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# Monitoring



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## MONITORING

Chaos Theory
Fluid Periodization
Fields of Monitoring

Types of Stress
Quantification of Stress
External vs Internal

ACWR
Measures of Fatigue

## PERIODIZATION

History & Theory
GAS
Training Variables

Periodization Models

Super-Compensation
Residual Effects
Interference Effects

## PERFORMANCE

Data Collection
Determinants

Performance Model
Profile of Requirement

Planning



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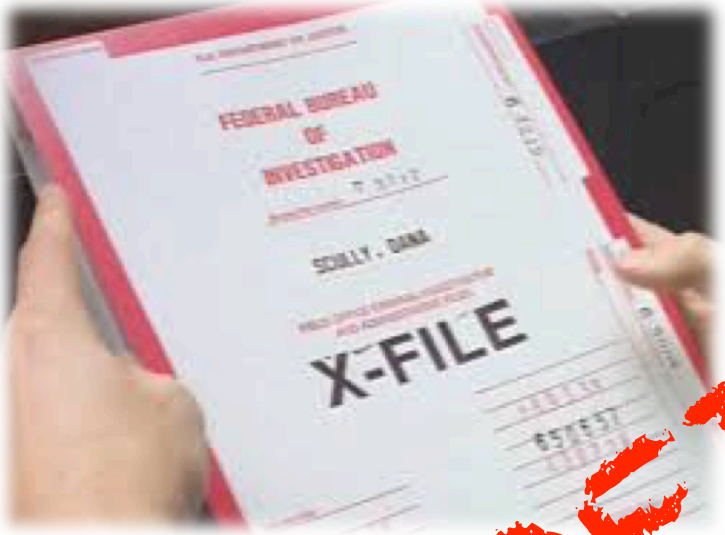


PROFILER

THE X FILES™

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DOSB




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# DATA COLLECTION

## Team Sports

### PRO

1. Age
2. Technical / Tactical Characteristics & Evaluation (Individual)
3. Body Compostion Height, weight etc.
4. Physical Condition (Level)
5. Psychological / Intellectual Profile

### MIX

...

### YOUTH

...

## Individual Sports

### PRO

1. Experience (Training Level, Training Age, Result)
2. Will, Targets, Motivation
3. Injury History
4. Classification for Disablity Athlete (Proficiency Level)
5. Family Support

...

### MIX

6. Motivation for the sport that was picked
7. Eperience with other sports
8. Targets / Motivation
9. Family Surrounding (support/sponsor for the athelte)
10. Medical history
11. Psychological evaluation
12. Beginner – Technical sklills evaluation / Tryout
13. Gymnastic evaluation (self-confident sports)

...

### YOUTH

...



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# DATA COLLECTION

## ✓ General Data

GENERAL PROFILE
NAME
AGE
SEX
WEIGHT
SIZE

## ✓ Case History

POSITION
SPORTS HISTORY
EXPERIENCE
LEVEL / LEAGUE
INTERNISTIC REPORT
ORTHOPEDIC REPORT
NUTRITION

## ✓ Injury Report

INJURY REPORT
INJURY
AND/OR
OVERUSE

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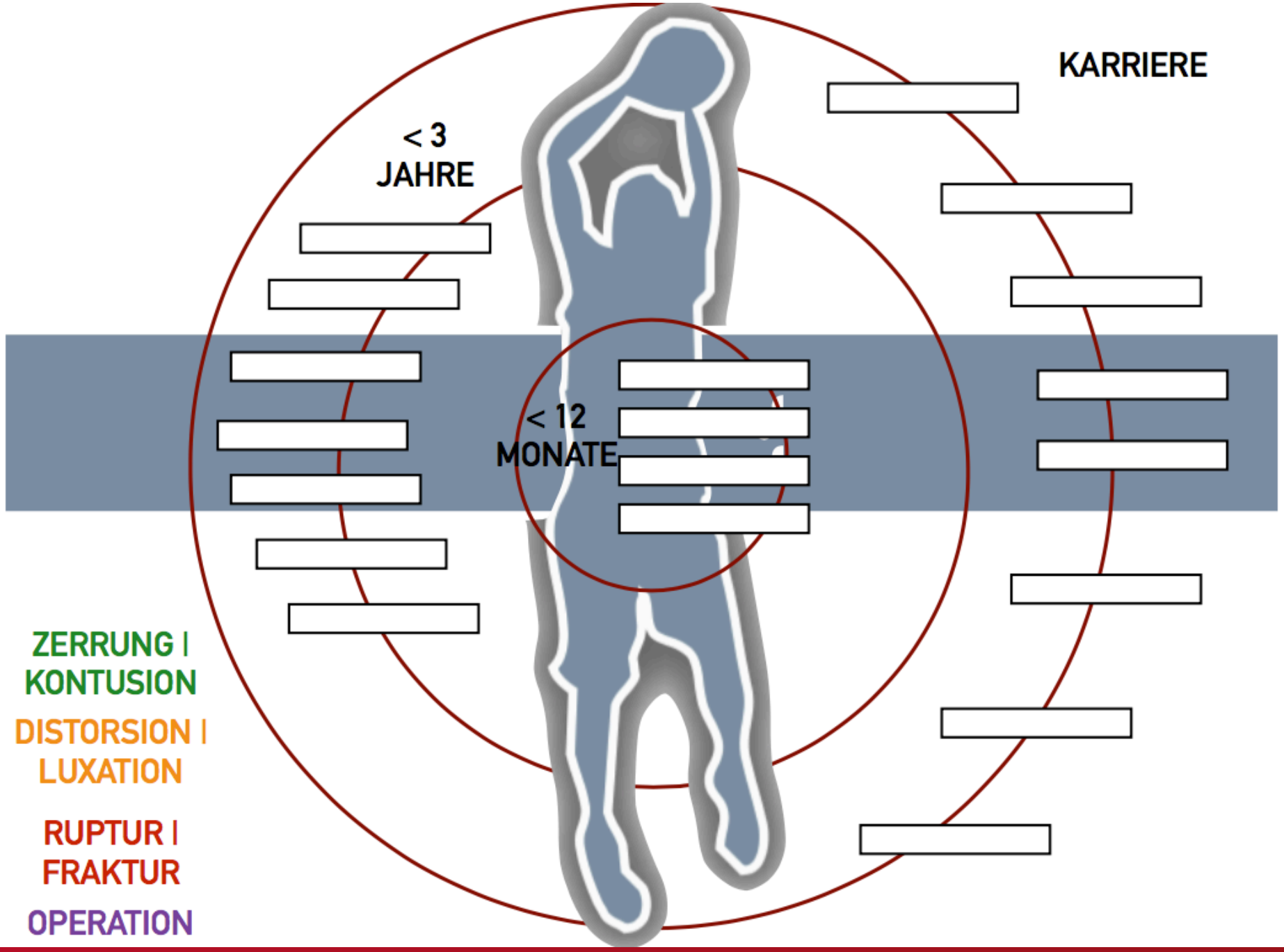


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# DATA COLLECTION

## ✓ PSYCHOLOGICAL STATUS

CHARACTER TRAIT
EXTROVERT
INTROVERT
SENSOR
INTUITIVE
THINKER
FEELER
JUDGER
PERCEIVER




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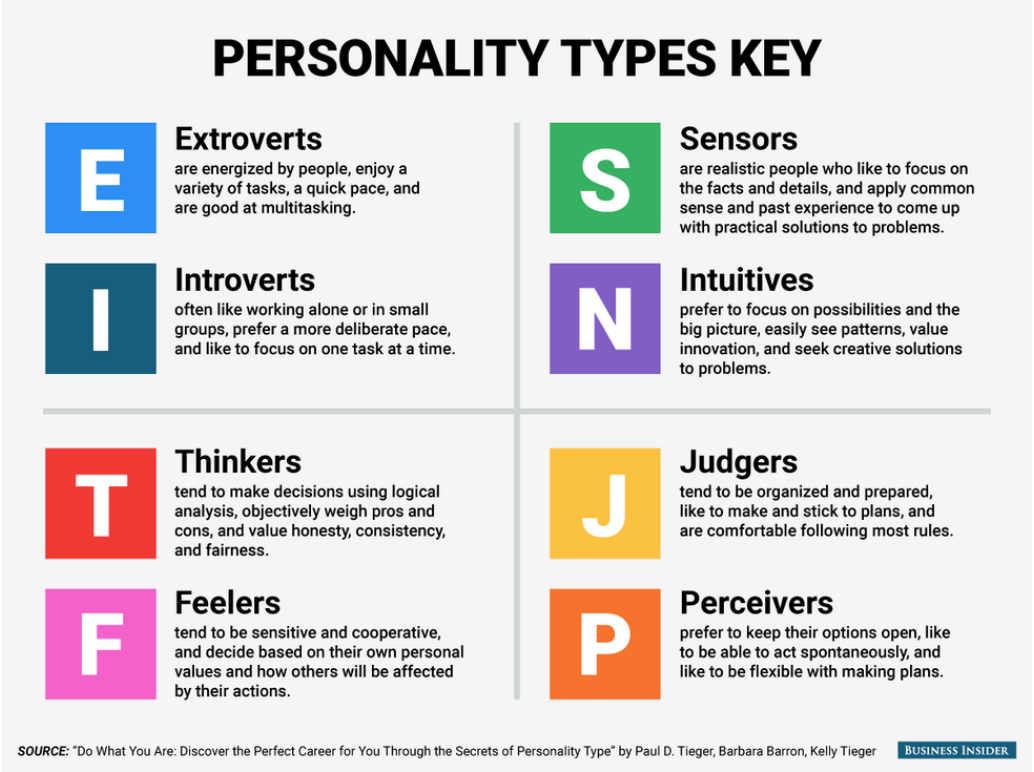
# DATA COLLECTION

## ✓ PSYCHOLOGICAL STATUS



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# DATA COLLECTION

## ✓ SOCIAL STATUS

FAMILY
FRIENDS
TEAMMATES
COACHES
STAFF
SCHOOLING
FANS
MEDIA



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# DATA COLLECTION

## ✓ Physical Status

MOVEMENT
EFFICIENCY
ENERGY SYSTEM
STRENGTH & POWER



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# DATA COLLECTION

## ✓ Technical / Tactical Status

VIDEO REPORTS
COACHES` REPORTS
TECHNICAL SKILLS
DECISION MAKING SKILLS
TACTICAL SKILLS
INDIVIDUAL TACTICS
TEAM TACTICS



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# DATA COLLECTION

- ✓ Tactics
- ✓ Technical
- ✓ Physical Status
- ✓ Social Status
- ✓ Psychological Status
- ✓ Case History
- ✓ General Data
- ✓ Injury Report

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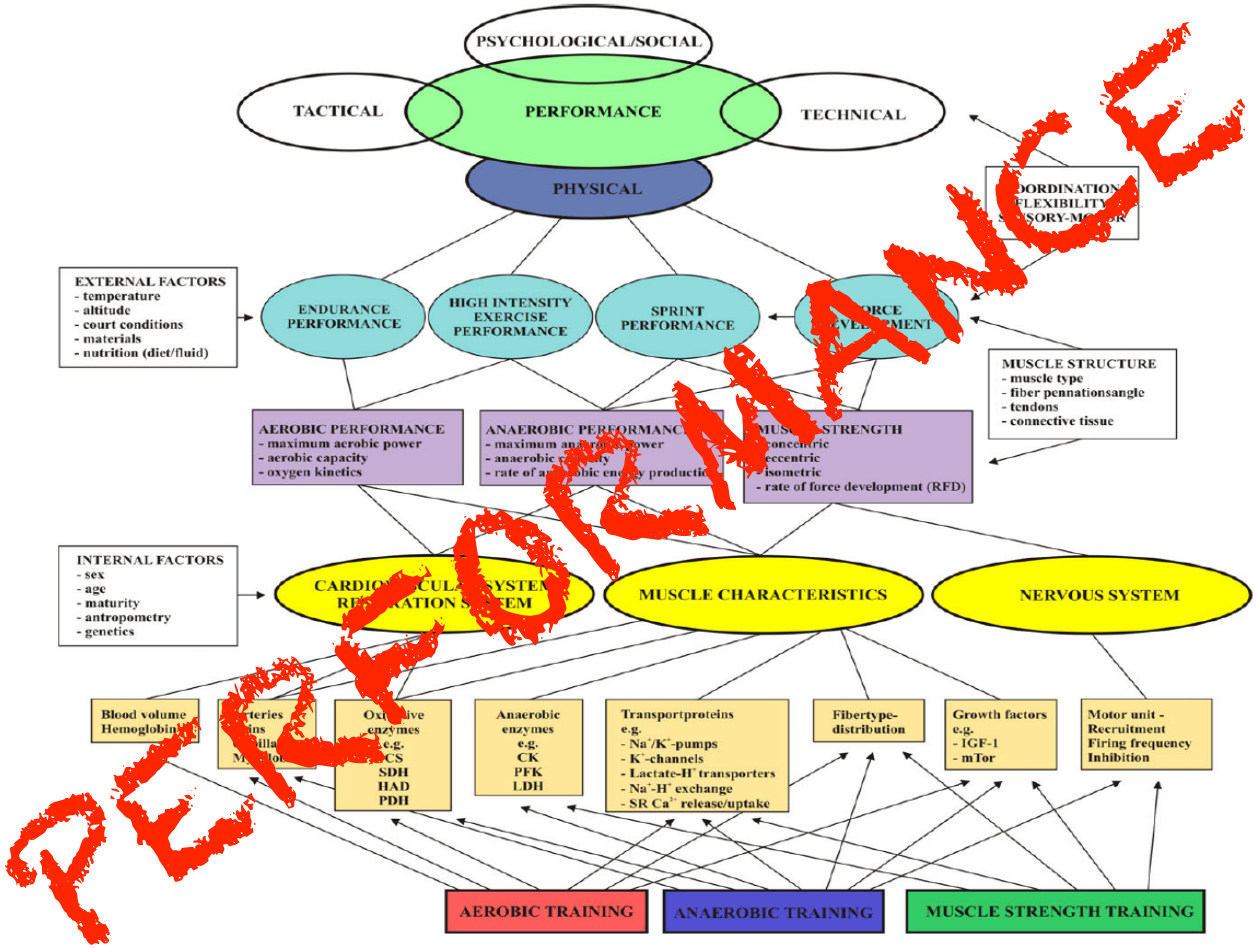


*Fig. 1.* A holistic model of the determinants of sports performance.



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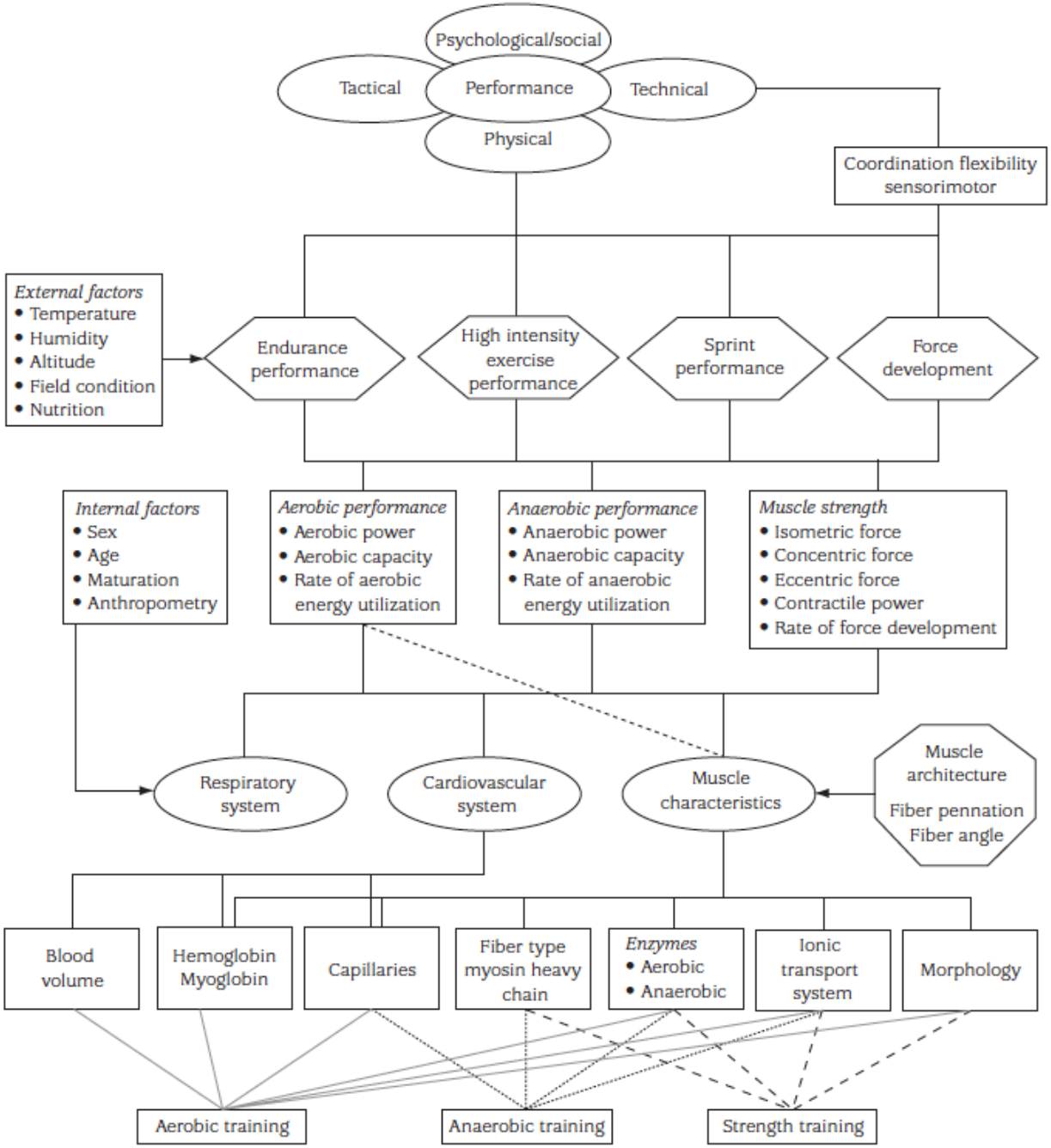



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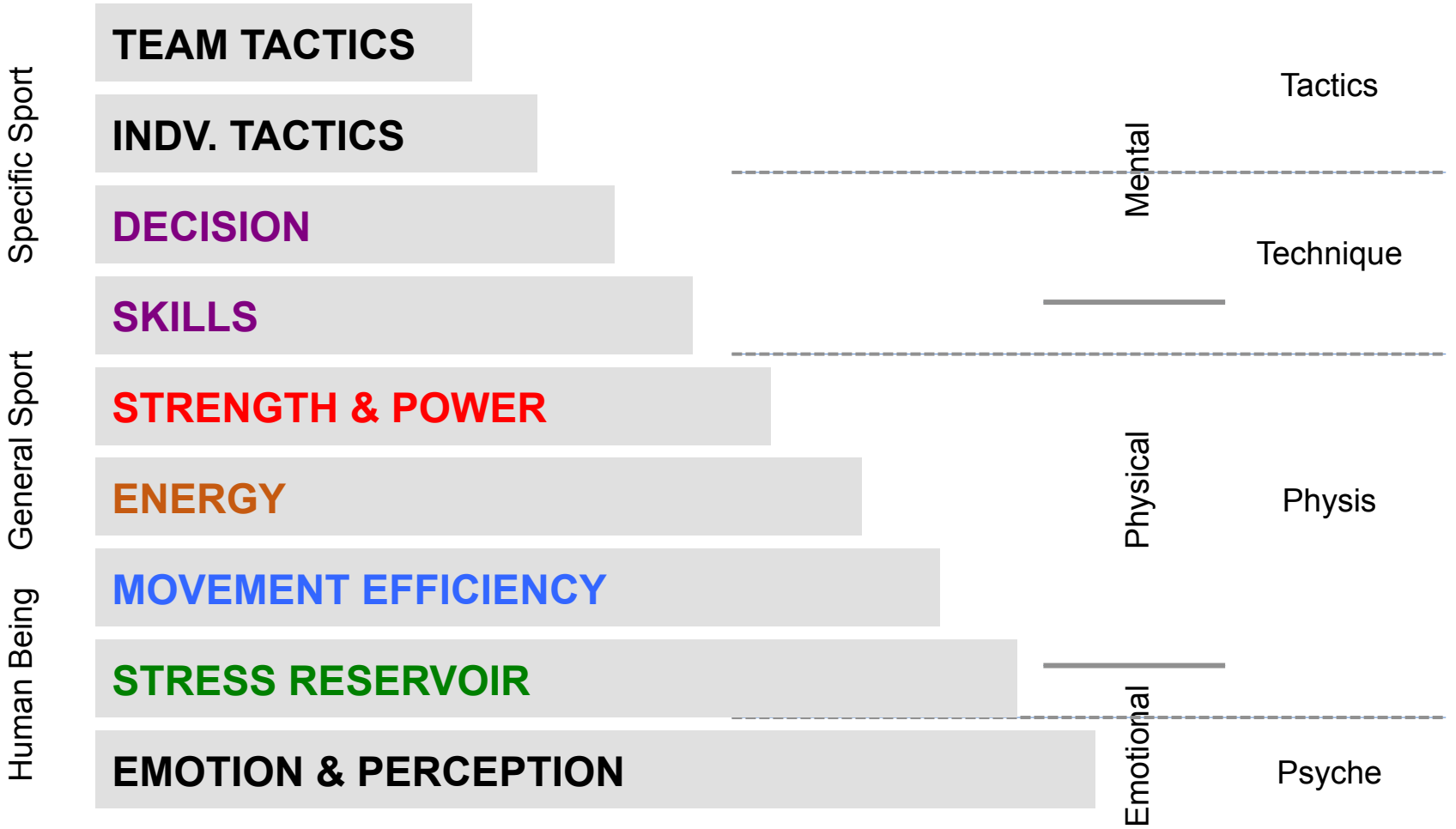
# Performance Model – W.I.N.



