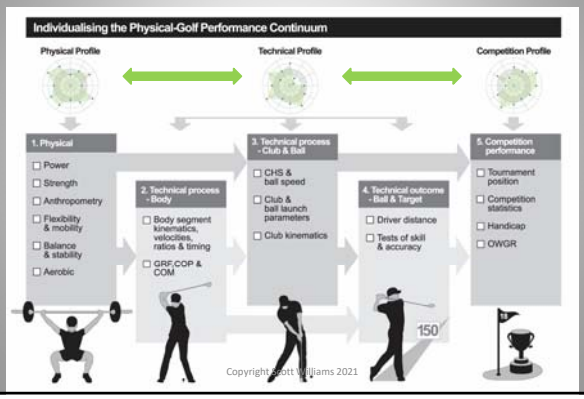
- The strengths and weaknesses of an athlete in an area of their game (Stand)

Often shown with a 'Radar Plot'

24

Use Combine to Create Profiles

(Williams 2021)



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Physical Profile

Fix weakness, maintain strengths

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Physical Profile

Fix weakness, maintain strengths

Copyright Scott Williams 2022

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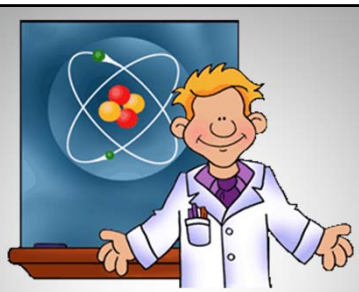
Competition Profile

Fix weakness, maintain strengths

28



Anthropometry, Flexibility, Balance, Endurance, Strength, Power

BENEFITS OF EACH FITNESS COMPONENT TO GOLF

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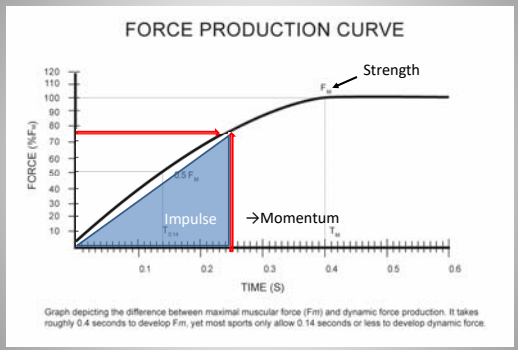
Force-Time Curve



30

Time available for maximal force development
(Verkoshansky 2009)

Sporting Movement	Time in Seconds
Sprinting (Foot Strike)	0.08-0.12
Jumping	0.17-0.18
Shot Put Release	0.15-0.18
Golf Downswing	0.20-0.30
Powerlifting (Deadlift, Bench Press, Back Squat)	0.80-4.0

31

Anthropometry in Golf

- Arm span, height and bodyweight are all strongly correlated (r = .5-.7) with driver club head and ball speed (Keogh et al 2009, Torres-Ronda et al 2014, Wells et al 2009)
- Fat-free mass is a better discriminator of low and high handicap golfers than just body mass (Keogh et al 2009)
- Explains the recent trend towards not just power, but building muscle

32

Flexibility in Golf

- Greater range of motion in swing
  - Allows more time for acceleration in downswing & able to remain more balanced
  - Thoracic rotation moderately correlated with CHS (Keogh et al 2009)
  - Left hip internal rotation & R shoulder external rotation are also important (Vad et al 2004, Sell et al 2007)

33

Quiz Time ☺

- What stretch routine is better for shot accuracy and distance?
  - Dynamic stretching before golf, static long hold stretching after golf (Stand)
  - Long-hold stretching before golf, dynamic stretching after golf (Sit)

34

And the winner is…*Stand!*

Dynamic stretching before golf, static long hold stretching after golf is best

Warm soft-tissue performs better, but long-hold stretching temporarily weakens the neuoro-muscular system

35

Flexibility in Golf

- Greater range of motion in swing
  - Allows more time for acceleration in downswing & able to remain more balanced
  - Thoracic rotation moderately correlated with CHS (Keogh et al 2009)
  - Left hip internal rotation & R shoulder external rotation are also important (Vad et al 2004, Sell et al 2007)
- Dynamic stretching is preferable pre-play (Gergley 2009, 2010)
- Long-hold stretching is best performed after play or training

36

Quiz Time ☺

- How could we increase the momentum of the club head in the golf swing to exert more force on the ball - without any increases in strength or power in the golfer?
  - Have longer limbs (Stand)
  - Increase range of motion of the golf swing (Sit)

37

And the winner is…*Stand and Sit!*

Both longer limbs and increasing range of motion (ROM) in the golf swing will in crease the amount of force generated during the golf swing.

But only ROM in the swing is trainable

Greater ROM may create longer levers in the golf swing and allow more time to produce force

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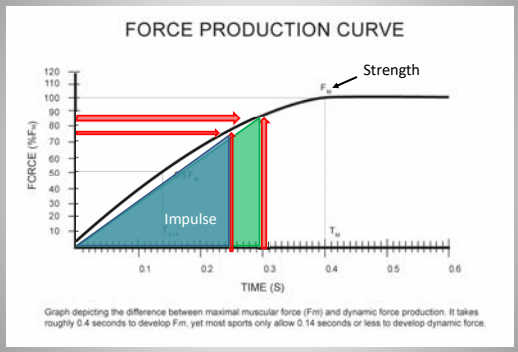
Increased ROM in Swing



Graph depicting the difference between maximal muscular force (Fm) and dynamic force production. It takes roughly 0.4 seconds to develop F.m, yet most sports only allow 0.14 seconds or less to develop dynamic force.

39

Quiz Time ☺

- Any drawbacks in performance by increasing ROM in the golf swing?

Thoughts from the audience….

40

Yes!

Player must be strong enough and skilled enough to effectively use an increased ROM in the golf swing

- Loss of balance
- Loss of timing
- Less centred strike

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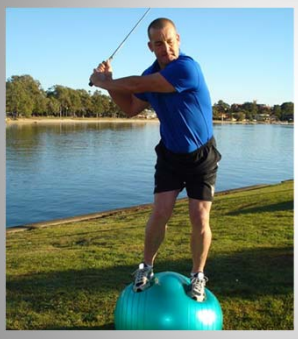
Balance in Golf



- Studies show that 1-leg balance & golf swing centre of mass control effectively differ with golf proficiency level (Sell et al 2007, Choi et al 2016a&b)
- Two-way relationship between good swing mechanics and good balance in the swing
- Balance vital for elite performance AND longevity in golf for older golfer
- Try: 1-leg pivot eyes closed

42

Strength & Power

- Strength is defined as the ability to produce force, often measured by peak force or maximum weight lifted (Driggers et al 2018)
- Power is defined as the ability to rapidly produce force (Mcmahon et al 2017)

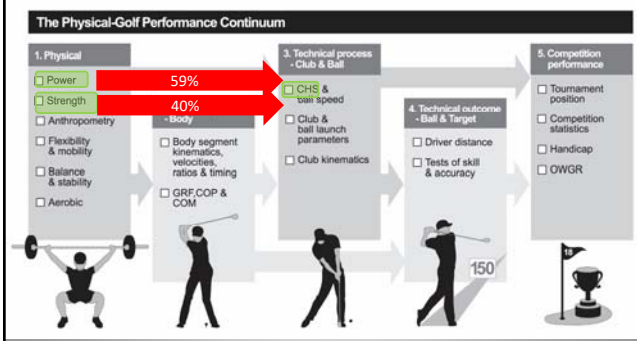
43

Quiz Time ☺

- What has a typically stronger relationship with Driver Club Head Speed?
  - Strength (Stand)
  - Power (Sit)

44

Strength & Power Predict Driver Club Head Speed



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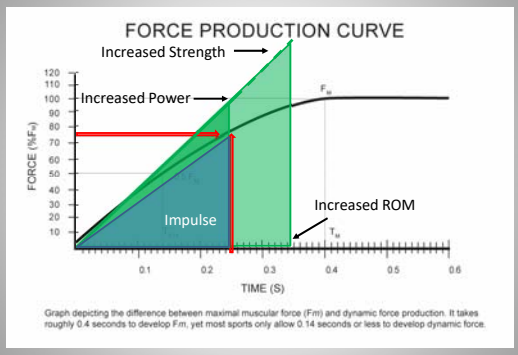
Increased Strength & Power in Swing



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How do we train to increase power?

- Produce force rapidly
- Strengthen weak athletes
- Speed up slow athletes
- Include a stretch-shorten-cycle/reflex:

A coordinated sequence of movement of body segments creates a stretch-shorten cycle in the musculo-tendinous structures - allowing for an increased acceleration of the more distal segment

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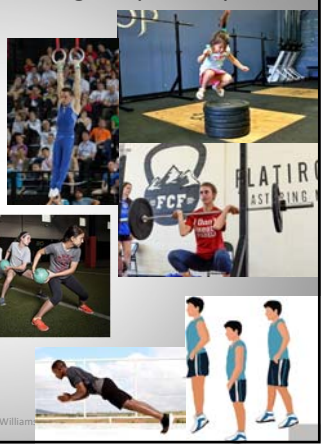
Stretch-shorten-cycle improves golf specific power

- Dynamic & acceleration
  - Jumps
  - Olympic lifting
  - Gymnastic movements
- Ballistic
  - Med ball throws
- Plyometric & impact
  - Skipping, drop jumps, clap push-ups



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Specific Muscle Function Required for Golf (Adapted Mchardy & Pollard 2005)