# Performance Model – W.I.N.

TEAM TACTICS

INDV. TACTICS

DECISION

SKILLS

STRENGTH & POWER

ENERGY

MOVEMENT EFFICIENCY

STRESS RESERVOIR

EMOTION & PERCEPTION

☑ If I do not have well developed ball-hand-skills (**technique**), I cannot make use of of my great 1st step explosiveness (**strength & power**).

☑ If I do not have the necessary mobility and stability in my hips (**movement efficiency**), I cannot absolve a complex movement pattern (**technique**).

☑ If I do not have the belief and the will (**emotion**) to win, the best VO2max (**energy**) does not count much.



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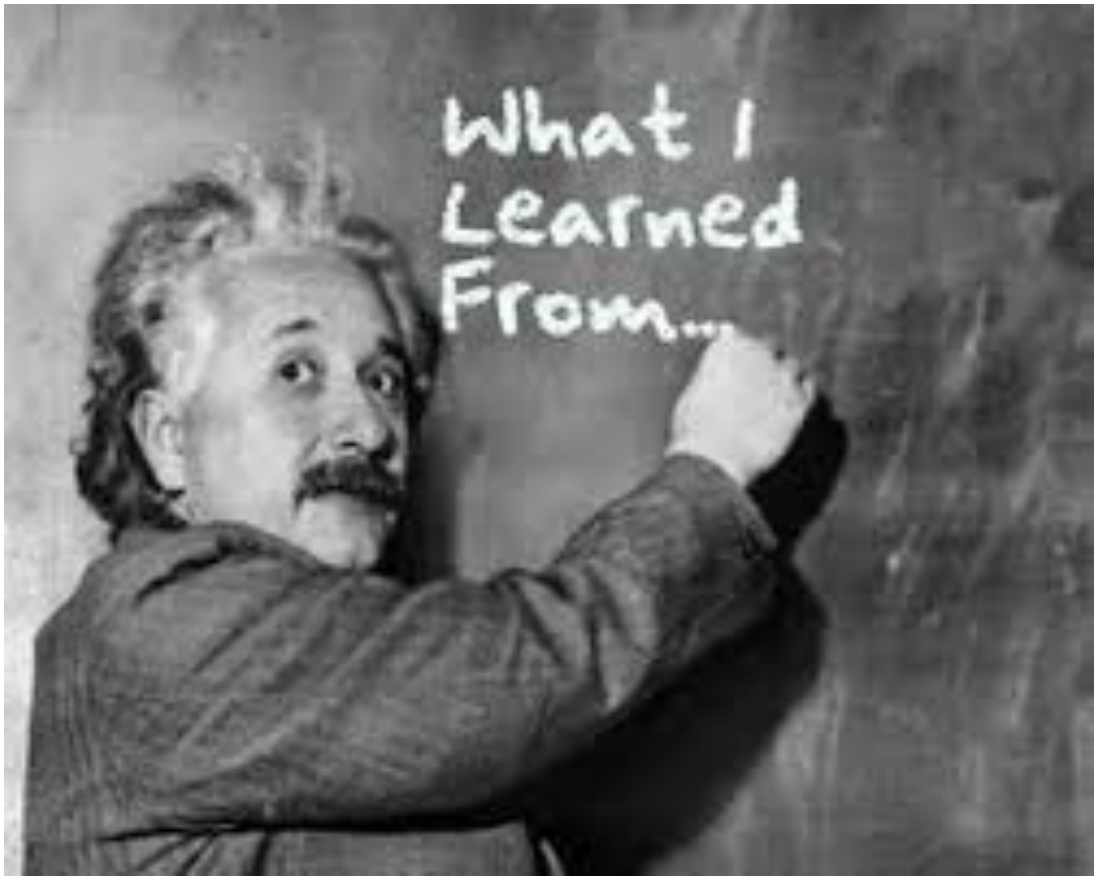



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- ☑ Determinants of sports performance are diverse and complex
- ☑ Data collection of general and specific determinants is fundamental
- ☑ A logical hierarchical structure is neccessary to prioritize the point of action
- ☑ Profile of requirements
- ☑ W.I.N – What is important now!


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- ✓ Tactics
- ✓ Technical
- ✓ Physical Status
- ✓ Social Status
- ✓ Psychological Status
- ✓ Injury Report
- ✓ Case History
- ✓ General Data

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## Develop Performance

## Maintain Performance

## Peak Performance


## Prevent Performance Loss


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# The Need for a Plan!

1. Manage training time and physical and psychological resources
2. Enable performance to peak, stay on a high level over time and prevent exhaustion.



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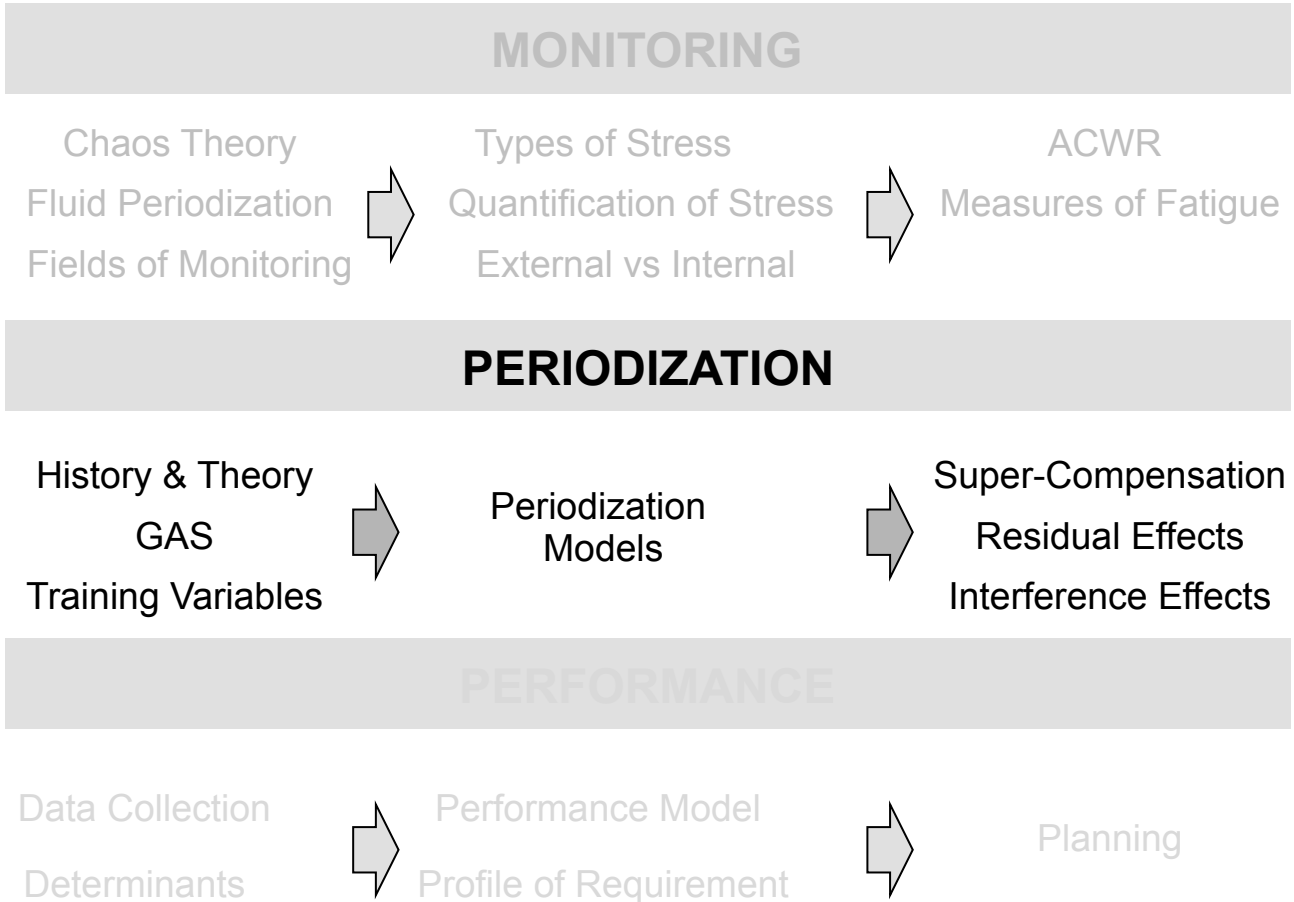




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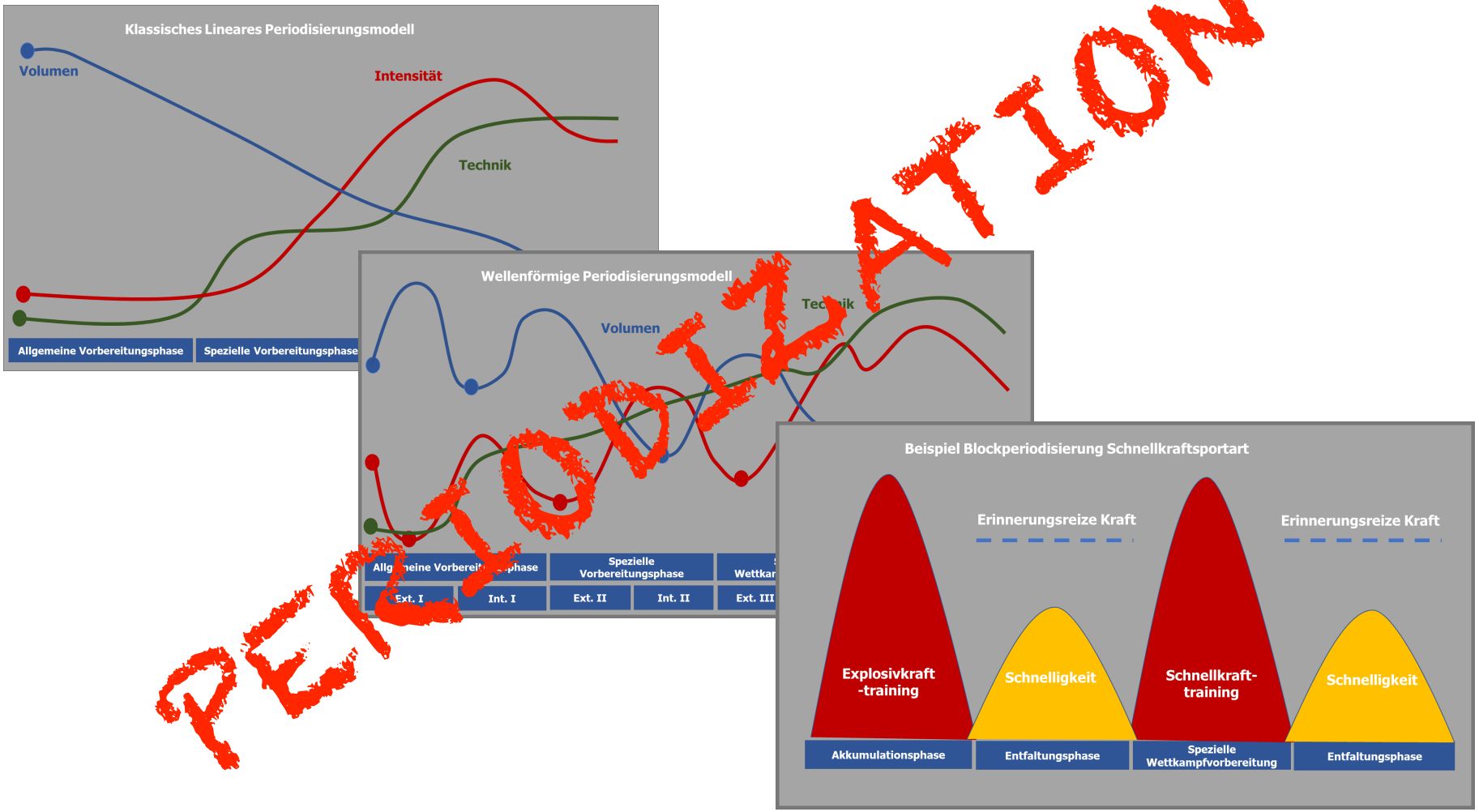





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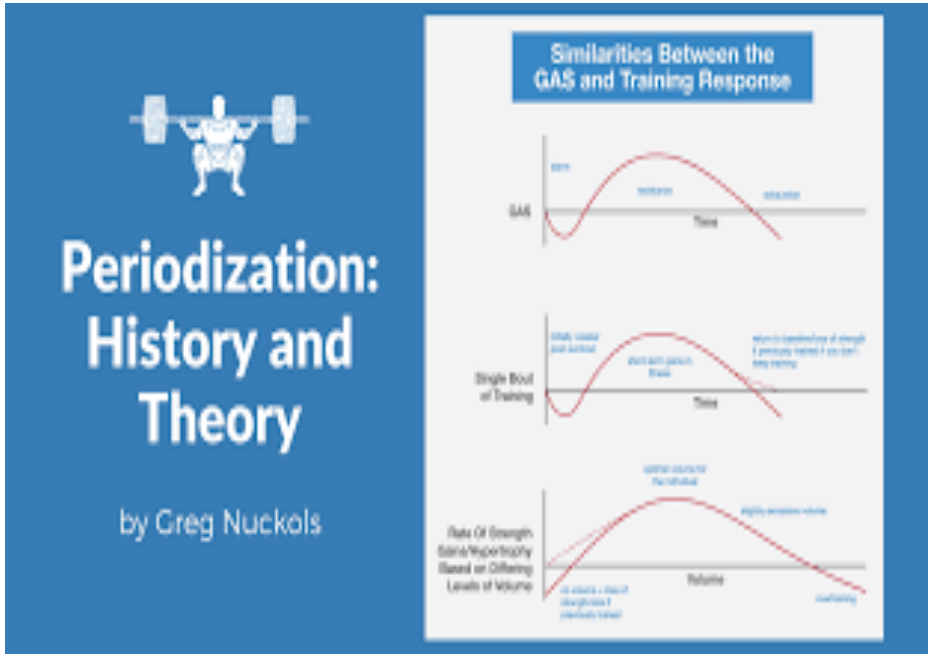
# History and Theory




**„The one best way“** to organize, manage and plan a process (Traylor, 1911).

**1st Step** – Collect information and formulate a plan.

**2nd Step** – Execute the plan.



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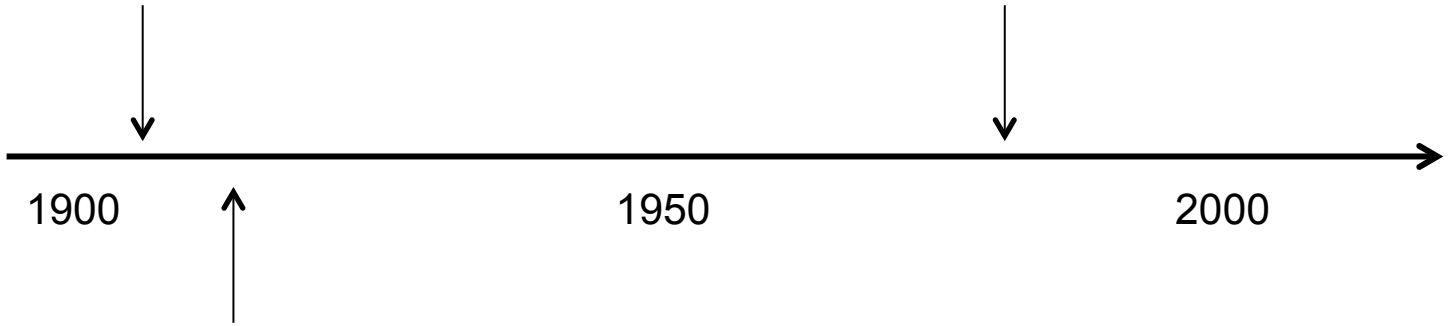
# History and Theory

In 1911 the **one best way** to organize, manage and plan a process (Taylor).

Around the 1980s **distinct and better-organized** models came-up (Matveyev).




Early 1900s **preparatory exercises and distinct training** phases (general, preparatory and specific) were suggested (Kotov).



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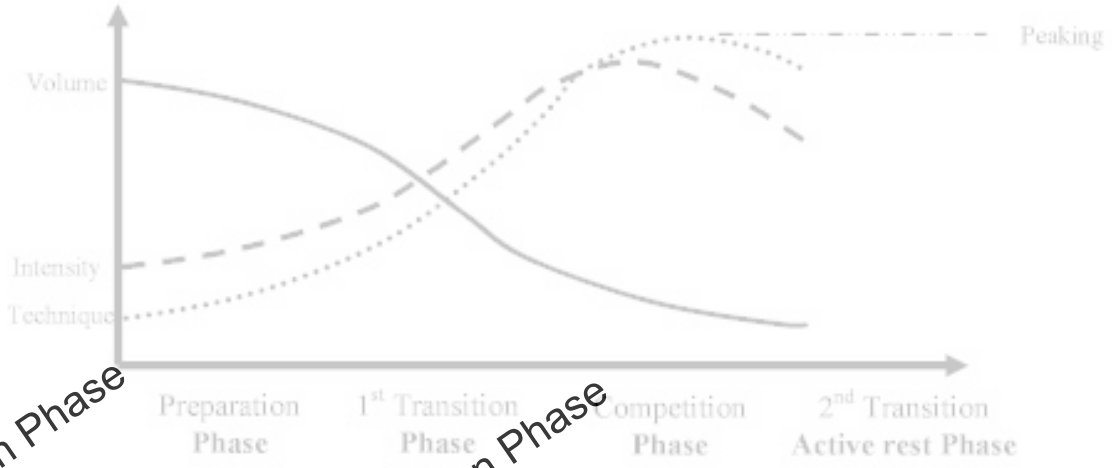
# Matveyev`s System




General Preparation Phase

Specific Preparation Phase

Pre- & Main Phase

Transition

| GPP | SPP | COMPETITION | TRANSITION |
|---|---|---|---|

Matveyev, L., 1981



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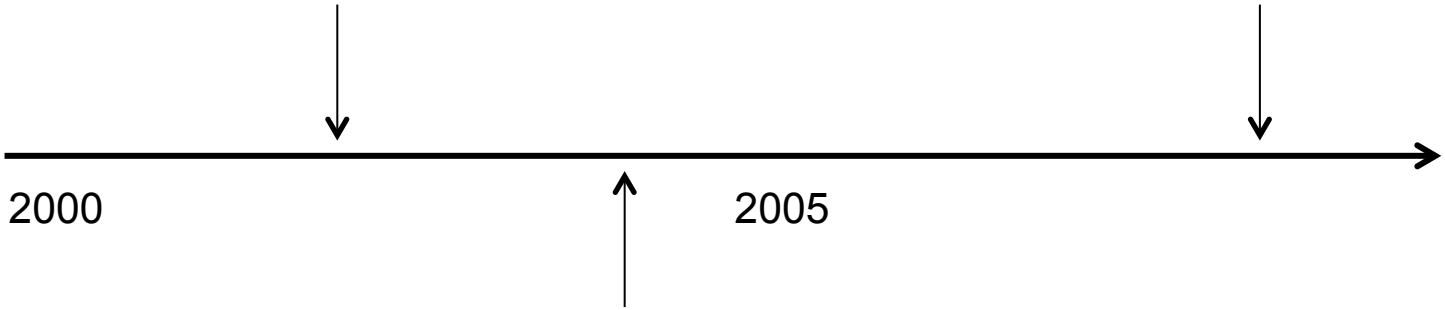
# History and Theory

Programmed **variation** in the training stimuli with the use of **planned rest periods** to augment recovery and restoration of an athlete`s performance potential (Kraemer & Häkinnen, 2002).

**Long-term cyclical structuring** of training and practice to maximize performance to coincide with important competitions (Verkhoshansky & Siff, 2009).




A **logical phasic model** of varying training volume, intensity factors, and exercise in order to optimize training progress (Mike H. Stone, 2004).