Phase of swing	Left upper body/trunk	Phase type	Strength type	Right upper body/trunk	Phase type	Strength type	Left lower body/trunk	Phase type	Strength type	Right lower body/trunk	Phase type	Strength type
Back swing	Subscapularis (33%)	Con	Control + Starting	Upper trapezius (52%)	Con	Control	Erector spinae (26%)	Iso & Con	Strength Control	Semimembranosus (28%)	Ecc & Iso	Deceleration
	Upper serratus (30%)	Con	Control + Starting	Middle trapezuis (37%)	Con	Control	Abdominal oblique (24%)	Con	Strength Control	Long head of the biceps femoris (27%)	Ecc & Iso	Deceleration
Forward swing	Rhomboid (68%)	Ecc, Iso & Con	Deceleration & SSC + Explosive	Pectoralis major (64%)	Ecc, Iso & Con	Deceleration & RA + Explosive	Vastus lateralis (88%)	Ecc	Max + Deceleration	Upper and lower gluteus maximus (100 % and 98%)	Ecc, Iso & Con	Deceleration & RA + Explosiv & Max
	Middle trapezius (51%)	Ecc, Iso & Con	Deceleration & SSC + Explosive	Upper serratus (58%)	Ecc, Iso & Con	Deceleration & RA + Explosive	Adductor magnus (63%)	Con	Starting Strength + Max	Biceps femoris (78%)	Iso & Con	RA + Explosive + Max
Acceleration	Pectoralis major (93%)	Iso	Maximal Strength	Pectoralis major (93%)	Con & Iso	RA + Explosive & Max.	Biceps femoris (83%)	Ecc & Iso	Max + Decelera	Abdominal oblique (59%)	Ecc, Iso & Con	Deceleration & SSC + Explosiv
	Levator scapulae (62%)	Con	SSC + Explosive	Upper serratus (69%)	Con & Iso	Explosiv. & Max.	Upper and lower gluteus maximus, vastus lateralis (58%)	Iso & Con	Deceleration + Max + RA	Gluteus medius (51%)	Ecc, Iso & Con	Deceleration & SSC + Explosiv
Early follow through	Pectoralis major (74%)	Iso & Ecc	Max + Deceleration	Pectoralis major (74%)	Iso & Con	Explosive + Max.	Long head of biceps femoris (79%)	Ecc	Deceleration	Gluteus medius (59%)	Con	Speed Strength
	Infraspinatus (61%)	Con	Explosive + Speed-Strength	Subscapularis (64%)	Con	Explosive + Speed Strength	Vastus lateralis (59%)	Con	Deceleration	Abdominal oblique (51%)	Con	Explosive & Speed-Strength
Late follow	Infraspinatus (40%)	Con	Speed-Strength	Subscapularis (56%)	Con	Speed-Strength	Semimembranosus and	Iso	Static Strength	Vastus lateralis	Con & Iso	Speed-Strength

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Most Highly Used Strength Types For Golf

Type	Description	Utilised	Load	Speed
Explosive Strength (Reactive Ability)	Maximum force in minimum time. Used in exercises and movements where the main muscular contraction is preceded by a mechanical stretch. The switch from stretching to active contraction uses the elastic energy of the stretch to increase the power of the subsequent contraction. The muscles ability to maximise the stretch reflex and create a stretch-shorten cycle is called its reactive ability (RA). Measured as max rate of force dev.	Transition to downswing. The better the reactive ability the less perceived effort in the swing.	Low to High	Fast
Speed-Strength	Ability to quickly execute an un-loaded movement or a movement against a relatively low external force. Measured by velocity.	Downswing to impact	Low	Fast
Deceleration Strength	Ability to quickly stop a movement under low or high force.	Trail side in backswing and lead side before impact	Low to High	Fast
Maximal Strength	Athlete's strength potential. Maximum voluntary isometric force that can be produced with no time limit.	Downswing and Impact	High	Slow to Mod
Starting Strength	Ability of the muscles to develop force at the beginning of the working contraction before external movement occurs. Measured as initial rate of force development.		High	Fast
Static & Explosive Strength Endurance	Ability to maintain muscular functioning under work conditions of long duration. Holding a given position or posture would be considered static strength endurance. Explosive strength endurance is repetitively executing explosive efforts.	Static for correct posture during practice and play . Explosive for quality long game practice.	Low	None
Strength Control (Neuro-Muscular Control)	Ability to maintain optimal posture and quality of movement through joint ranges.	Underpins all movements in the swing and all allows for technical retraining	Low	Slow to Mod
Strength over Range of Motion	The ability to exert force over the full amplitude or range of movement.	Allows dynamic correction of swing and ability to maximise	Low to High	Slow to Fast

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Endurance

- Aerobic system is typically tested with VO2max
- Allows the competitive golfer, in practice and competition:
  - Greater concentration
  - Injury prevention
  - Improved posture
  - Increased quality of skill execution over longer periods of time

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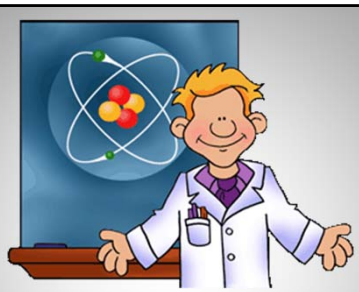


G.A.S PRINCIPLE, F.I.T.T FORMULA, SPECIFICITY

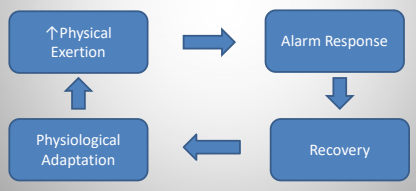
PHYSICAL TRAINING PRINCIPLES FOR GOLF

53

General Adaptation Syndrome

Hans Selye's General Adaptation Syndrome (GAS) in response to stress – first presented in the 1950's