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# Periodizaiton Cycle Hierarchy

| Periodization Cycle | Description |
|---|---|
| Quadrennial Cycle | Multi-year plan: ≥ 4 years |
| Macrocycle | Description of complete training period: ≤ 1 year |
| Mesocycle (Phase) | Description of singular training cycle or block: 3-4 weeks |
| Microcycle | Describes the structural unit of a mesocycle: 1 week |
| Workout | Describes the structural unit of a microcycle: hours/minutes |



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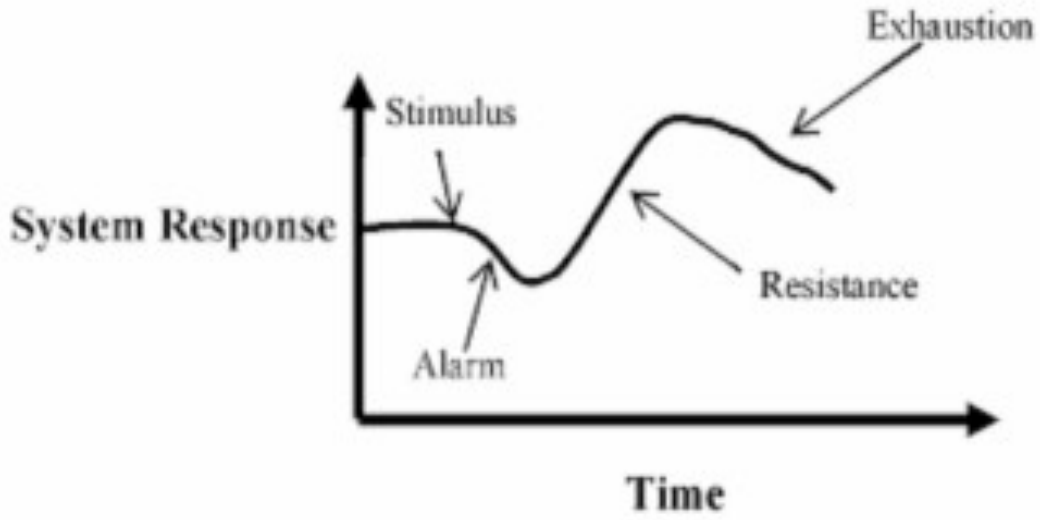
# General Adaptation Syndrom - GAS




## SHOCK – ADAPTATION - FATIGUE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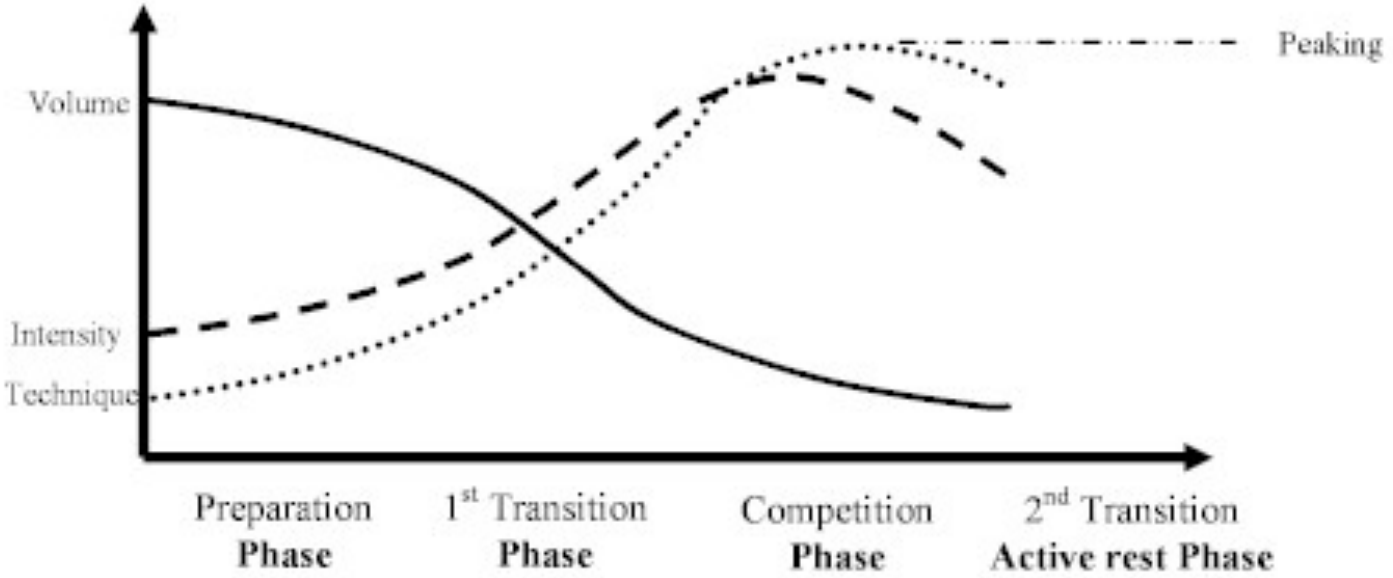
# Manipulating Training Variables




Matveyev, L., 1981



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| | Energy System Training | Strength Training |
|---|---|---|
| **Managing Load** | • Order and type of exercise (complexity)<br>• Volume (repetition e.g. intervals, covered distance)<br>• Intensity (velocity (m/s, km/h), Watt, HF (b/min), VO2max (%)) | • Order and type of exercise (complexity)<br>• Volume (sets and reps, total load, total reps)<br>• Intensity (movement velocity, load (kg / %), time under tension) |
| **Managing Regeneration** | • Frequency (Load to Recovery ratio)<br>• Breaks in between intervals and series<br>• Breaks after and in between workouts<br>• Long breaks (Tapering) or recovery phases<br>• Sleeping status<br>• Stress Management<br>• Nutrition<br>• Training Age<br>• Sex | • Frequency (Load to Recovery ratio)<br>• Breaks in between sets and series<br>• Breaks after and in between workouts<br>• Longs breaks (Tapering) or recovery phases<br>• Sleeping status<br>• Stress Management<br>• Nutrition<br>• Training Age<br>• Sex |

Tabelle Belastungs- und Regenerationsmanagement im Ausdauer- und Krafttraining (Lambert, Mujika, 2013, Zatsiorsky, Kraemer, 2008, Sanders, Montgomery, Woods, 2001, Verkhoshansky, Siff, 2009, Weineck, 2010)

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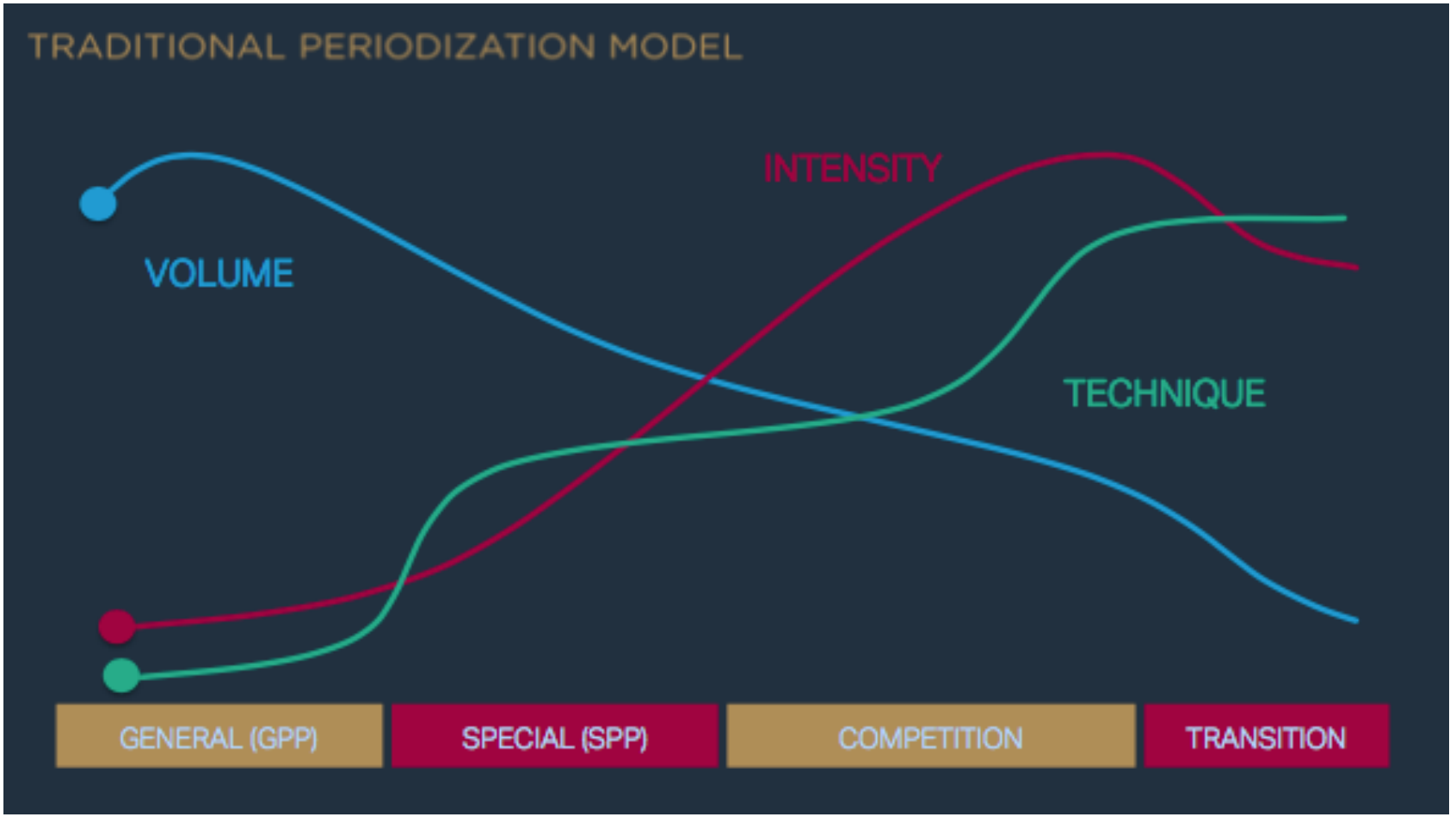



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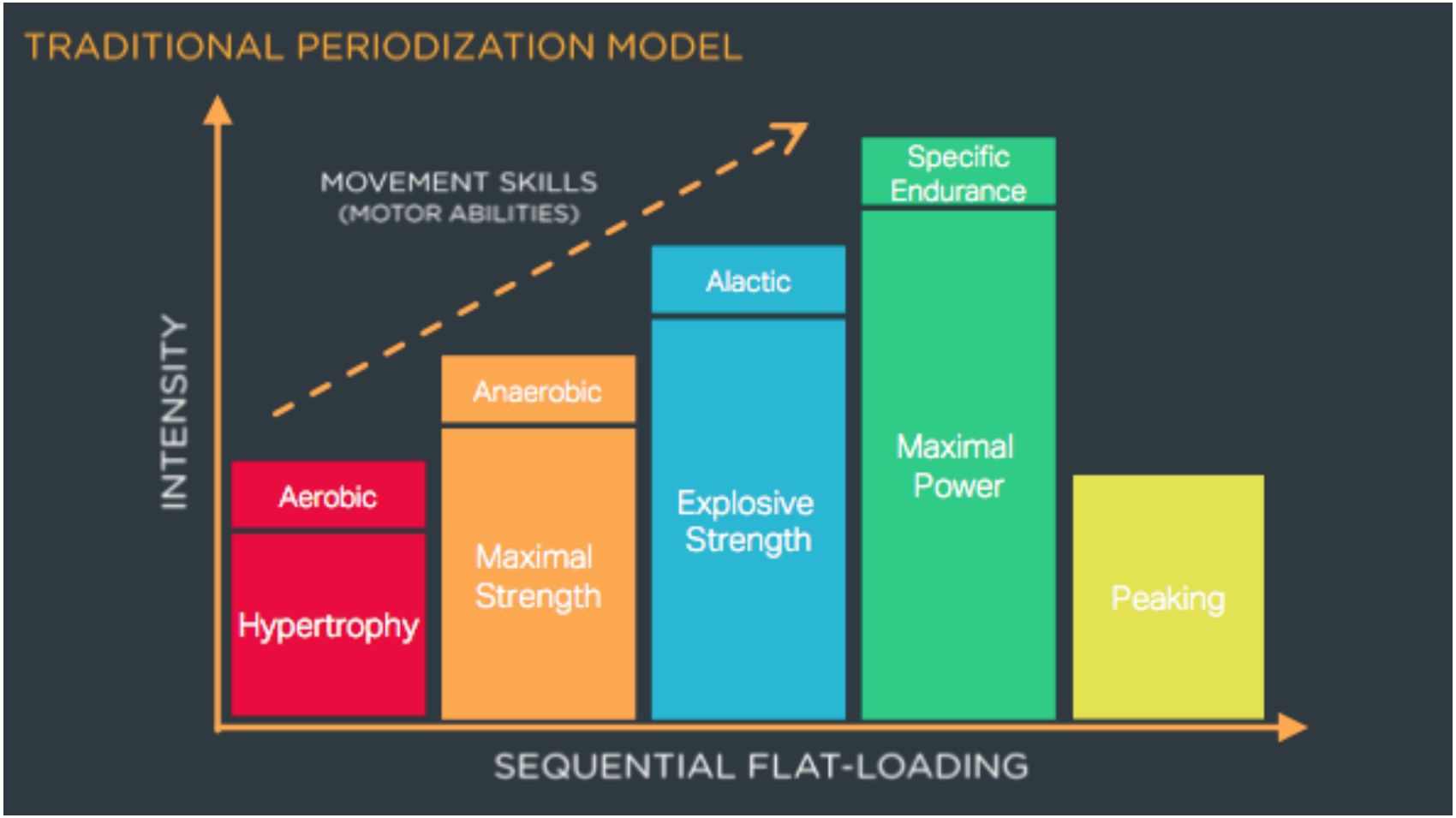



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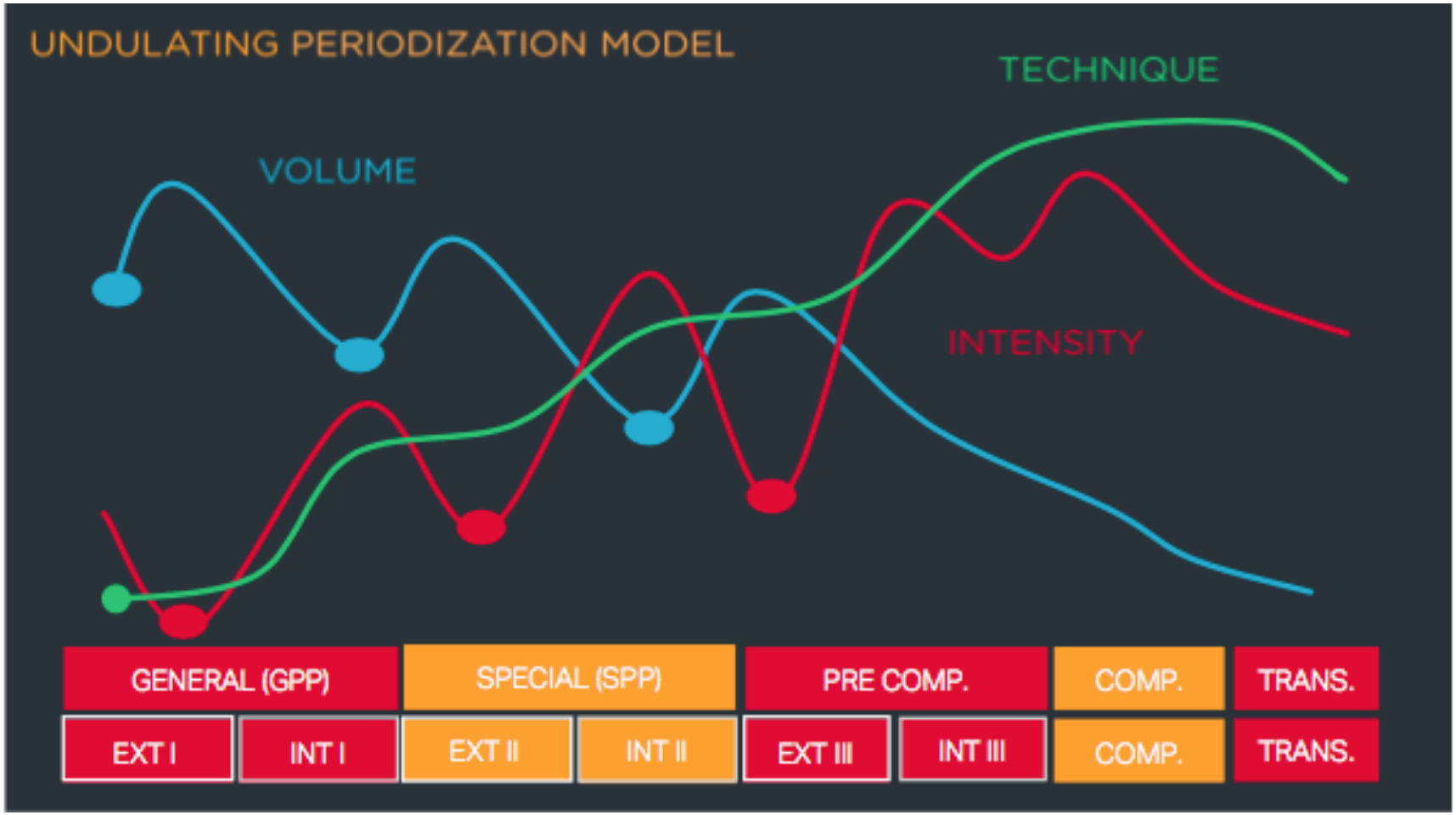



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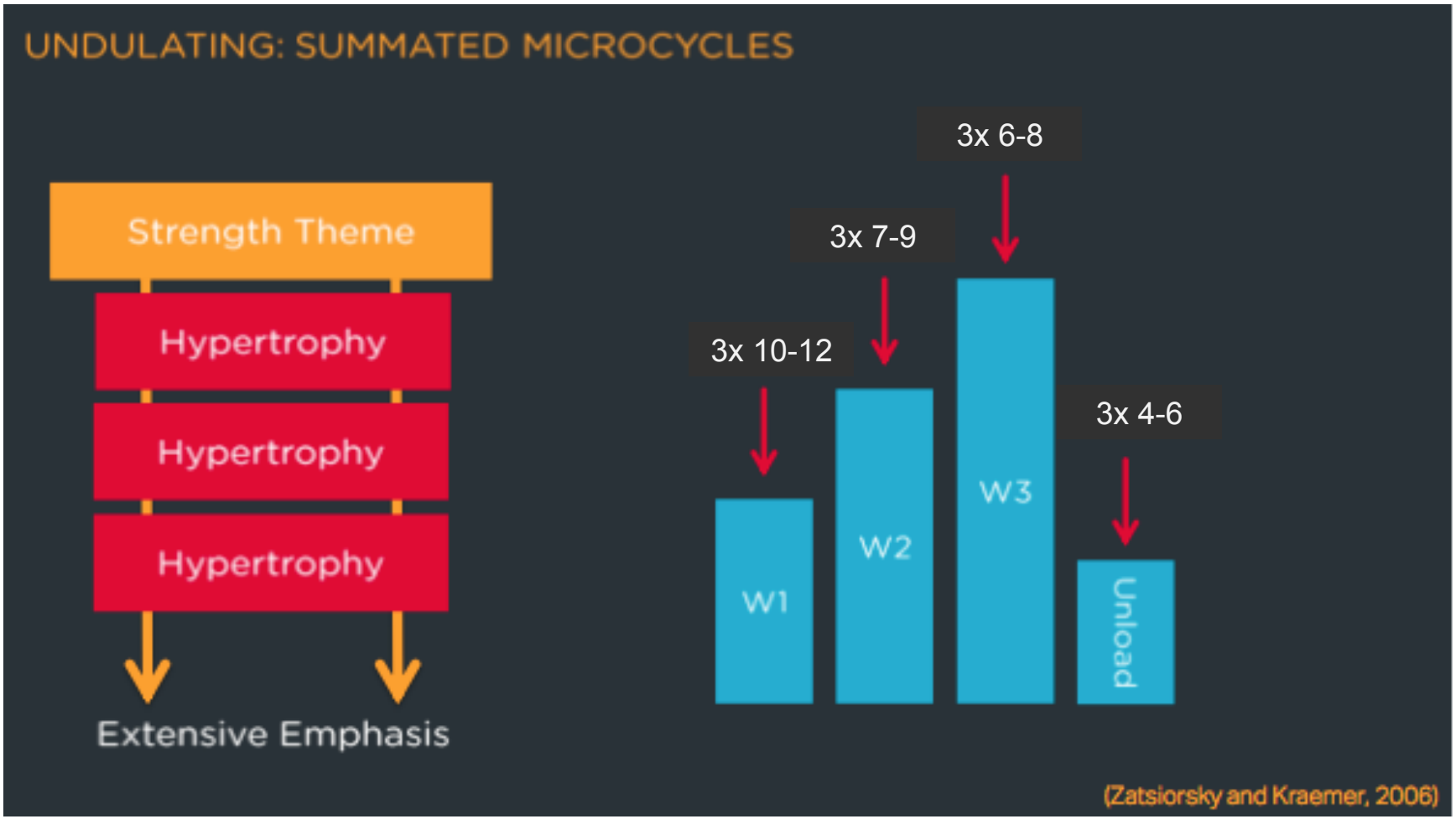