The need for progressive overload



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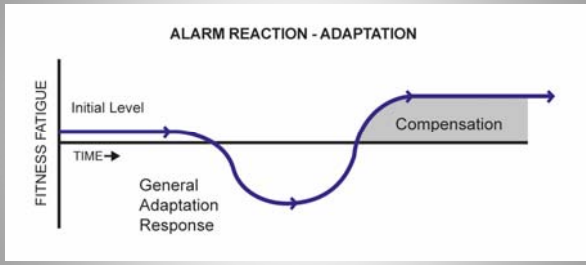
Alarm Reaction – Adaptation



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FITT Formula

- Frequency

- Time

- Intensity

- Type

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GOLF INJURY

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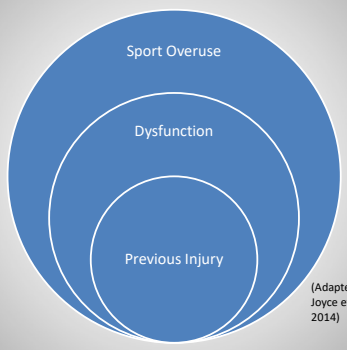
Injury Prediction Model



(Adapted from Joyce et al 2014)

58

Mechanical Cause of Injury (Cabri et al 2009)

Amateurs = 23% (Cole et al 2016)
(11 studies, ~5000 golfers, ~2000 injuries)

Pros = 33% (Cole et al 2016)
(3 studies, ~570 golfers, ~780 injuries)

59

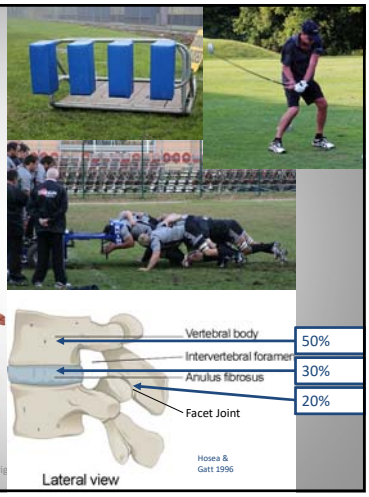
Driver Forces on Body

Compression loads 8x person's body weight
- ~6100 N (Amateurs)
- ~7600 N (Professionals)
- ~8700 N NFL Lineman hitting blocking sled (Hosea & Gatt 1996)

The spine is somewhat equipped to handle these forces…

The muscular system does it's best to support the spine
- Erector spinae, acting as spinal stabilizers generate up to 106% MVIC in downswing (Sorbie et al 201
- Vital we train this system as spinal tissues have poor ability to recover from injury

So, we know that the sport of golf is physically vigorous and that injuries are common…



50%
30%
20%

60

Vote Time ☺

- Which case study do you want? Trainee PollDynamic stretching before golf, static long hold stretching after golf (Stand for the one you want)
  - A) A female LET tour professional who improved to her first tour victory
  - B) A male pre-trainee athlete whose handicap dropped from 7 to 1 in 10 months?
  - C) 2018 PGA Performance Squad results over 10 months?

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2018 PGA Golf Performance Program

CASE STUDY - SQUAD

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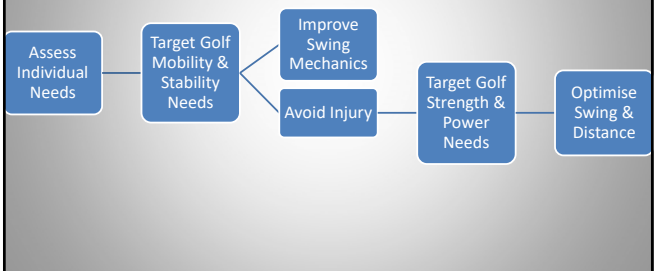
PGA Performance Program Physical Approach

(Smith 2010, Smith et al 2011, Williams et al 2018)



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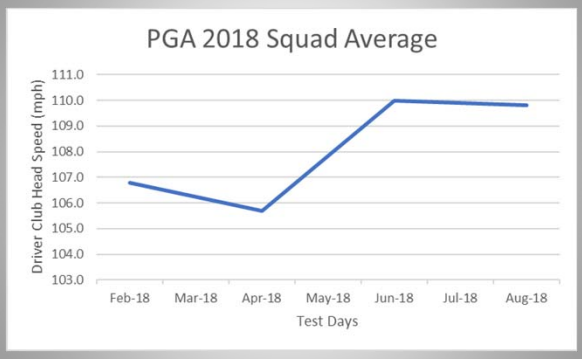
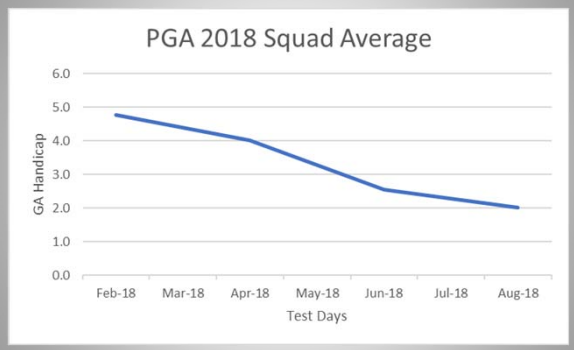
Physical → Technical



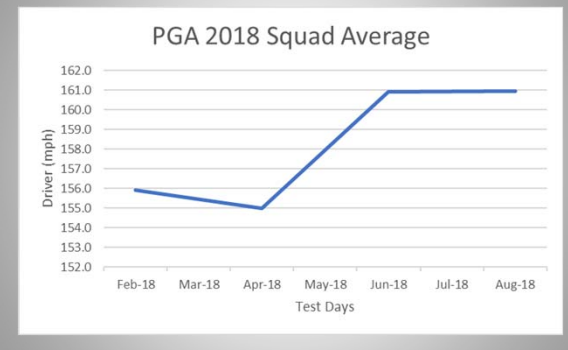
64

Physical → Technical



65

Physical → Technical



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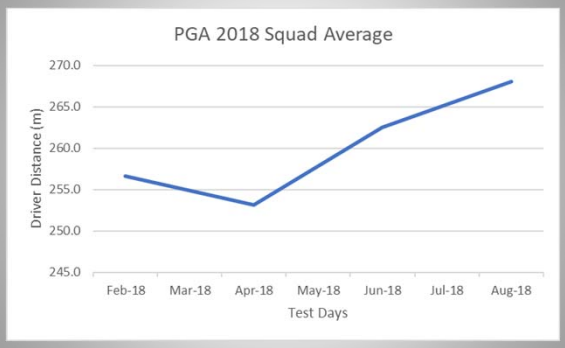
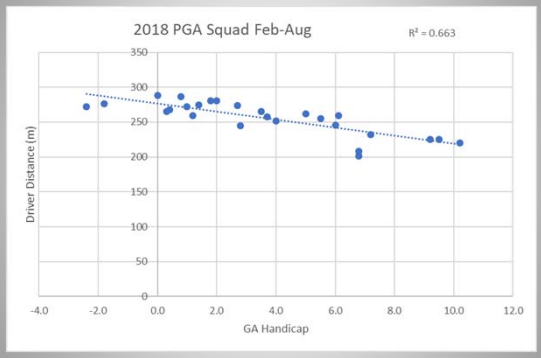
Physical → Technical



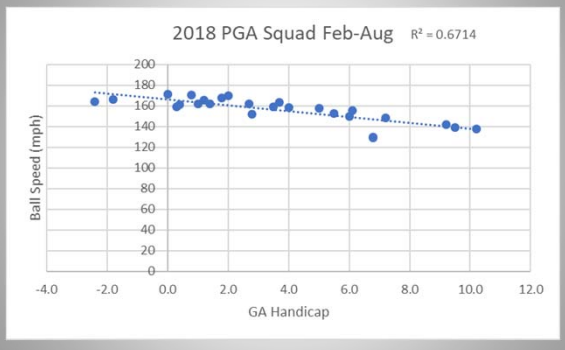
67

Physical → Technical → Score



68

Physical → Technical → Score



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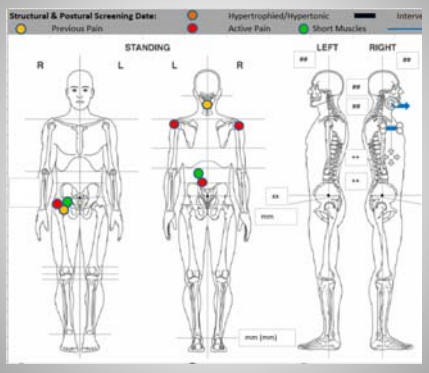
24years old male aspiring sub-elite golfer

CASE STUDY: 2018 PGA ATHLETE

70

Feb 2018 – Pain & Muscle Imbalances



71

His Program

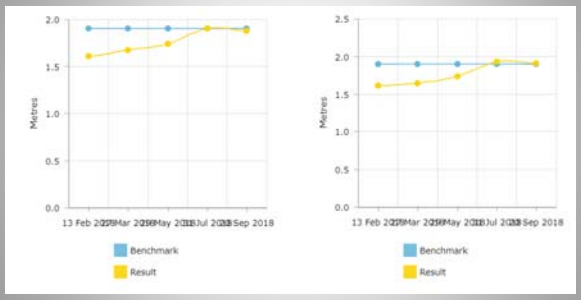
- Address weaknesses in 3rd session per week + 15min extra program per day…
- Steady progression with lower weights for first 3 months of S&C program
- Estimated 1RMs:
  - –May 2018: Deadlift= 80Kg, Back Squat= 40Kg, Bench Press= 50Kg
  - –October 2018 = 140Kg, Back Squat= 87Kg, Bench Press 61Kg