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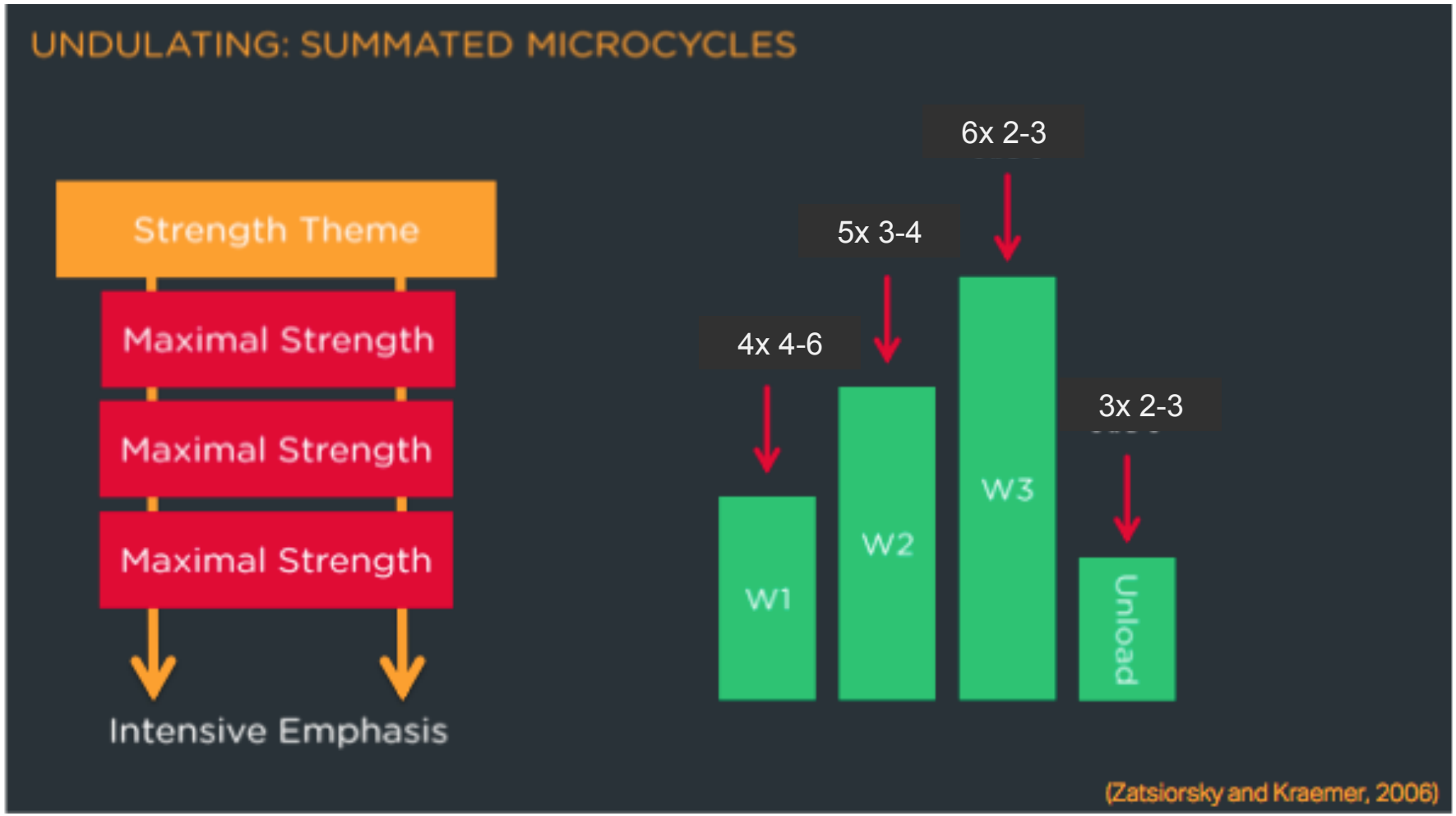




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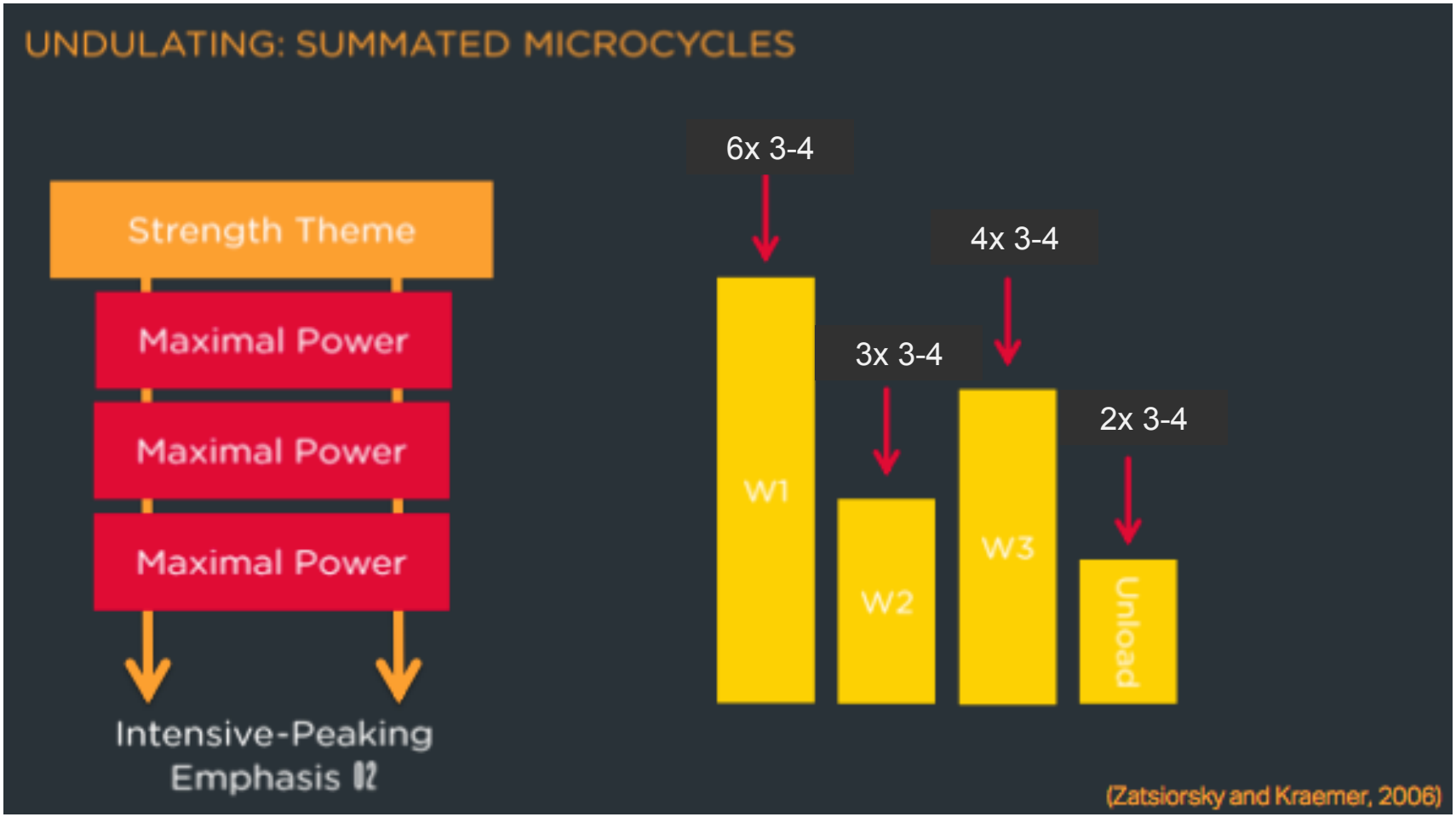




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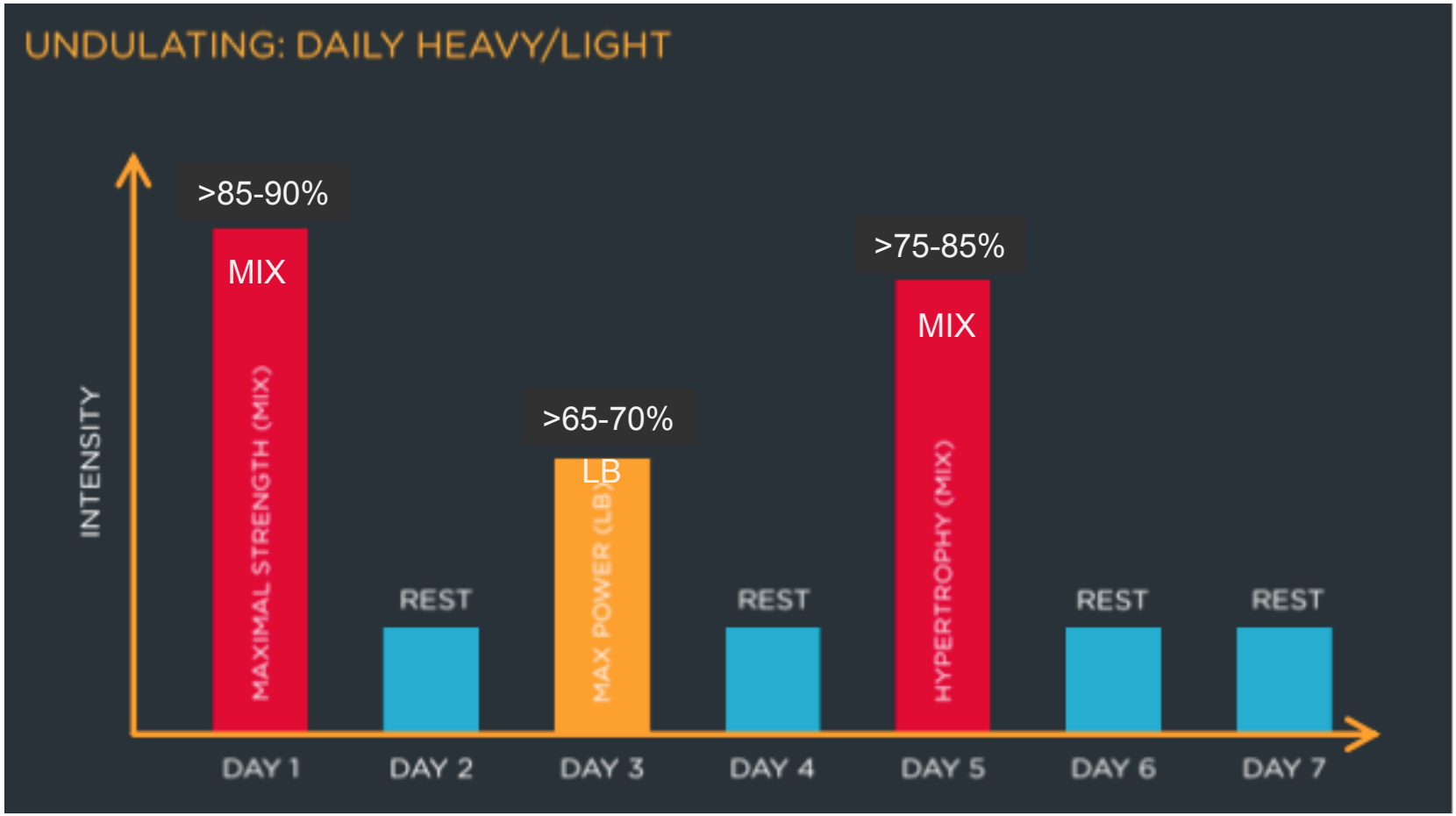




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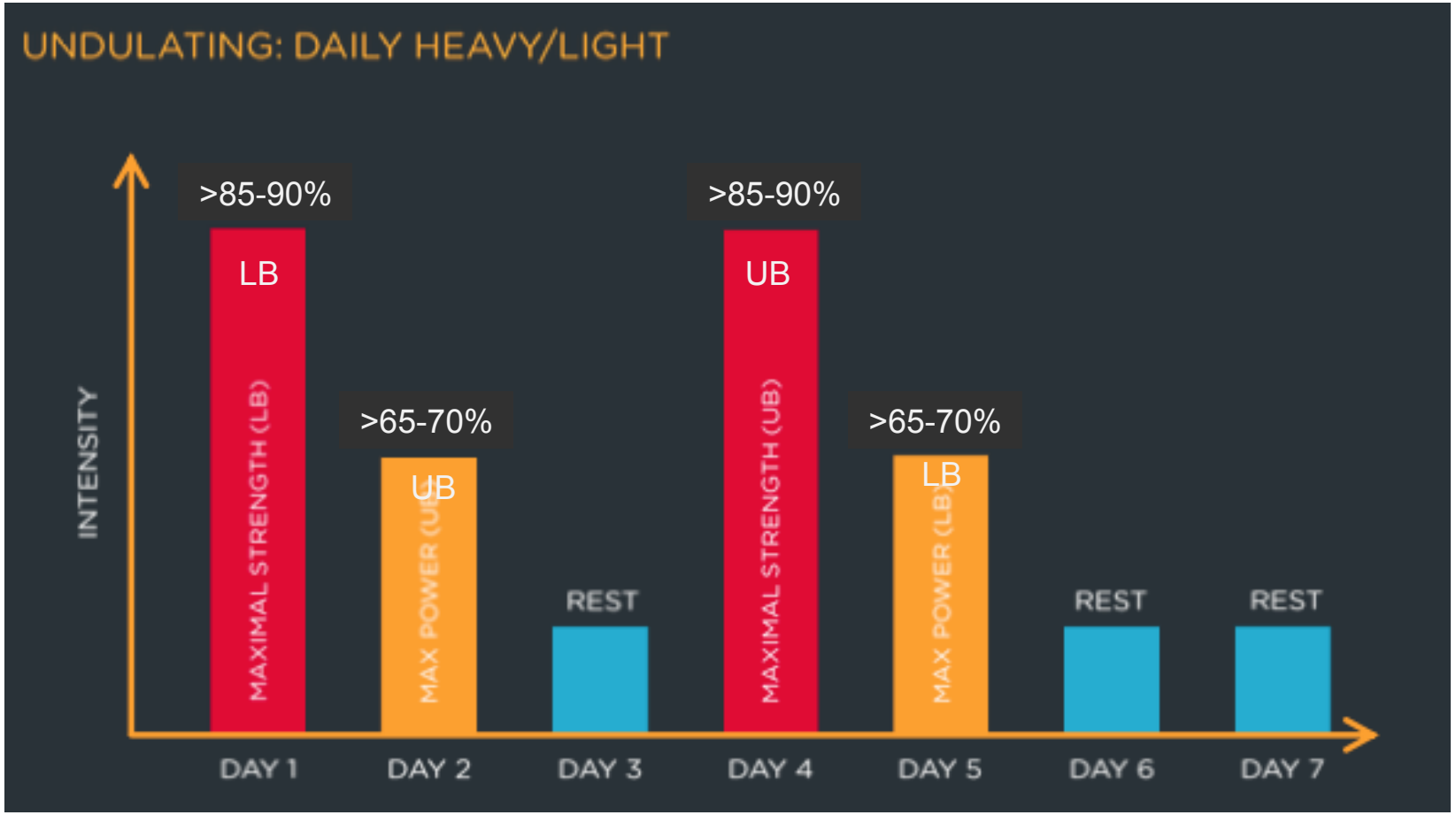




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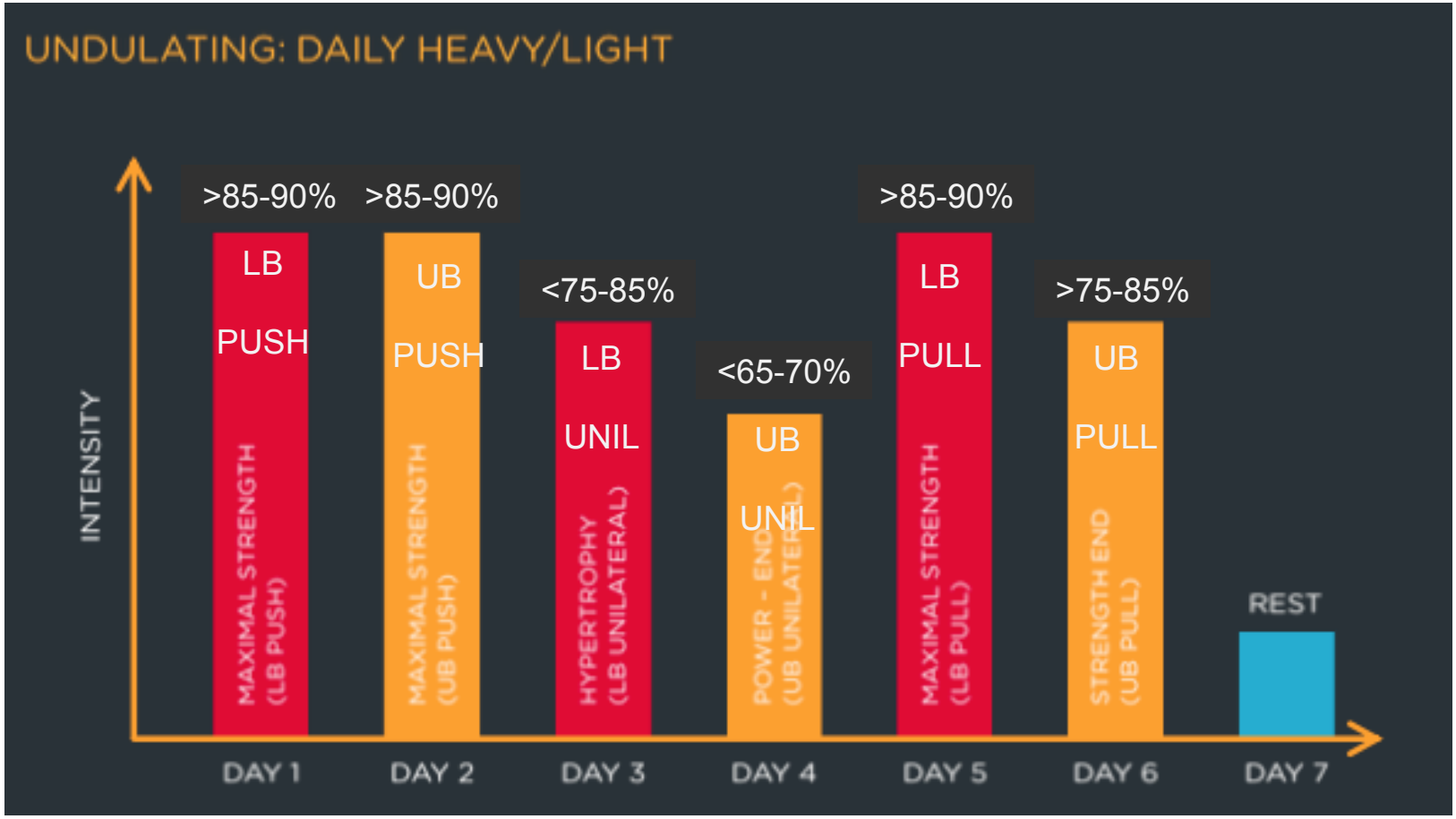




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# Five steps to increasing the effectiveness of your strength training program

Charles Poliquin
Maximanthropology
Ottowa, Ontario
Canada

| Weeks | 1-4 (EXT) | 5-8 (INT) | 9-12 (EXT) | 13-16 (INT) |
|---|---|---|---|---|
| Reps | 8-10 | 3-4 | 6-8 | 2-3 |
| Sets | 3 | 5 | 4 | 5 |
| %1RM | 75-80% | 85-90% | 80-85% | 90-95% |

One of the first papers to recommend undulating as a form of periodization for highly trained athletes



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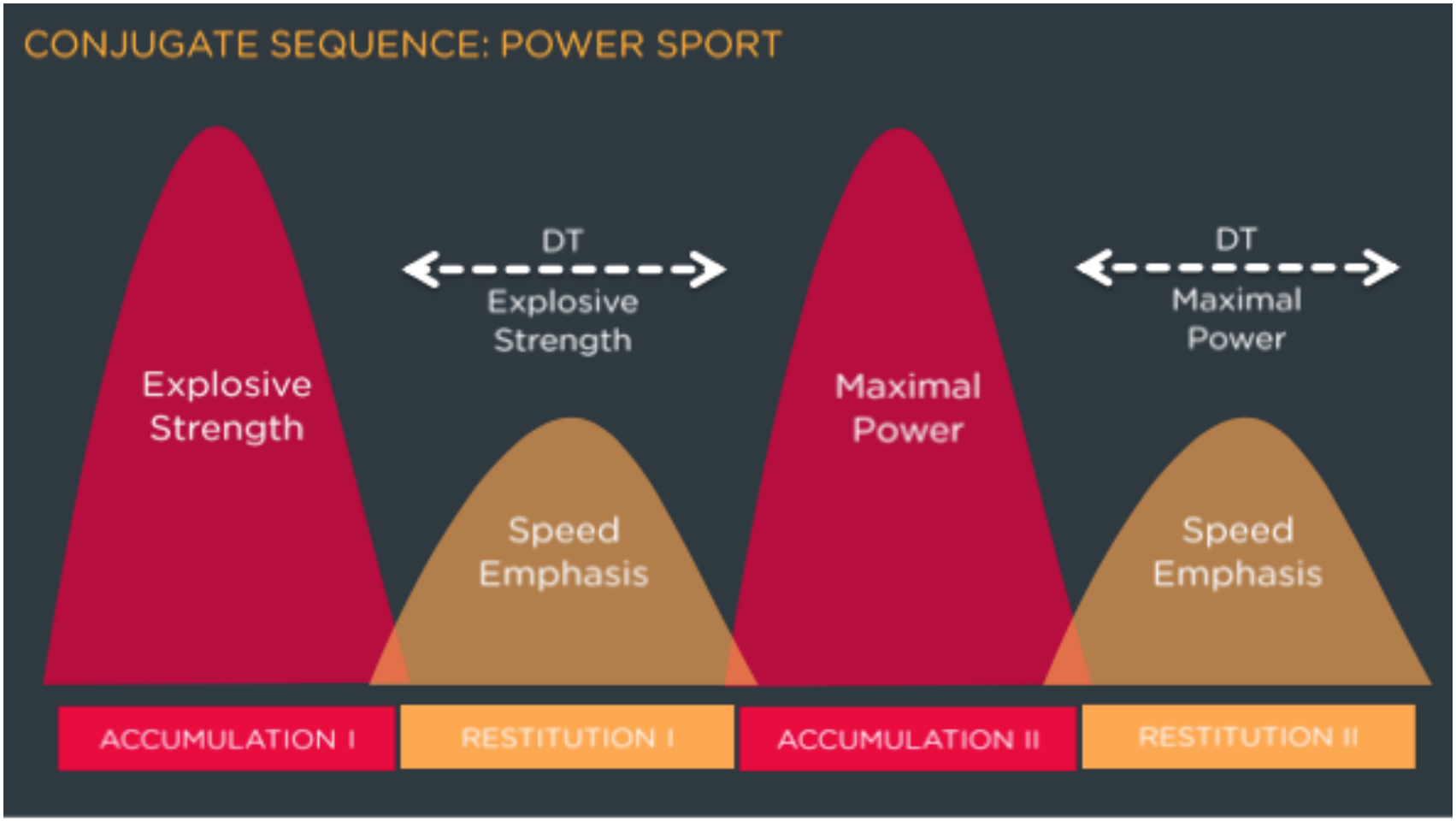