72

Body Weight

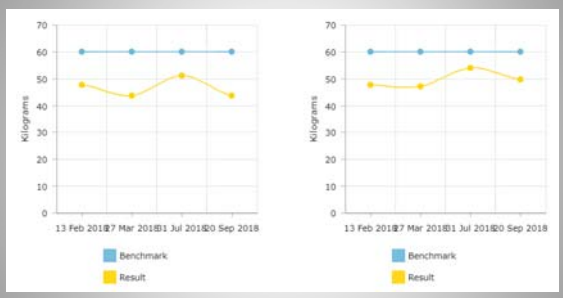
73

Left & Right Lateral Jump



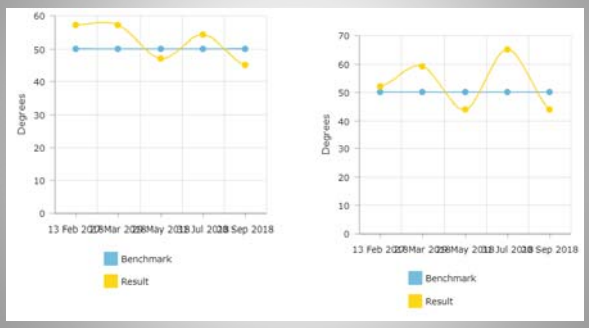
74

Left & Right Grip Strength



75

Left & Right Hip External Rotation



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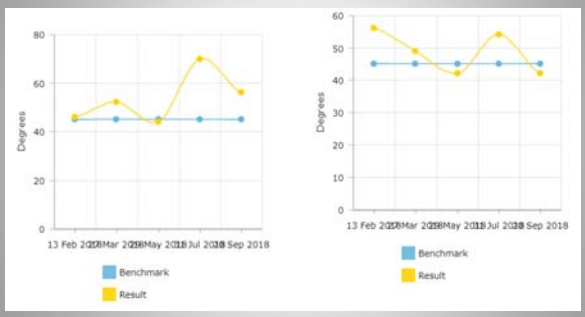
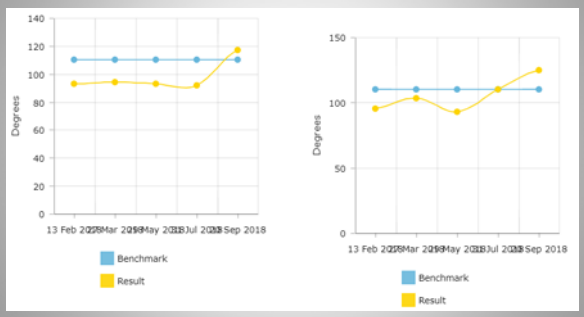
Left & Right Hip Internal Rotation



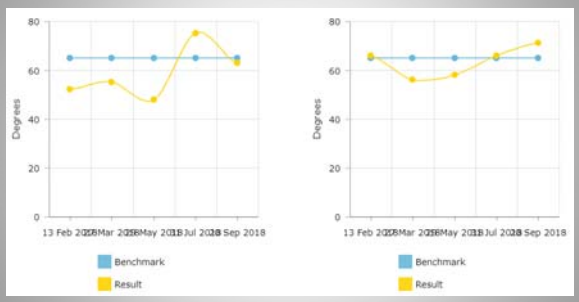
77

Left & Right Shoulder Complex External Rotation



78

Left & Right Seated Rotation



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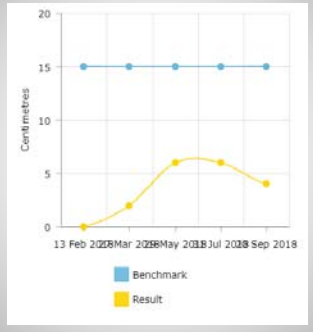
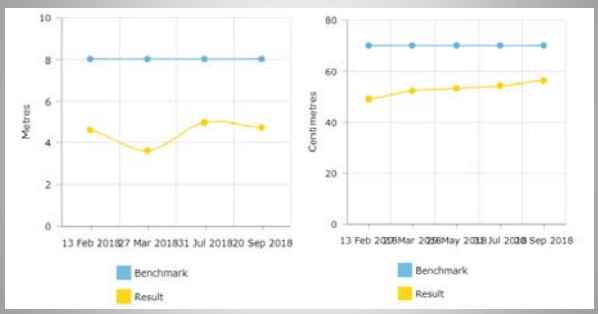
Sit & Reach



80

MB Chest Pass & Vertical Jump



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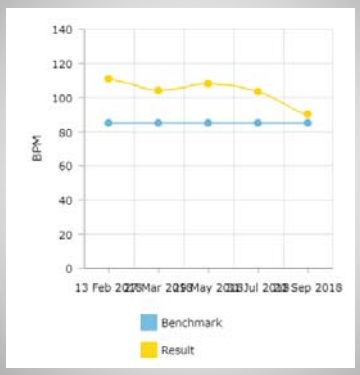
YMCA Step Test