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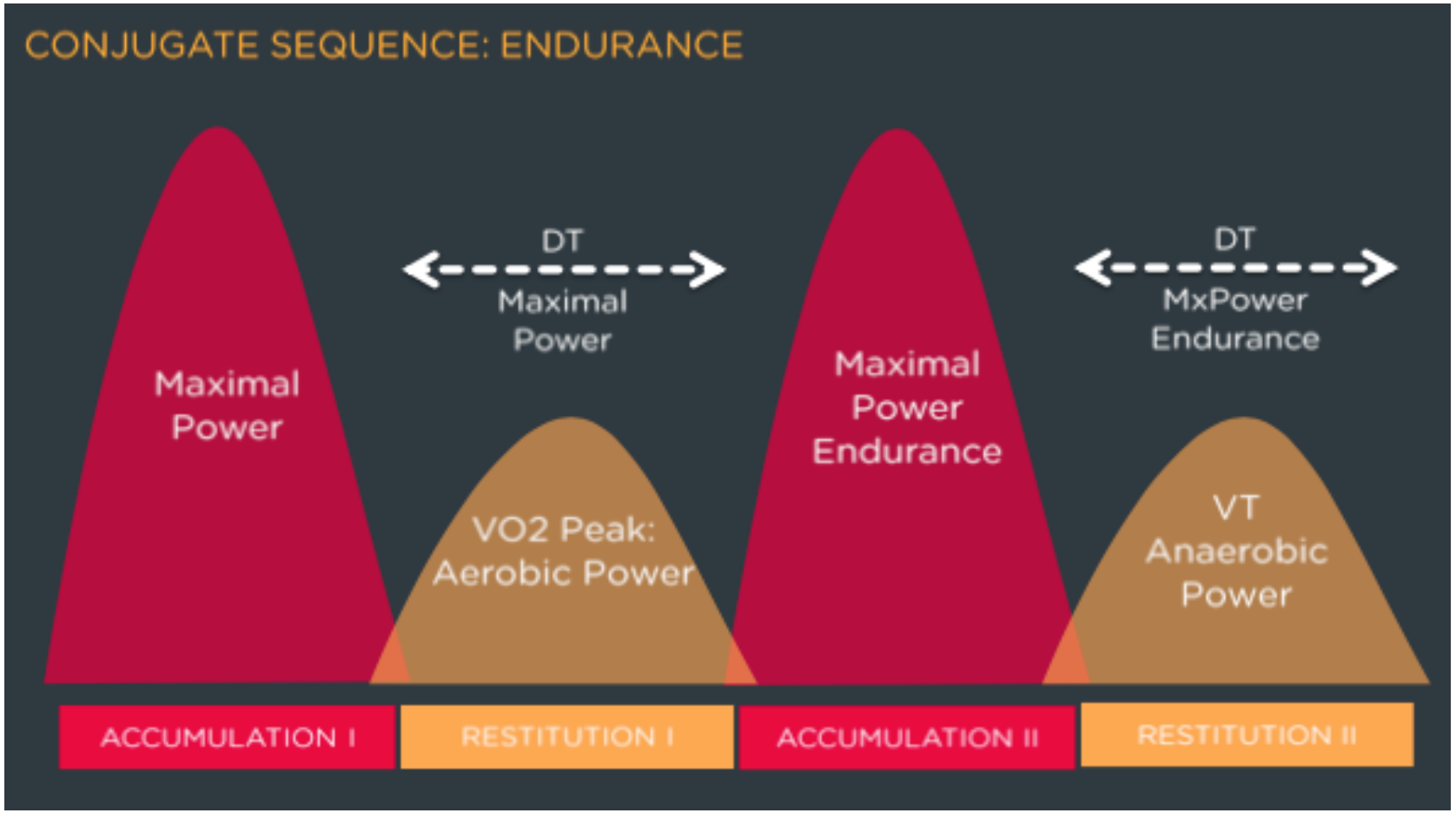




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| Traditional Model | | |
|---|---|---|
| **Mesocycle** 1 | Week 1-4 | 5 sets of 10 reps @65-70% (HYP) |
| Mesocycle 2 | Week 5-8 | 4 sets of 6 reps @75-80% (STR) |
| Mesocycle 3 | Week 9-12 | 3 sets of 4 reps @85-90% (POW) |

| Non-Traditional Model (DUP) | | |
|---|---|---|
| **Microcycle** 1 | Week 1 Day 1 | 5 sets of 8 reps @70% (HYP) |
| | Week 1 Day 2 | 4 sets of 4 reps @85% (POW) |
| | Week 1 Day 1 | 3 sets of 1 reps @95% (STR) |



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## Non-Traditional Model (WUP)

| | | |
|---|---|---|
| **Mesocycle 1** | **Week 1** | 5 sets of 8 reps @70% (HYP) |
| | Week 2 | 4 sets of 4 reps @85% (POW) |
| | Week 3 | 3 sets of 1 reps @95% (STR) |
| | Week 4 | Unloading / Deloading |

## Blockperiodization

| | | |
|---|---|---|
| **Mesocycle 1** | Week 1 Accumulation | 5 sets of 5 reps @75-80% Focus on STR |
| | Week 2 Transmutation | 3 sets of 3 reps @80-85% Focus on STR |
| | Week 3 Realization | 5 sets of 2 reps @90% Focus on STR |



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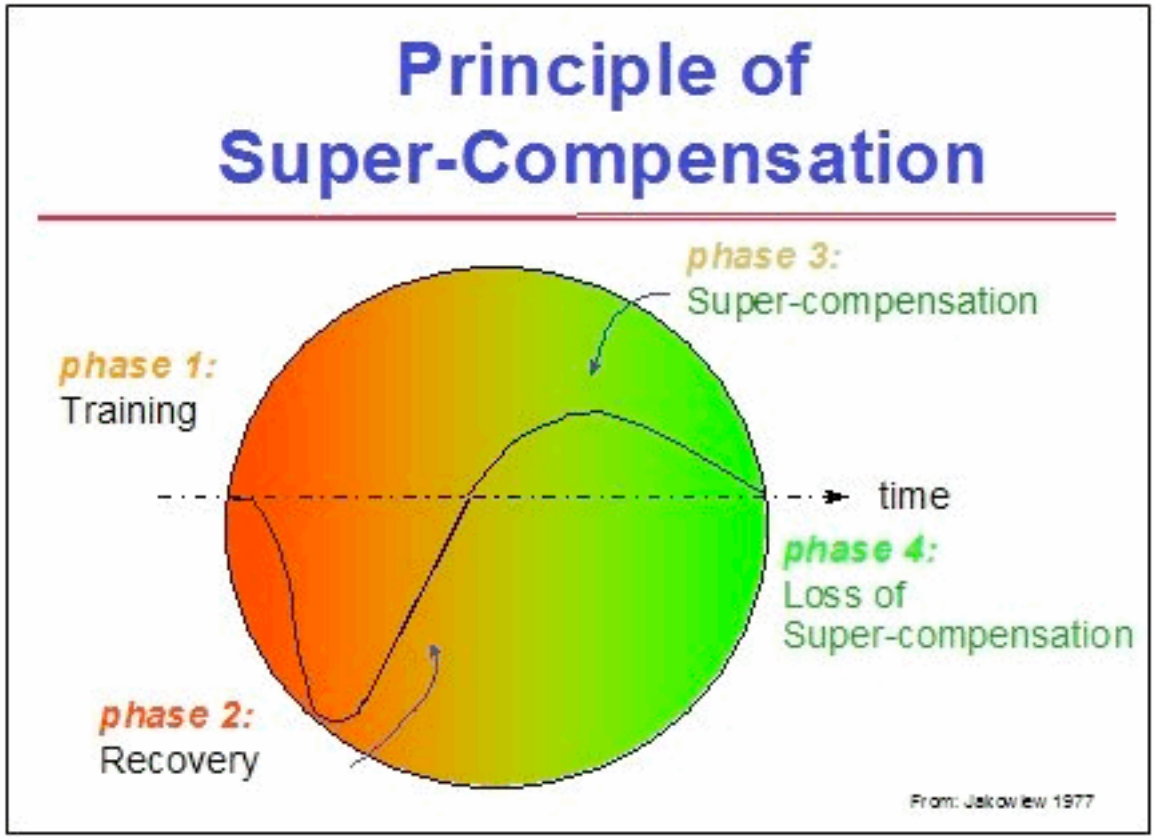


Jakowlew, 1977



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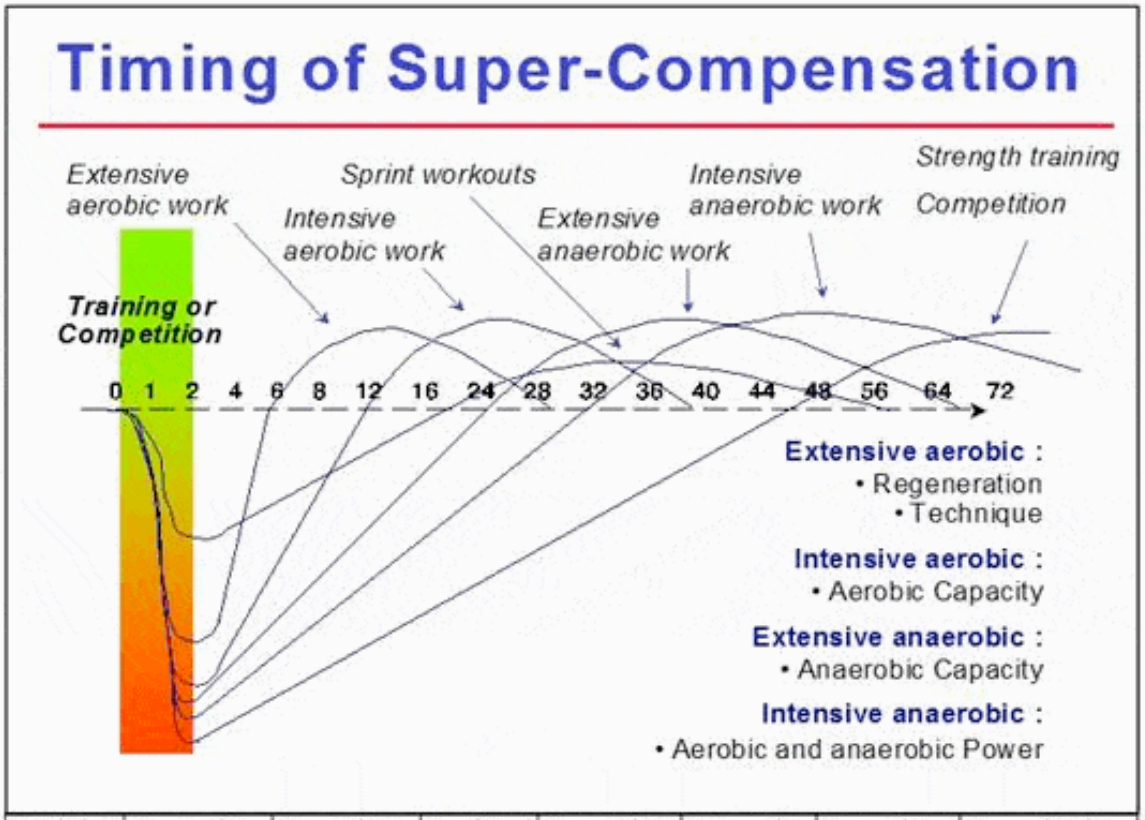
# Timing of Super-Compensation




| Training types | Extensive Endurance | Intensive Endurance | Sprints/ Short Sets | Extensive Anaerobic Training | Extensive Strength Training | Intensive Anaerobic Training | Intensive/ Strength Training/ Competition |
|---|---|---|---|---|---|---|---|
| From | 8 | 24 | 30 | 36 | 40 | 40 | 48 |
| To | 12 | 30 | 40 | 48 | 60 | 60 | 72 |



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| | |
|---|---|
| **Short Term Regeneration** | |
| Replenishing CK-Stores (70 % ATP after 1 minute) | 3 – 5 min |
| Body Temperature | 10 to 60 min |
| Heart Rate / Blood Pressure | Up to 20 min |
| Lactic Acid Level | 30 to 180 min |
| **6 – 36 Hours** | |
| Electrolyte Adjustment (Return to normal and new supply of K and NA) | 1 up to 6 hours |
| Replenishing Glycogen (Liver) | Up to 24 hours |
| Replenishing Muscle Glycogen | Max 24 - 36 hours |
| Replenishing Proteins | Over 48 hours |
| **Over 48 Hours** | |
| Restock Muscle Enzymes | 48 – 60 hours |
| Reconstruction of Protein Structures / Mitochondria | 48 – 72 hours |
| Glycogen Store Supercompensation | 48 – 72 hours |
| Replenishing Electrolytes (Mg, Fe) | 48 – 72 hours |
| Reconstruction of Hormones / Resynthesis of Catecholamines | 48 – 72 hours |
| Resynthesis of Cortisol | 3 – 5 days |
| New Production of Structural Proteins | Days to weeks |

(Hollmann & Strüder, 2009, Neumann, Pfützer & Berbalk, 1999; Neumann, 2014; Lambert & Mujika, 2013, Keferstein, 2014; Weineck, 2010; Zintl & Eisenhut, 2001; Keul, 1986; Badke et al., 1995; Viru, 1995, Bradley, Tenney, Helsen, 2014)

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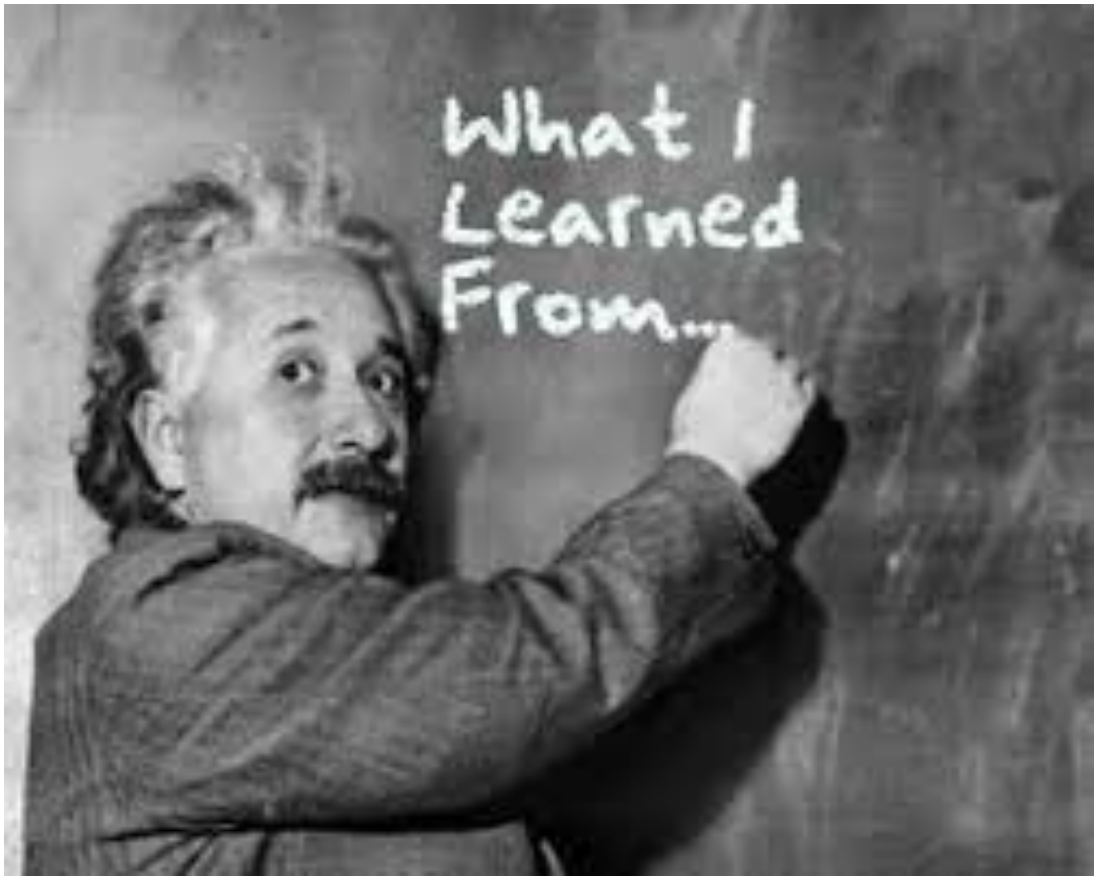
# Residual Effects

| System | Residuals (in days) | Effect |
|---|---|---|
| Aerobic System | 30 ± 5 | • Increase of aerobic enzymes<br>• Increase of mitochondrial/capillary Density<br>• Increase of glycogen storages<br>• Greater metabolic rate |
| Anaerobic System | 18 ± 4 | • Increase of aerobic enzymes<br>• Increase of H+ Buffering<br>• Improved lactate acid tolerance<br>• Increase of glycogen storages |
| Max Strength | 30 ± 5 | • Improved neural mechanisms<br>• Increase of myofibrillar density (FT)<br>• Greater hypertrophy (vie an increase of FT density (length and pennation) |
| Strength Endurance | 15 ± 5 | • Greater hypertrophy (mainly ST)<br>• Improved aerobic/anaerobic enzymes<br>• Improved lactate acid tolerance and blood circulation |
| Max. (alactid) Velocity | 5 ± 3 | • Improved motor control (inter-/intramuscular coordination) K<br>• Improved neuromuscular functuion<br>• Increased phosphocreatine storage |

Issurin, 2010

# Interference Effects

| Targeted Ability | Compatible Training Modalities | Non-Compatible Training Modalities |
|---|---|---|
| Aerobic System | Alactic Sprints, Strength Endurance, Maximum Strength (Hypertrophy) (done afterwards) | Anaerobic Glycolitic Endurance |
| Anaerobic Glycolitic System | Aerobic Restoration (active), Mixed Aerobic-Anaerobic Endurance, Strength Endurance | Aerobic Endurance, Maximal Strength (done before) |
| Anaerobic Alactic System | Aerobic Endurance, Aerobic Restoration (active), Explosvie Strength, Maximal Strength (done afterwards) | Anaerobic Glycolitic Endurance |
| Maximum Strength (Hypertrophy) | Maximum Strength (Innervation), Stretching Exercises, Aerobic Restoration (active) | Any exhaustive load afterwards because they disrupt restoration |
| Technical Skills | Any training modality after performing | Any training modality before performing |





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- ☑ Failing to plan is planning to fail
- ☑ Periodization manages time and resources
- ☑ Periodization improves productivity and reduces planning problems
- ☑ Periodization manipulates training variables and follows the GAS
- ☑ Consider residuals, regeneration times, and interference effects
- ☑ Periodization Models: Traditional & Non-Traditional


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## MONITORING

Why monitor?
Fluid Periodization
Fields of Monitoring

Types of Stress
Quantification of Stress
External vs Internal

ACWR
Measures of Fatigue

## PERIODIZATION

History & Theory
GAS
Training Variables

Periodization Models

Super-Compensation
Residual Effects
Interference Effects

## PERFORMANCE

Data Collection
Determinants

Performance Model
Profile of Requirement

Planning



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# The One Piece



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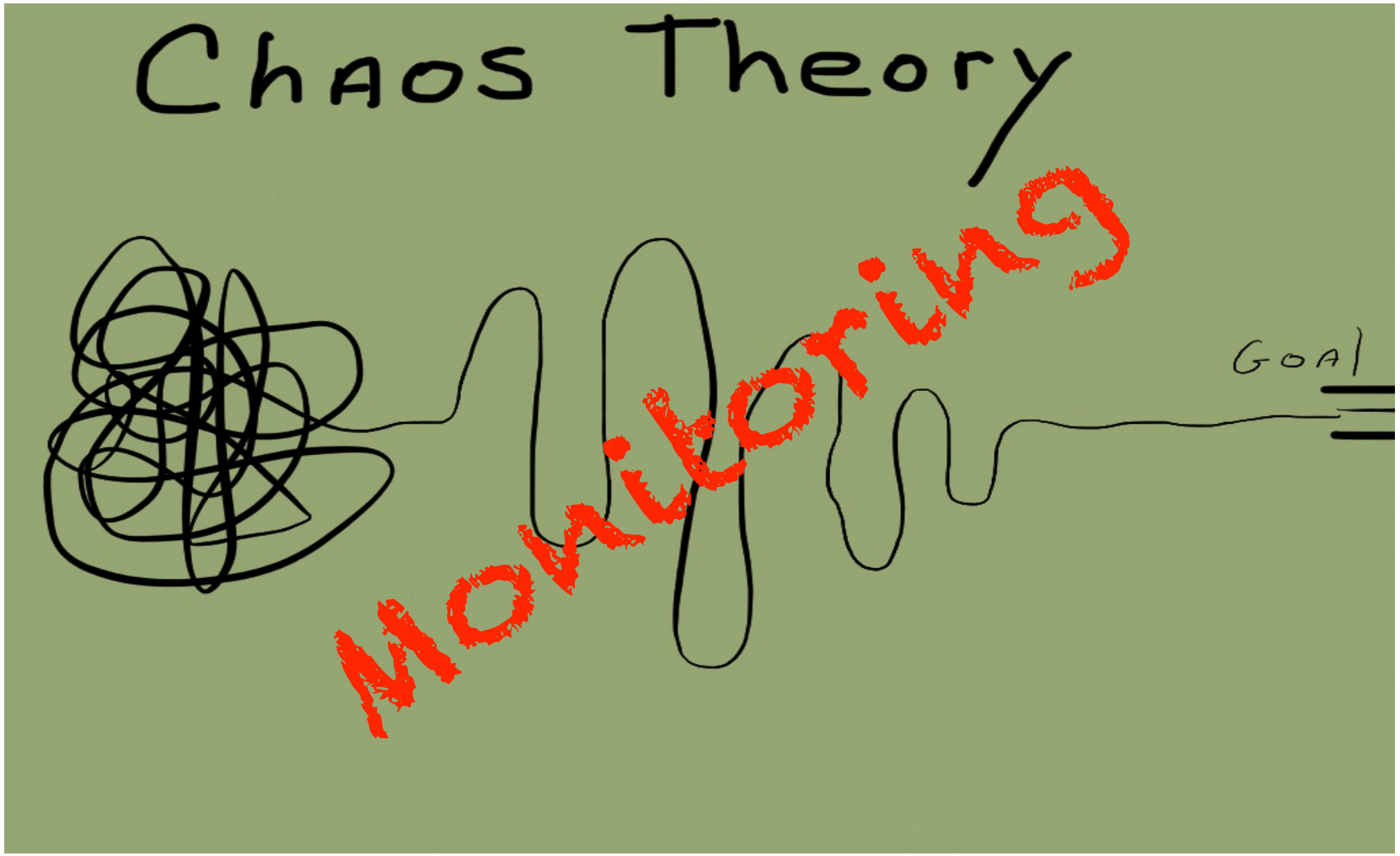



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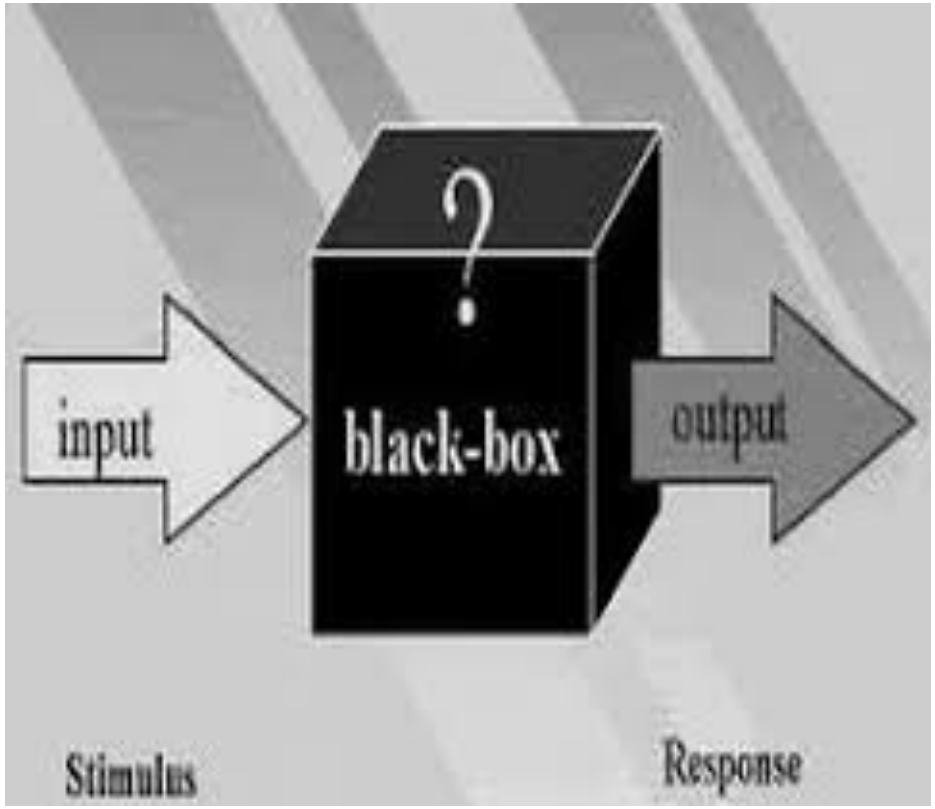





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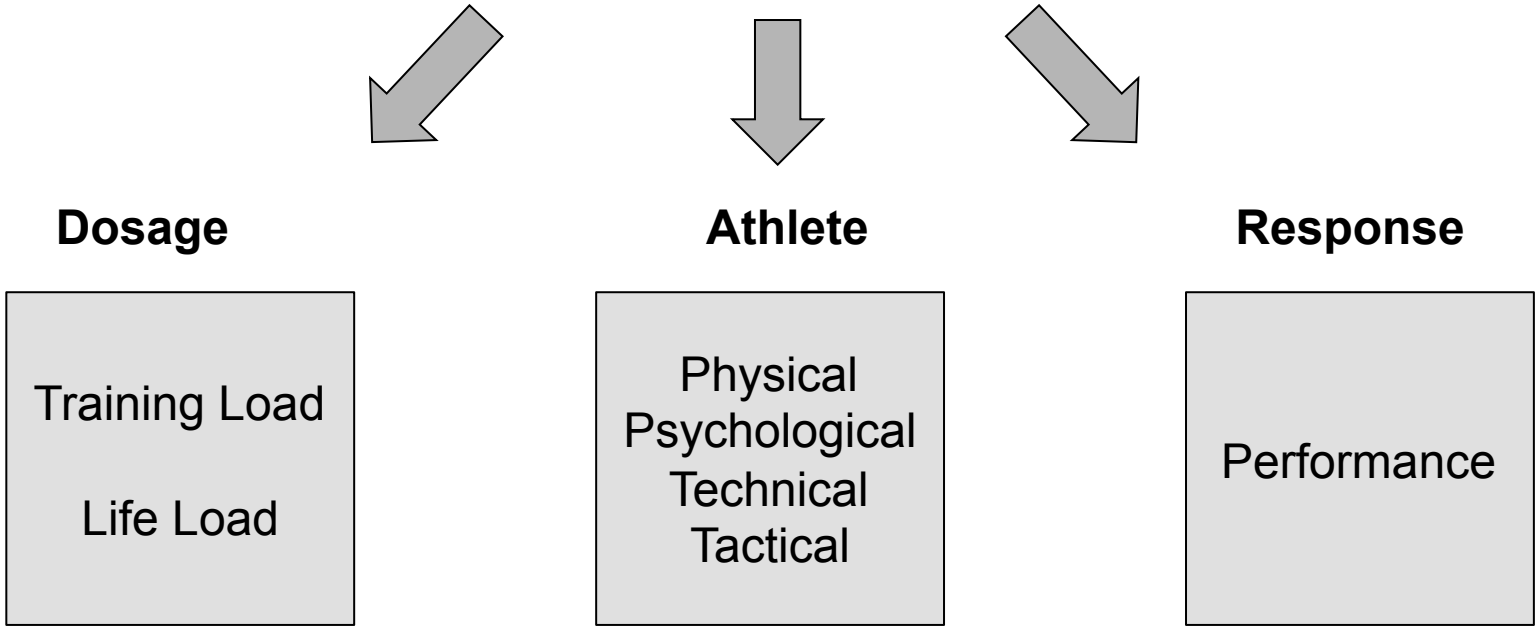
# Monitoring



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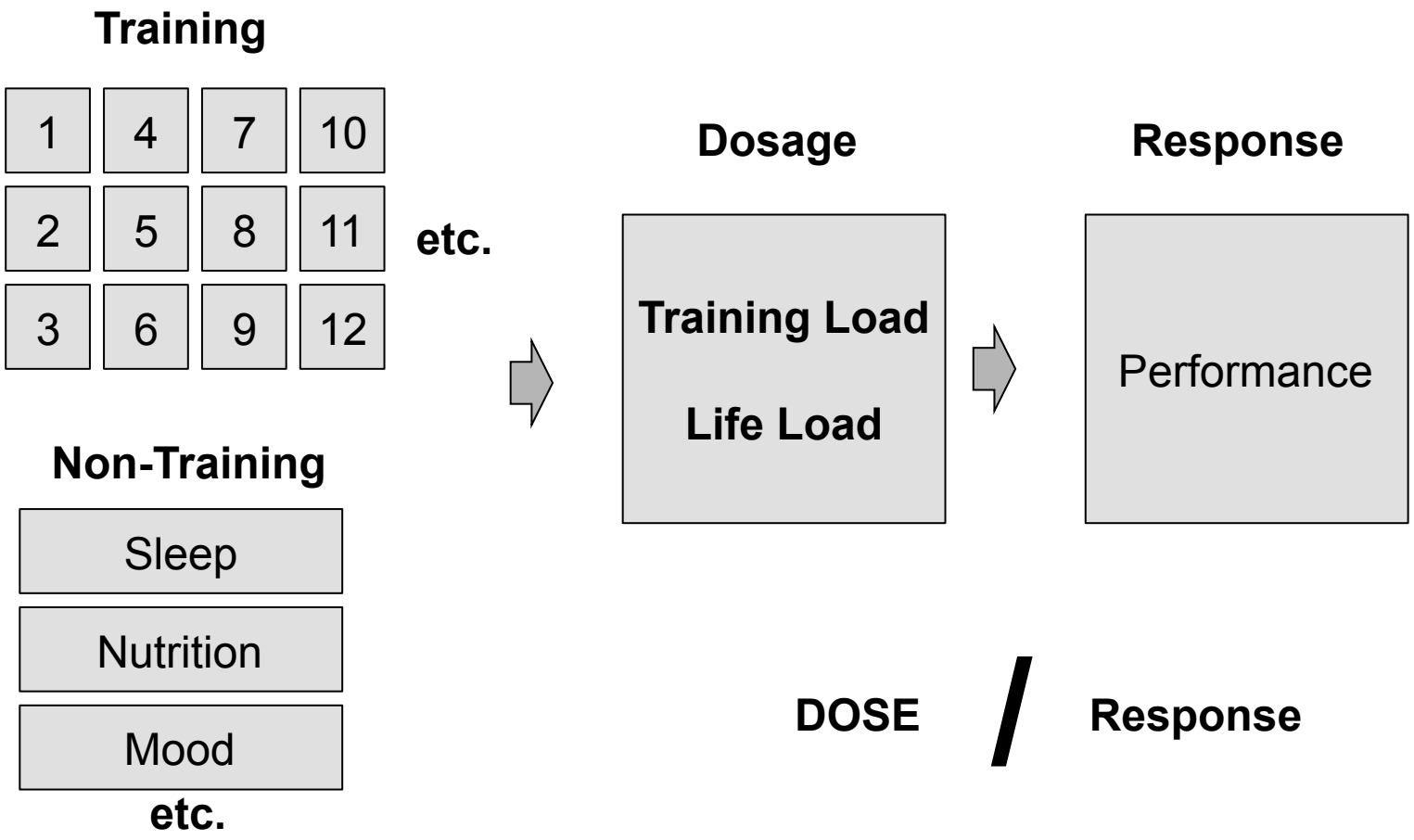




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# Fluid Periodization

UKnowledge

University of Kentucky
UKnowledge

Theses and Dissertations--Kinesiology and Health Promotion

Kinesiology and Health Promotion

2015

The Effect of Fluid Periodization on Athletic Performance Outcomes in American Football Players

Christopher W. Morris

Morris, C. W. , 2005



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# Fluid Periodization

Table 8. Comparison of resistance training and running volume between experimental and control groups in 59 American football players.

| | Control (n=28) | Experimental (n=31) | Absolute Difference | % Difference | Effect Size | P-Value | Power |
|---|---|---|---|---|---|---|---|
| Core Volume* | 22078 ± 550 | 20078 ± 2717 | -2000 | -9.50% | 1.20 | <0.01 | 0.94 |
| Accessory* Volume | 10815 ± 365 | 9478 ± 754 | -1337 | -13.21% | 1.14 | <0.01 | 0.92 |
| Running Volume* (sRPE AU) | 12493 ± 1243 | 12859 ± 1583 | 366 | 2.88% | 0.19 | 0.33 | 0.28 |

Morris, C. W. , 2005



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# Fluid Periodization

Table 7. Comparison of anthropometric and performance outcomes between experimental groups in 59 American football players.

| | Control (n=28) | | | | | | Experimental (n=31) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre-Test Mean | ± | SD | Post-Test Mean | ± | SD | Absolute Difference | Pre-Test Mean | ± | SD | Post-Test Mean | SD | Absolute Difference | % Difference | Effect Size | P-Value | Power |
| Weight (kg) | 108.44 | ± | 23.51 | 110.54 | ± | 22.99 | 2.10 | 105.18 | ± | 22.49 | 107.46 | ± 22.25 | 2.29 | 9% | 0.05 | 0.36 | 0.06 |
| Body Fat (%) | 17.34 | ± | 6.70 | 18.11 | ± | 6.32 | 0.76 | 15.30 | ± | 6.54 | 15.79 | ± 7.60 | 0.49 | -36% | 0.12 | 0.65 | 0.07 |
| Fat Mass (kg) | 20.85 | ± | 12.98 | 21.83 | ± | 12.48 | 0.98 | 17.00 | ± | 10.35 | 17.70 | ± 11.22 | 0.70 | -29% | 0.11 | 0.40 | 0.07 |
| Fat-Free Mass (kg) | 87.03 | ± | 12.64 | 88.14 | ± | 12.58 | 1.11 | 85.98 | ± | 13.40 | 87.69 | ± 15.41 | 1.71 | 54% | 0.30 | 0.69 | 0.20 |
| Vertical (cm) | 73.21 | ± | 8.77 | 75.16 | ± | 9.63 | 1.95 | 76.86 | ± | 9.61 | 81.86 | ± 8.74 | 5.01 | 157% | 1.02 | 0.001† | 0.97 |
| Vertical Power (W) | 7125.66 | ± | 1215.49 | 7335.58 | ± | 1214.77 | 209.92 | 7374.59 | ± | 976.43 | 7782.10 | ± 937.07 | 407.50 | 94% | 0.86 | 0.001† | 0.90 |
| Broad Jump (cm) | 265.27 | ± | 26.43 | 266.87 | ± | 24.05 | 1.60 | 275.33 | ± | 21.07 | 286.38 | ± 20.08 | 11.05 | 592% | 0.81 | 0.001† | 0.86 |
| Triple Broad Jump (cm) | 893.30 | ± | 42.73 | 889.85 | ± | 45.40 | -3.46 | 895.81 | ± | 37.05 | 904.03 | ± 38.31 | 8.22 | 338% | 0.63 | 0.18 | 0.35 |
| Medicine Ball OH Throw (cm) | 1707.47 | ± | 172.83 | 1655.40 | ± | 151.98 | -52.07 | 1807.32 | ± | 165.06 | 1781.39 | ± 174.02 | -25.93 | 50% | 0.26 | 0.60 | 0.19 |
| Aerobic Effeciency (bpm) | 21.29 | ± | 16.22 | 31.04 | ± | 13.40 | 9.75 | 18.21 | ± | 15.45 | 43.20 | ± 18.60 | 24.99 | 156% | 1.01 | 0.001† | 0.91 |

In conclusion, fluid periodization produced greater improvements in performance outcomes at a reduced training load compared to a similar unmodified periodization scheme. These findings highlight the importance of modifying training parameters based upon the daily physiological state of the athlete.

Morris, C. W. , 2005



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# Purposes of Monitoring

Risk of Injury

Risk of Illness

Training Load

Regeneration




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# Risk of Injury

- ✓ Monitoring enhances injury prevention
- ✓ Prevention of Overtraining
- ✓ Prevention of Undertraining



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# Risk of Illness

- ✓ Frail immune system (up to 2hrs after)
- ✓ Lymphocytes : granulocytes ratio
- ✓ Recharge and replenish (carbs)



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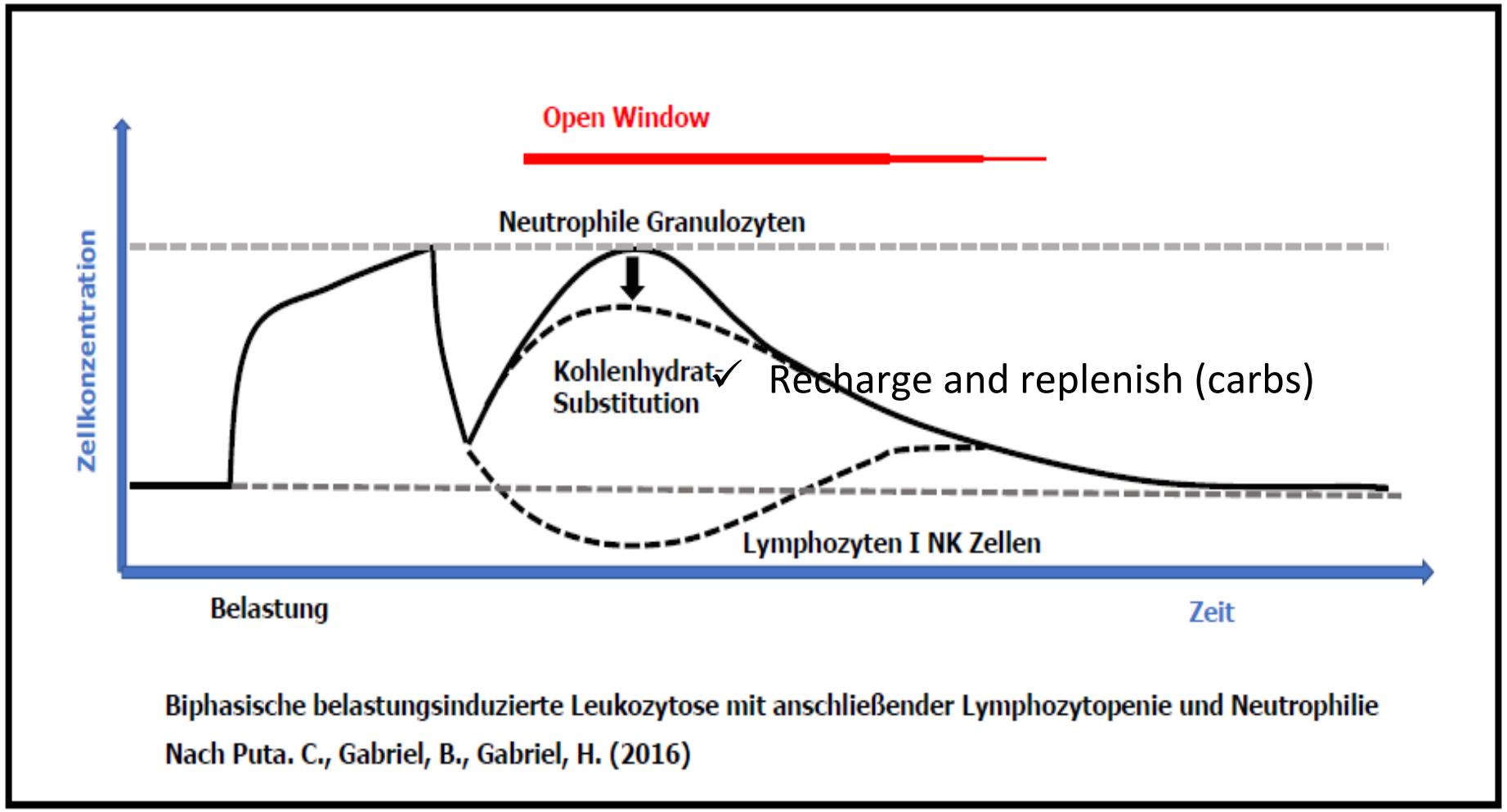


Biphasische belastungsinduzierte Leukozytose mit anschließender Lymphozytopenie und Neutrophilie

Nach Puta. C., Gabriel, B., Gabriel, H. (2016)



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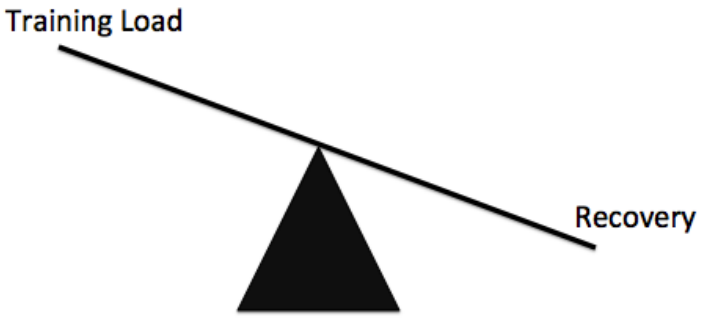
# Training Load


- ✓ Perceived load (coach vs athlete)
- ✓ Different reactions to training loads (too easy vs too hard)



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# Regeneration


- ✓ Progress of recovery processes
- ✓ Individuality of recovery processes
- ✓ Selection of recovery strategies
- ✓ Balance of recovery and adaptation


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# Stress

Environmental demands exceeding our actual psychological, physiological resources.