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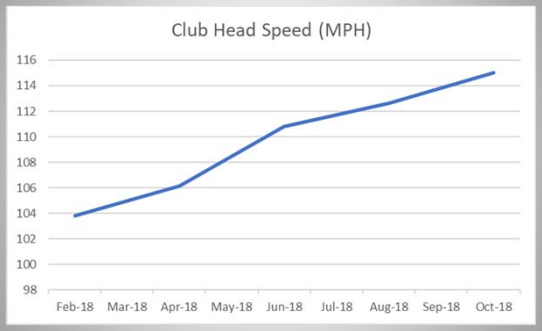
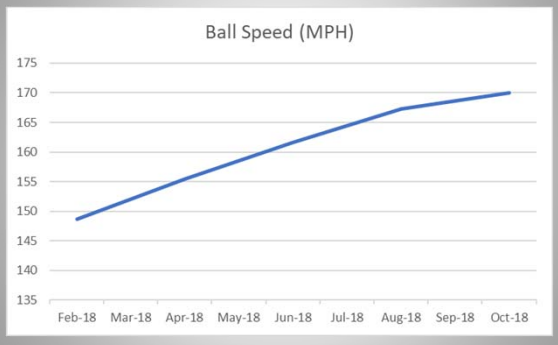
Physical Improvement = ↑ Club Head Speed



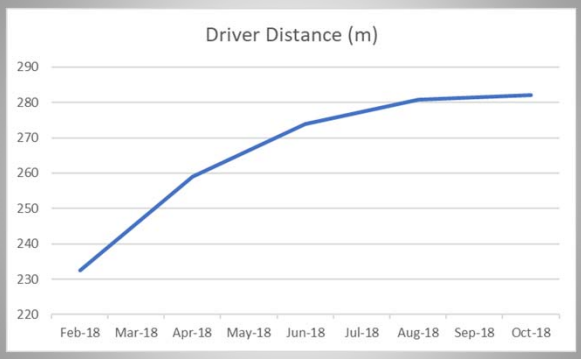
83

Good Mechanics and Centred Strike = ↑ Ball Speed



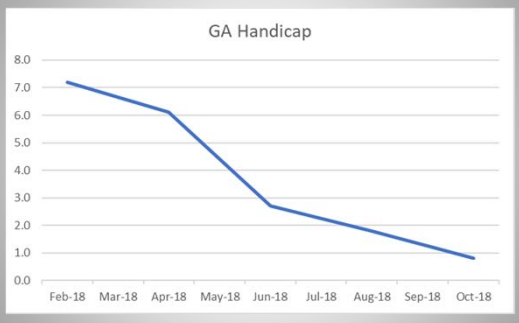
84

Optimised Launch Conditions = Greater Distance



85

Handicap dropped quickly



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Physical progression and transfer to performance leading to first European Tour victories

CASE STUDY: STACEY KEATING (PETERS)

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Stacey Keating (Peters) Golf Swing 2011

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2007-2010: Postural improvement, functional training, variety of patterns, bodyweight strength





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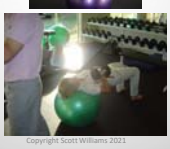
2007-2010 Cont'd








90

2011: Golf specific & travel programs, functional strength progression, posture focussed, began power training.



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December 2011 to June 2012: Level 3 strength, power & speed training

- Begin progression towards using Olympic lifting
- Learn all compound lifts
- Build strength, power & speed concurrently
- Periodised emphasis on golf specific and more speed oriented as we get closer to competition

92

2012: Level 4: Strength, power & speed block training system

- Build Strength then Power then Speed separately and in that order then taper for competition
- Introduce Triphasic Training in Strength Block
- Introduce Novice Olympic Lifting as Part of Power Block
- Introduce Oscillatory Method for faster relaxation in Speed & Golf-Specific Block

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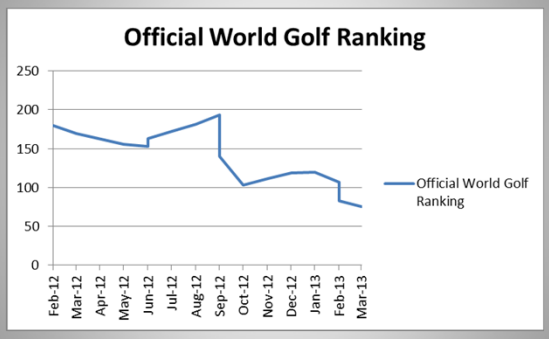
Stacey Keating OWGR Over 2Years



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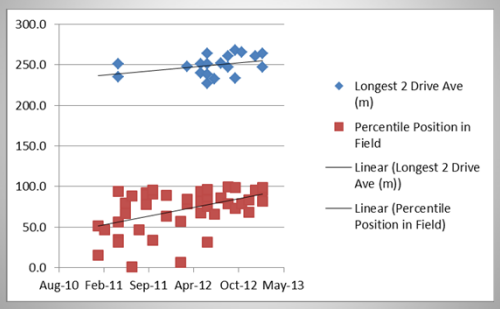
Driver Distance vs. Leaderboard Position



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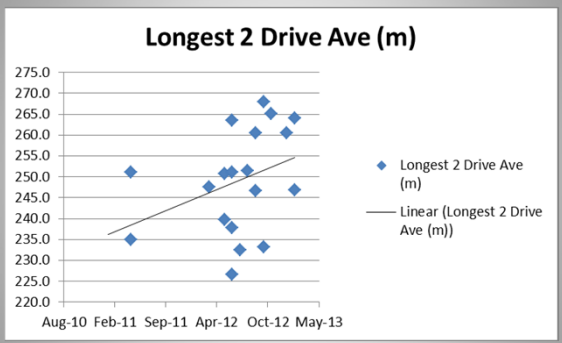
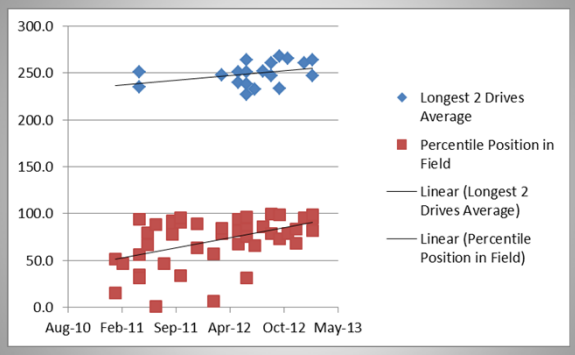
Stacey Keating Driver Distance Over 2Years



96

Driver Distance vs. Leaderboard Position



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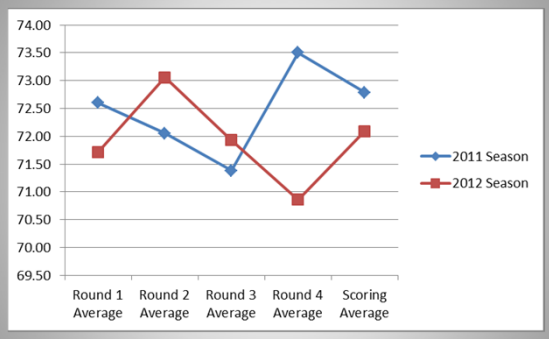
Stacey Keating: Rise to the Occasion



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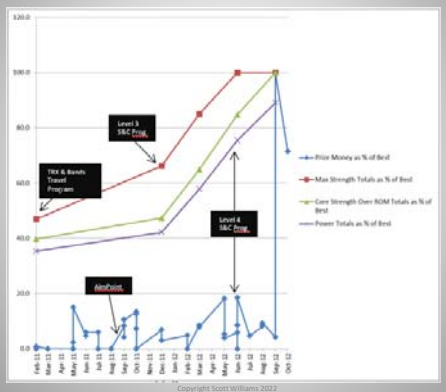
Fitter She Got, The Better She Played



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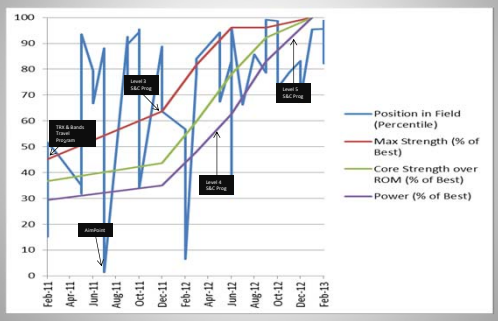
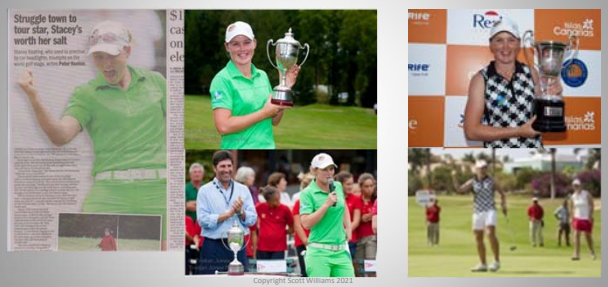
Physical & Competition Performance Correlation – Stacey Keating



100

Back to Back Wins: Spanish & French Opens 2012



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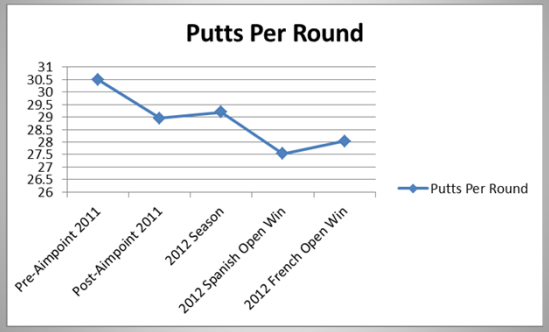
The Aim-point Effect



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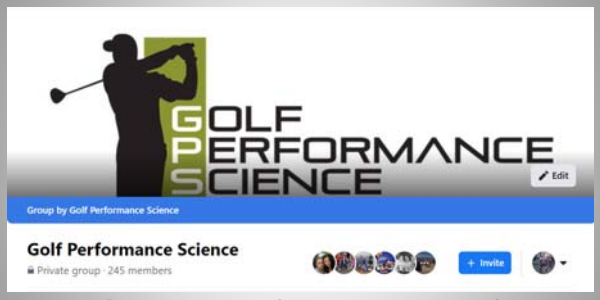
Join my FB private group



Science is the "pursuit and application of knowledge and understanding, following systematic methodologies based on evidence" (sciencecouncil.org)

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Question Time!

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