**Eustress**

**Distress**

Stress is triggered by external or internal stressors or demands and is followed by an adaptive response.



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| 1. Metabolic / 2. Neuronal Stress | 3. Psychological / 4. Environmental Stress | |
|---|---|---|
| **Physical Load** | **Competition Load (preparation / postprocessing** | **Other Load / Environmental Load** |
| Game / Competition<br>Training<br>Regeneration<br>Testing<br>Physiotherapie<br>Rehabilitation | Traveling<br>Jetlag<br>Performance Data Analysis<br>Learning Tactics/Technique<br>Video Analysis | Temperature / Climate<br>Height<br>Sponsoring/Commercial Events<br>Media Events<br>Social Media |
| | **3. Psychological Stress** | |
| **Nutrition** | **Social Relationships** | **Personal Development** |
| Individualisation<br>Timing<br>Supplementation<br>Alcohol / Drugs | Family<br>Friends<br>Coach<br>Team Members<br>Staff<br>Agent / Manager<br>Fans<br>Media | Career Planning<br>Schooling<br>Apprenticeship<br>Academic Studies<br>Work |

Based on Kenneth et al., 2016, McGuigan, 2017

# Quantification of Stress


- ✓ Uncover training stress and an athlete`s reaction
- ✓ Subjective vs objective measuring methods
- ✓ Draw the right conclusions from collected data


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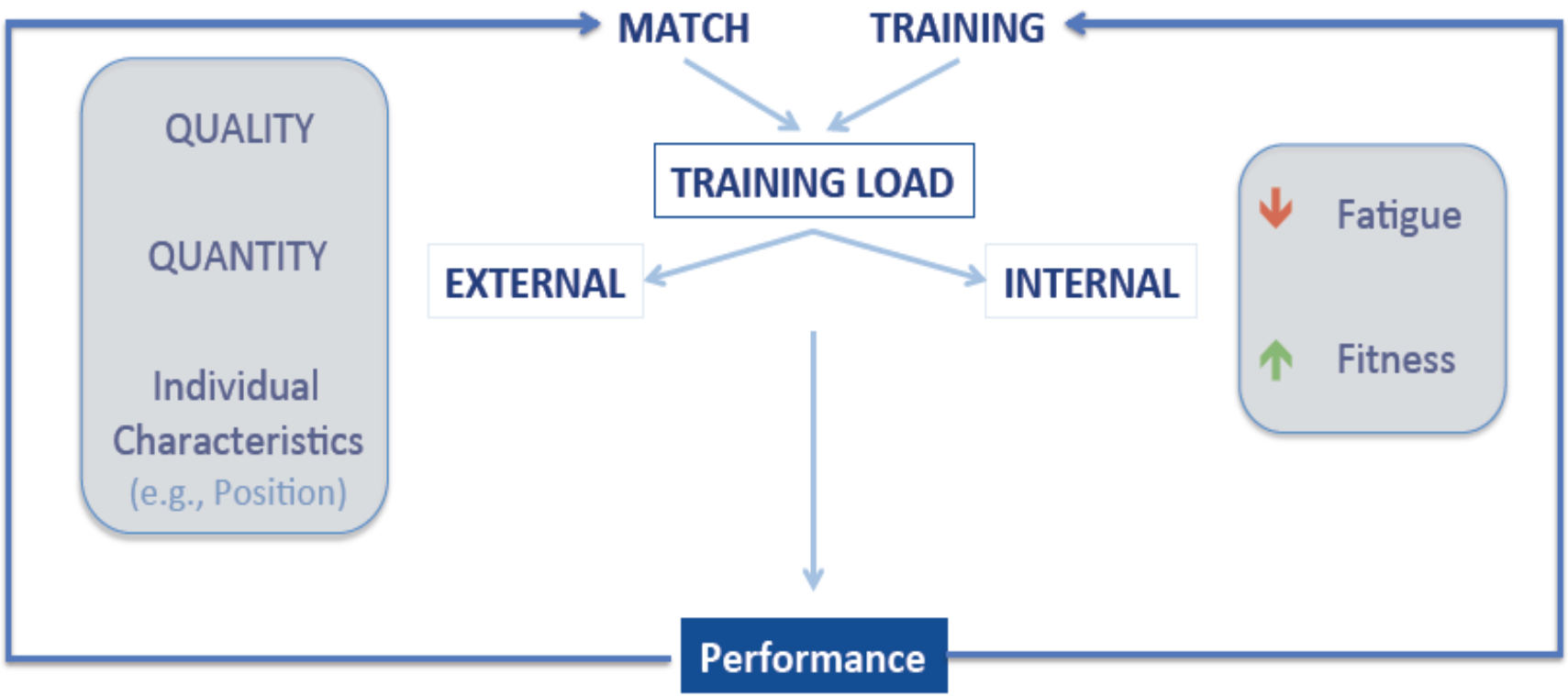
# External vs Internal Load




„Fatigue is a natural and necessary piece of the puzzle.“ (McGuigan, 2017)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## External Load

Distance (m)
Velocity (km/h)
Training Time (min)
Power (W)

GPS Systems


Accelerometer


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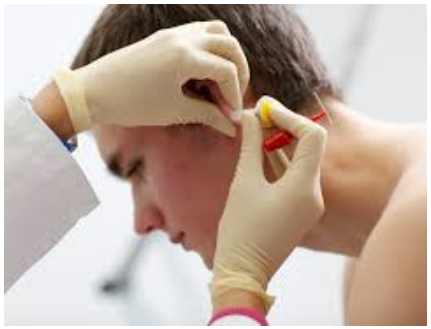
# External vs Internal Load

## Internal Load

Heart Rate (HR)
Perceived Exertion (RPE)
Lactate (mmol/l)

**Rating of Perceived Exertion (RPE) - Skala**

| 1 - 10 Borg Rating of Perceived Exertion Scale | |
|---|---|
| 0 | Rest |
| 1 | Really Easy |
| 2 | Easy |
| 3 | Moderate |
| 4 | Sort of Hard |
| 5 | Hard |
| 6 | |
| 7 | Really Hard |
| 8 | |
| 9 | Really, Really, Hard |
| 10 | Maximal: Just like my hardest race |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# Training Load

**External Load**

Distance (m)
Velocity (km/h)
**Training Time (min)**
Power (W)

x

**Internal Load**

Heart Rate (HR)
**Perceived Exertion (RPE)**
Blood Lactate (mmol/l)

=

Training Load

<u>Team Sports</u>

300-500 = Low Int.

600 = Moderate

700-1000 = High Int.

60 min Workout

A) 6 RPE

B) 8 RPE

360 Arbitrary Unit

480 Arbitrary Unit



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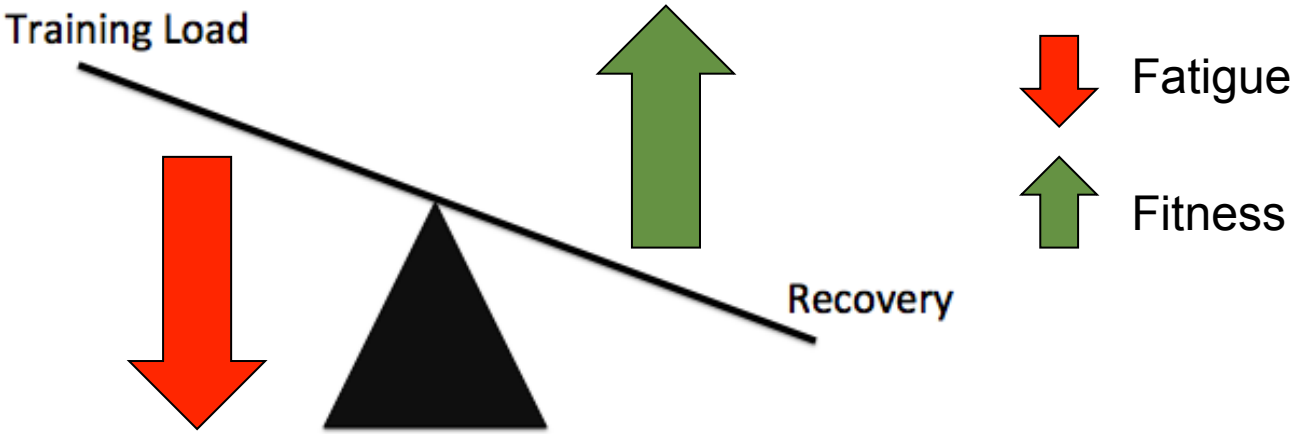
# Fitness and Fatigue




The performance of an athlete in response to training can be estimated from the difference betweeen a negative function (fatigue) and a positive function (fitness) (1975, Banister et al).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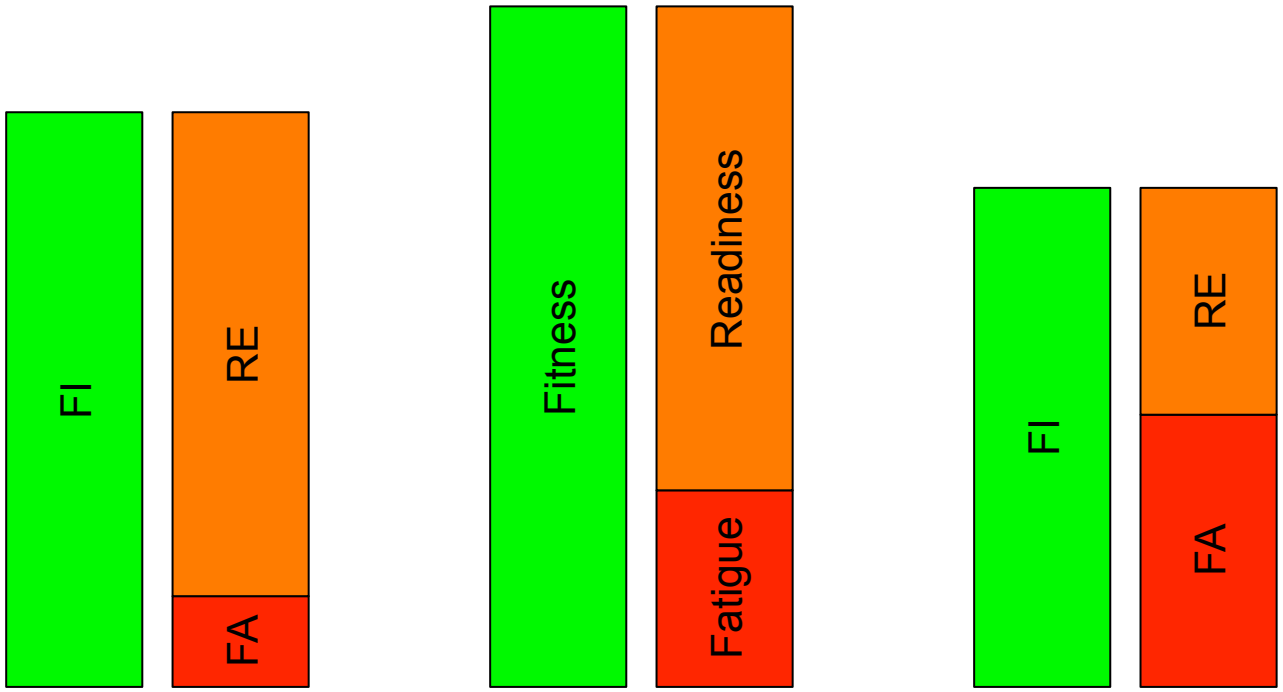
# Readiness





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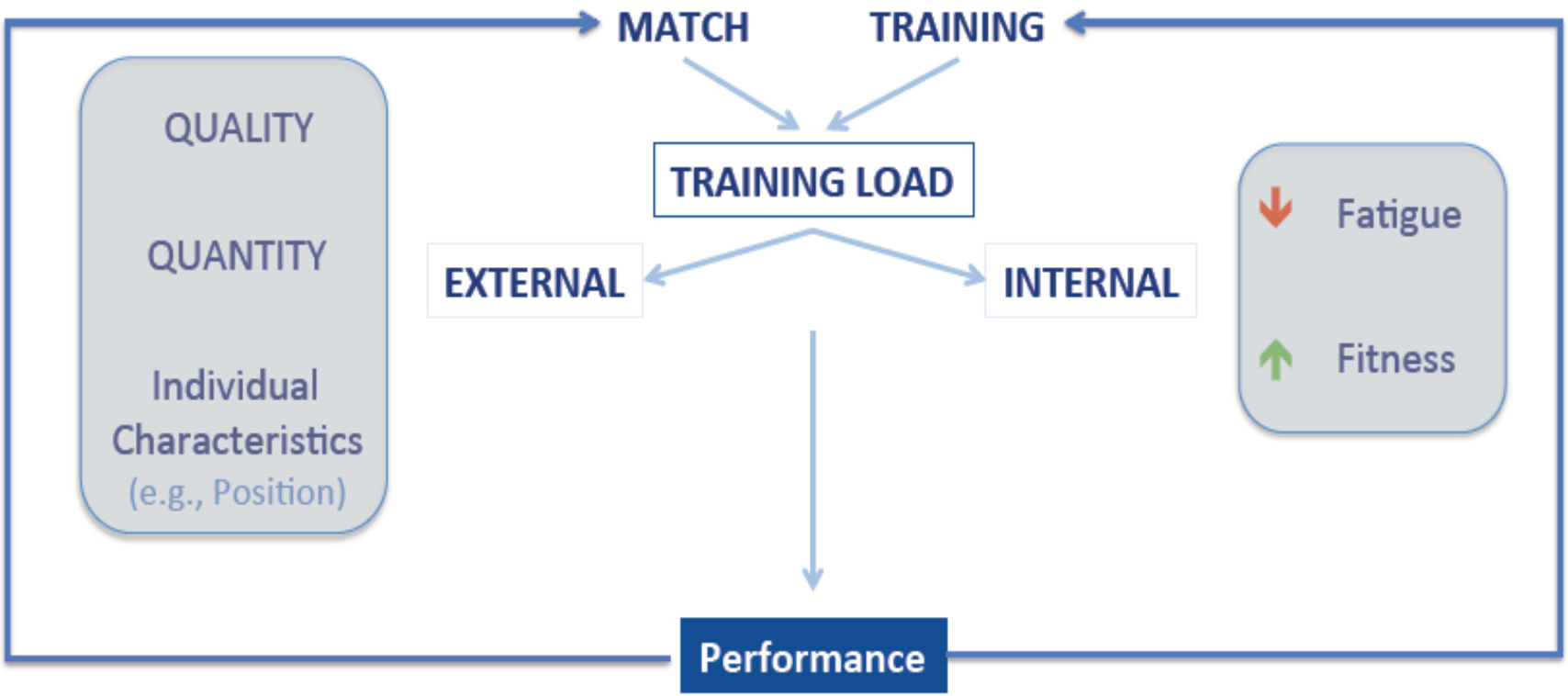
# ACWR – Acute Chronic Workload Ratio





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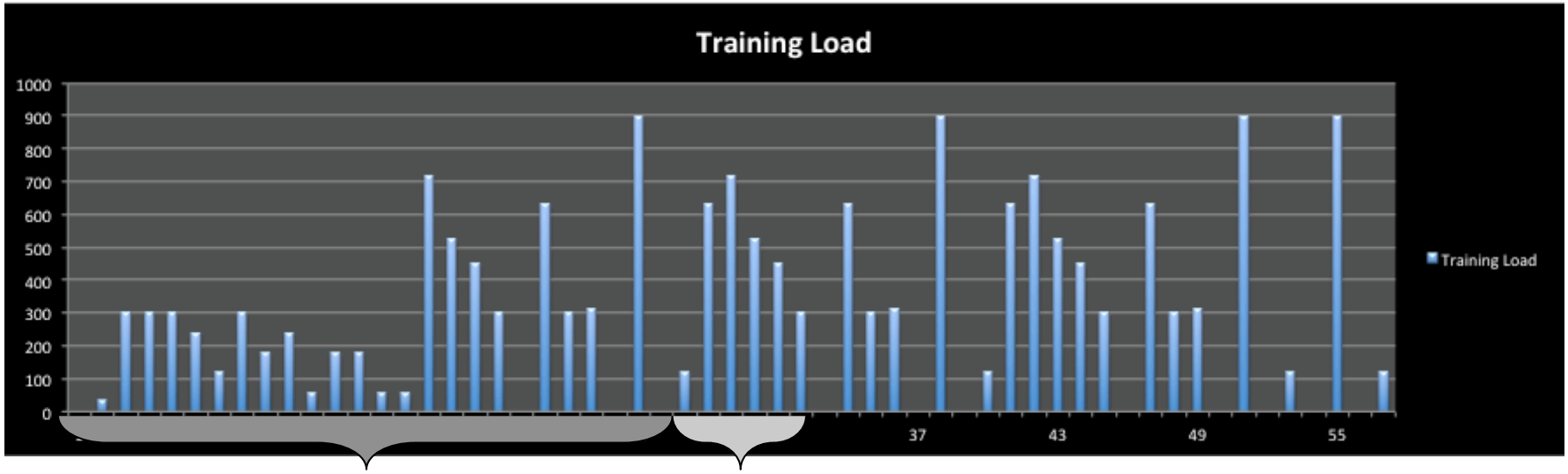
# ACWR – Acute Chronic Workload Ratio




**Chronic Load**
(4-week average)

**Acute Load**
(Last 7-10 days)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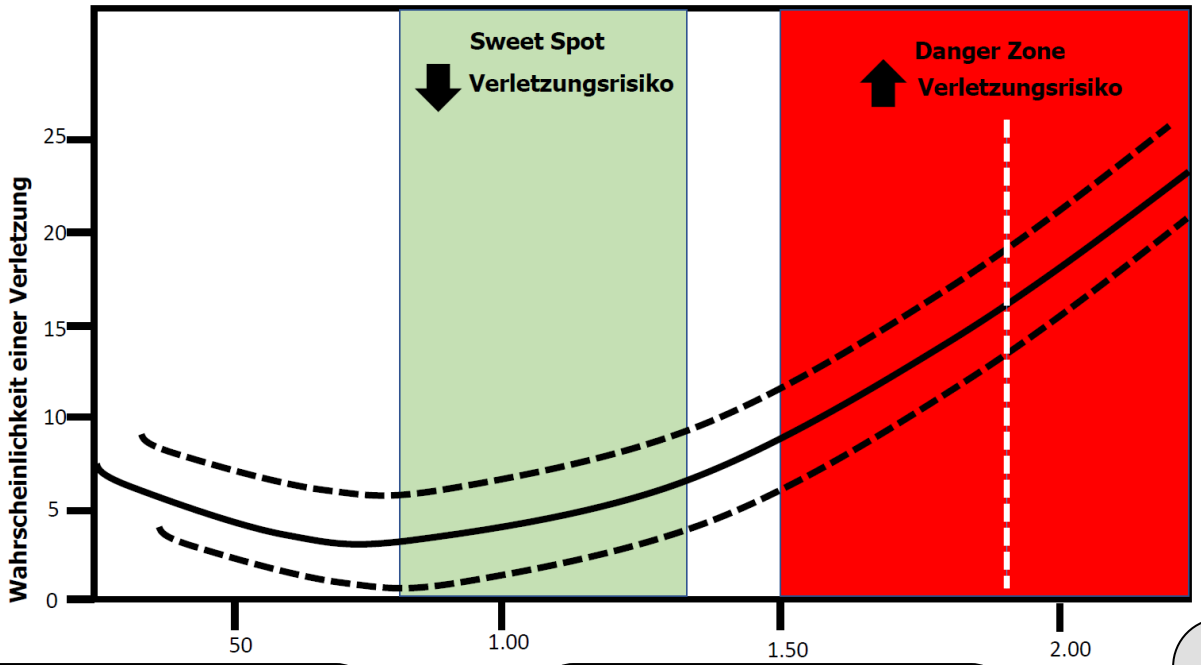
# ACWR – Acute Chronic Workload Ratio




**Week 5:** 2500 / **Av. Week 1-4:** 1300 = **ACWR** 1,9

Redrawn from Blanch and Gabbett, 2015



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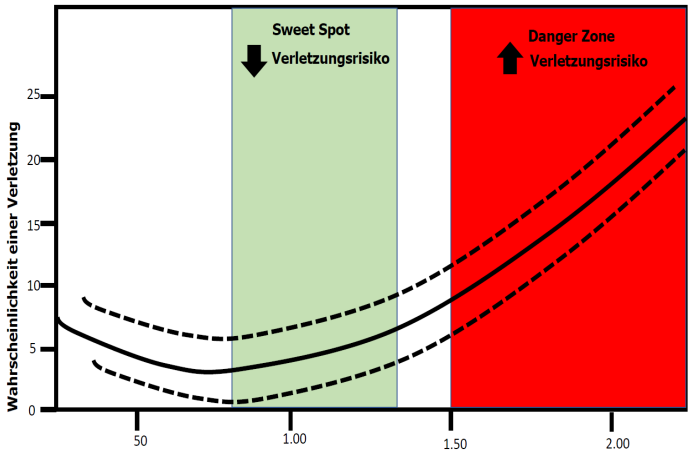
# ACWR – Advantages




- ✓ Simple and easy investigaion
- ✓ Easily included into training processes
- ✓ Light impact on athletes

- ✓ Helpful insights into training-load progression
- ✓ Overview of changes in workload over time
- ✓ Relationships of excessive and rapid increases in training-load and soft-tissue injury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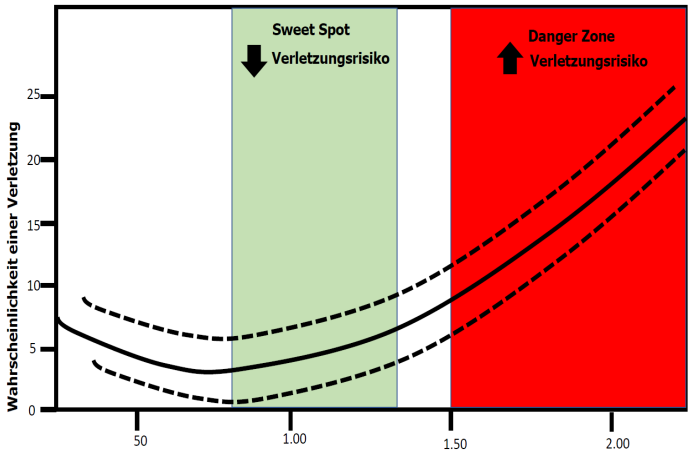
# ACWR – Issues




- ✓ Data needs to be reliable and accurate
- ✓ Data needs to be valid
- ✓ Peer-pressure when reporting RPE
- ✓ Replication of RPE among team mates
- ✓ Overwhelming data collection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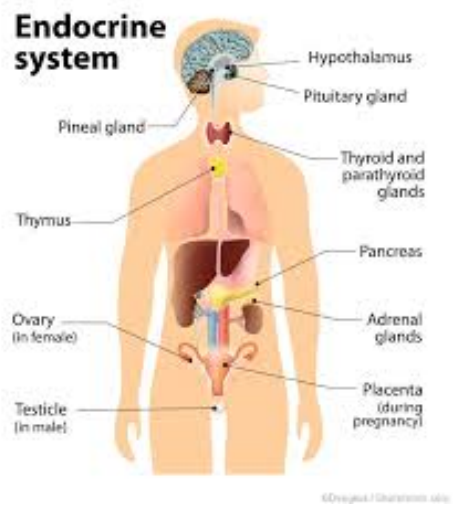
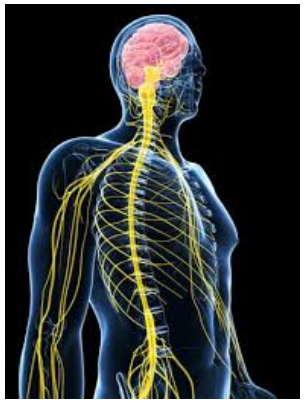
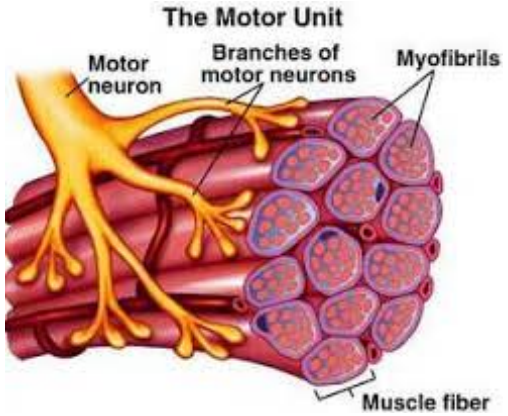
# Measures of Fatigue




Hormon System



Neuromuscular-System




Muscular System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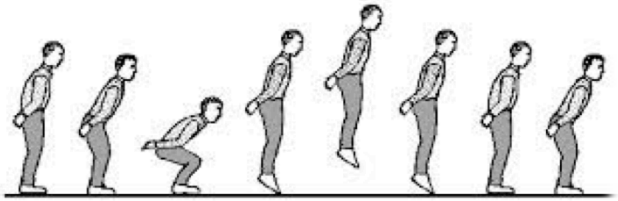
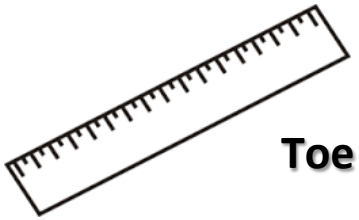
# Monitoring Methods

Handkraft

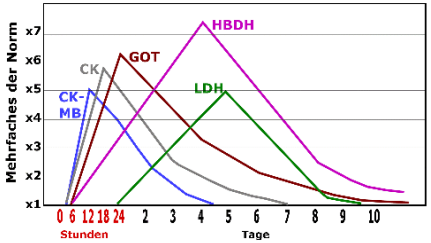


Sprungkrafttest

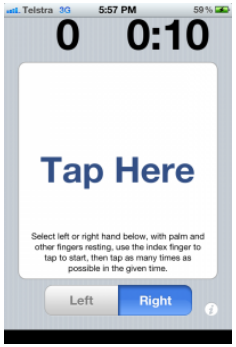


Toe Touch

Herzfrequenz




Creatinkinase



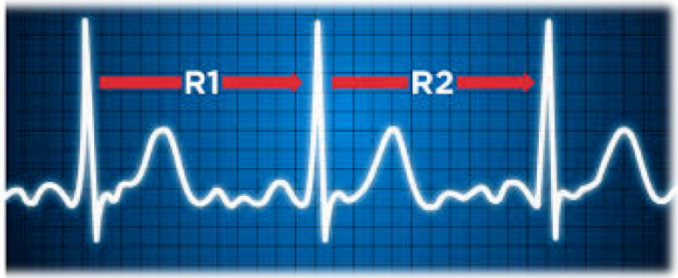

CNS Tap Test

Psychometrie

Serumharnstoff

Groin Sqeeze

Gewicht




Herzfrequenzvariabilität

Sams, 2014, Keferstein, 2015, Crow et al. 2010, Verrall et al., 2005, Mens, et al., 2002, Meyer et al., 2013



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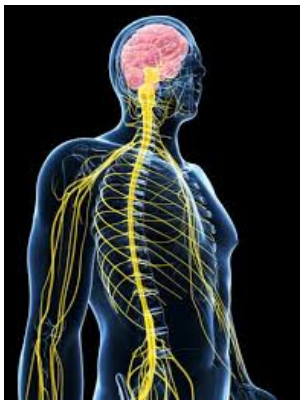

## Neuromuscular System

- ✓ Nervous System – CNS and PNS
- ✓ Muscular System – Skeletal, Cardiac, Smooth

Exhaustion of the neuromuscular system leads to reduction in maximum strength efforts. Deficits can be observed in the CNS, muscle excitation, and muscle contraction quality.



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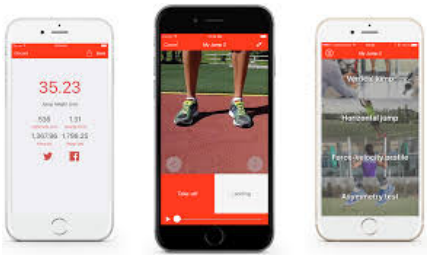
# SSC-Test

✓ Vertical Jump

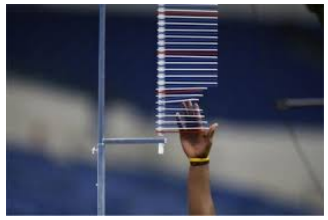
Simple, non-exhaustive and wide spread method to determine an athlete`s CNS freshness and readiness to train.

Force Plate




Smartphone Application


Motion Sensor/ Accelerometer



Vertical Jump Tester



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# SSC-Test

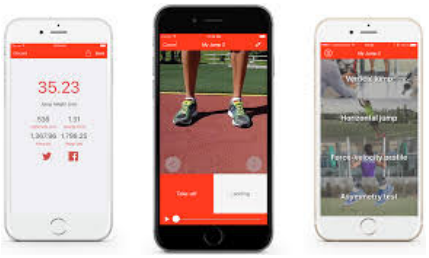
✓ Vertical Jump

Squat Jump (SJ)

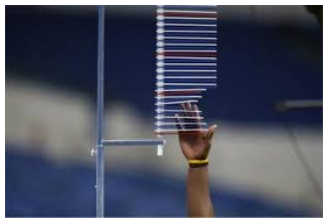
Static Arms Counter Movement Jump (CMJ) = SJ + 10-15%

Free Arms Counter Movement Jump (CMJ) = CMJ + 15-20%


A difference of <>8% within one to two days is concerning.









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# Grip Strength -Test

✓ Grip Strength

Simple, non-exhaustive method. It offers a snapshot of freshness and readiness. It has been proven useful in geriatrics.

Grip Strength Dynamometer



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# Toe Touch-Test

✓ Toe Touch

Simple, non-exhaustive method and an indicator of the freshness of the CNS.

Toe Touch



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# HRV-Test

- ✓ Heart Rate Variability

By now common method used in sports. It measure the natural variability of the heart rhythm.


Application


Heart Rate Sensor


Online Software



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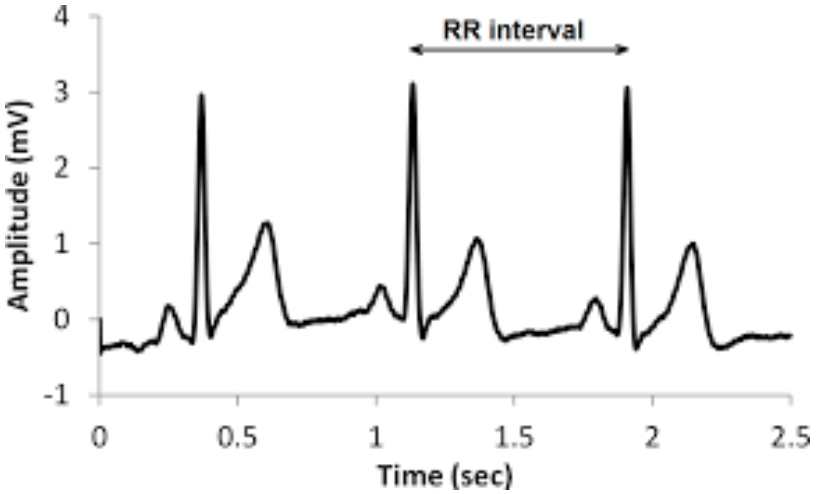
# HRV

- ✓ Heart Rate Variability




Heart Beat Fluctuation Range

The higher the HRV
the higher regulatory processes.

The lower the HRV
the lower the regulatory processes.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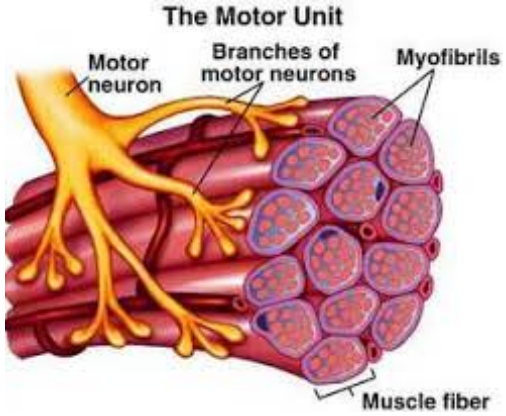


# Muscular System

- ✓ Peripheral Muscular System – Skeletal, Cardiac, Smooth

Exhaustion of the muscular system leads to reduction in mechanically created strength.



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# CK-Test

✓ Creatine Kinase Serum

A blood sample analysis to detect with the CK value as a marker of muscular damage done by mechanical muscular work.


Creatine Kinase


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# Serum Urea Test

✓ Serum Urea

A blood sample analysis of the urea concentration as an indicator of a catabolic metabolism and thus a caloric deficit and a high energy demand.

Serum Urea



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# Psychometry Test

✓ Psychometry

A questionnaire regarding muscle feeling and soreness as a means to detect the freshness of the muscular system.

Wellness Questionnaires



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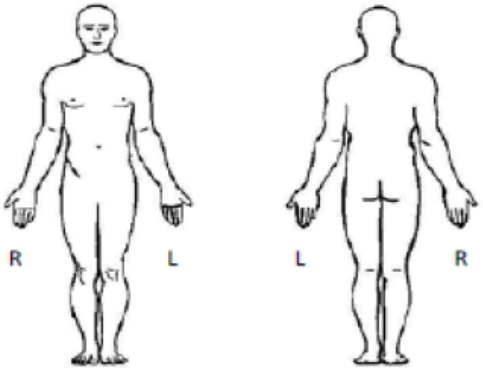
# Psychometry Test

| **Athletik - Handball – Bundesliga**<br>**Regenerationsbogen / Saison 2015 / 2016**<br>**Name:**_____ |  |
|---|---|

| **Monitoring** | **1** (Super) | **2** (gut - good) | **3** (ok) | **4** (nicht gut – not good) | **5** (schlecht – bad) |
|---|---|---|---|---|---|
| **Schlafqualität** (Sleep Quality) | | | | | |
| **Schlafdauer (Std)** (Sleep Duration (H)) | **Mehr als 9 (Std)** | **9 (Std)** | **8 (Std)** | **7 (Std)** | **Unter 7 (Std)** |
| **Energielevel** (Level of Energy) | | | | | |
| **Muskelzustand** (Muscle Condition) | | | | | |
| **Gib an:**<br><br>**O = Muskelkater / Schmerzen (Pain / Aching)**<br><br>**X = Verletzung (Injury)** |  | | | | |

Teilweise übernommen von Konzept by All Out (Bodycheckprotokoll)



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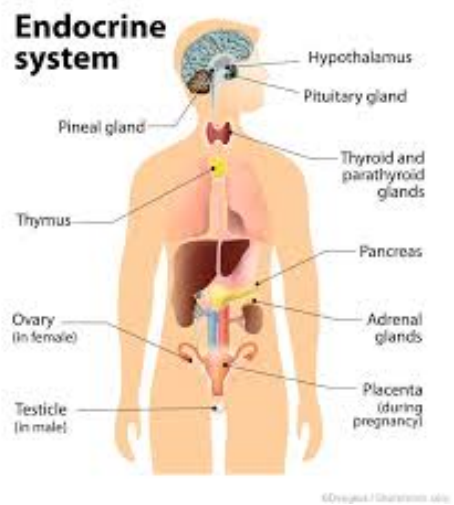
# Hormone System




- ✓ Hormone System Status

The hormone status gives insight to an athlete`s status and can indicate a starting overloading and/or overtraining.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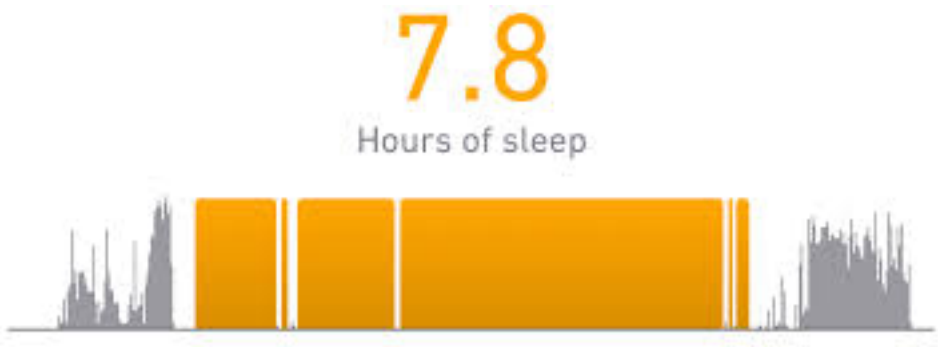
# Sleep

- ✓ Sleep Quality & Quantity

A very important parameter to gather information on the athlete`s hormone status. A good sleep means a good physical and psychological recovery.

Sleep Quality




Sleep Quantity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# Wellness Questionnaire

- ✓ Sleep Quality & Quantity

| | |
|---|---|
| **Athletik - Handball – Bundesliga**<br>**Regenerationsbogen / Saison 2015 / 2016**<br>**Name:**_____ |  |

| **Monitoring** | **1** (Super) | **2** (gut - good) | **3** (ok) | **4** (nicht gut – not good) | **5** (schlecht – bad) |
|---|---|---|---|---|---|
| **Schlafqualität** (Sleep Quality) | | | | | |
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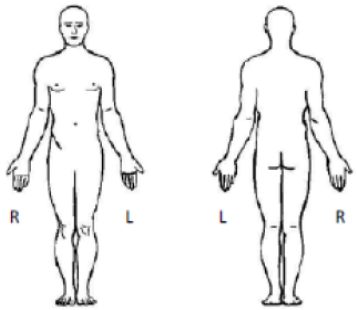
| **Energielevel** (Level of Energy) | | | | | |
| **Muskelzustand** (Muscle Condition) | | | | | |
| **Gib an:**<br><br>**O = Muskelkater / Schmerzen (Pain / Aching)**<br><br>**X = Verletzung (Injury)** |  | | | | |

Teilweise übernommen von Konzept by All Out (Bodycheckprotokoll)

Redrawn from Ribekke, T.



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# Blood & Saliva

✓ Blood & Saliva Sample

A test method to determine the cortisol, testosterone and catecholamine status and thus can give an insight into the stress response.

Blood

Saliva



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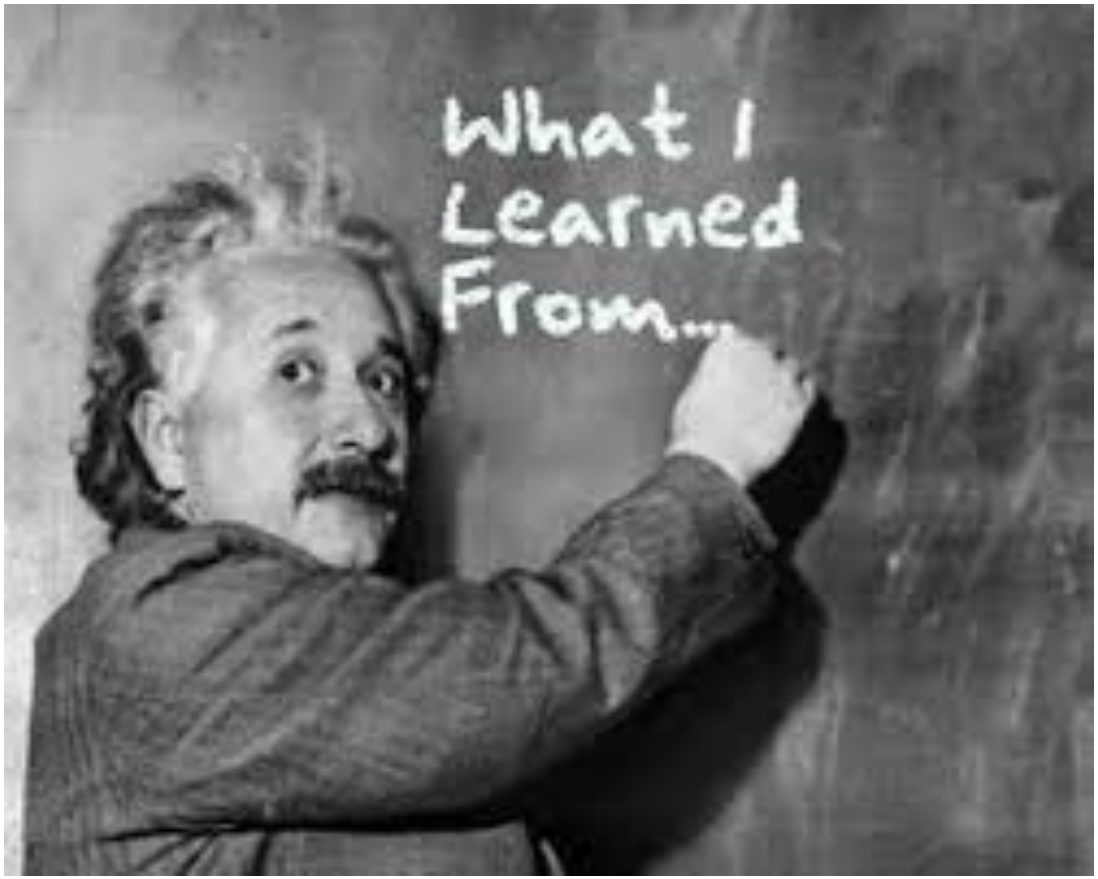
# Gängige Methoden des Monitoring

| Monitoring variable | Level of use | Level of evidence | Practical value |
|---|---|---|---|
| GPS und Accelometrie | High | Moderate | Moderate to High |
| RPE | High | High | High |
| Abfrage Wellness | High | High | High |
| Biochemische und hormoneller Marker | Low | Moderate | Low |
| Herzfrequenzmessung | High | Moderate to High | Moderate to High |
| Leistungstest | Moderate | Moderate | Moderate |
| Movement Screen | High | Low | Moderate |
| Neuromuskuläre Tests (z. B. Sprünge) | Moderate | Moderate | Moderate |

Akenhead, Nassis, 2016, McCall et al., 2014, Saw et al., 2016 Taylor et al., 2012





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- ☑ Account for the importance of individualized monitoring
- ☑ Consider the purposes of monitoring (Injury, Illness, TL, Regeneration)
- ☑ Consider individual adaptation and stress response
- ☑ Quantifying Training Stress (External Load vs Internal Load)
- ☑ Measures of Fatigue and Fitness (Neuromuscular, Muscular, Hormonal)


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