

AI utilization in analysis of nutritional biomarkers



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Disclosures

Red Bull High Performance  
Amplio  
Corto  
MWI

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AI in daily use

Google searches/suggestions  
Google maps  
Amazon recommendations  
FedEx/UPS shipping routes  
Commercial air travel  
LinkedIn connections  
Spotify suggestions  
Facebook ads  
Uber/Lyft

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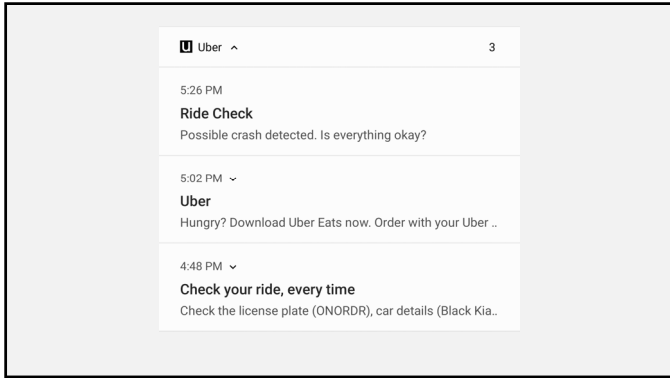
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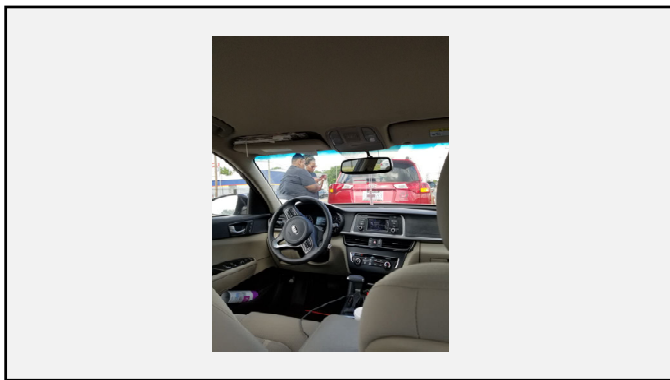
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**Ideal AI nutrition optimization platform**

- Platform should provide a **personalized** neural networked simulation linking:
  - Medical status
  - Nutritional status
  - Strength/Power
  - Coordination
  - Aerobic Conditioning
  - Cognitive Function
  - Rest & Recovery
- Simulation enables trainers and Operators to instantly *measure, monitor, plan,* and *predict* performance in an easy to understand format
- Continuously integrate industry standard and/or custom sensors
- Enable 24/7 assessment of individual Operators

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### AI platform should generate an Integrated, Holistic, Adaptive, Human Performance Simulation

- Optimized AI platform understands specific causes and effects that impact the Operator
- It can understand at a personalized level cause and effect across performance domains, e.g. the impact of nutrition on endurance
- It continuously adapts its suggested interventions based on evaluating actual performance results in real time

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### Ideal approach to utilizing AI

	Current AI	Gen 2 AI
Statistical Method	Correlation	Causation
Prediction Type	Trend analysis – All factors held constant because you don't know which ones are important	Focus of causal latent features allow for analysis of possible alternative outcomes
Prescription Type	Do more of the same	Choose actions that produce desired outcomes
Training Data Type	Exhaustive Complete Data set	Incomplete or missing data okay
Learning Type	Pattern matching to training data	Outcomes-based experiential learning
Model flexibility	Static and often brittle (due to bias or incomplete training data)	Adaptive, model continuously learns using Bayesian Belief Propagation

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### Creating a causal model

- The model consists of:
  - $N$  observations defined by a latent feature vector of dimension  $D$ ,  $(X_{N \times D})$
  - $(X_{N \times D})$  is a product of two matrices of  $K$  latent variables
    - $K$  represents different factors that affect performance some known and unknown
- The goal is to find a low-dimensional latent hierarchical space capturing the variations making up the model.
  - Using probabilistic matrix factorization,  $X_{N \times D} = Z_{N \times K} \times A_{K \times D}$ .
    - $Z$  represents the similarity between emerging event observations
    - $K$  distinct entity classes
    - $A$  characterizes the sharing of similar features over the  $K$  discovered entities.
- As explained in Griffiths and Ghahramani (2011),  $X_{N \times D}$  can be viewed as the product of a probabilities process.
  - $X_{N \times D}$  is conditionally dependent on  $Z$  and  $A$ ,  $P(X|Z, A)$ .
  - Now we need to find the value of  $K$  which can be inferred during the learning process
- $K$  are the latent priors which are causal to predicting the outcome based on a given probability.

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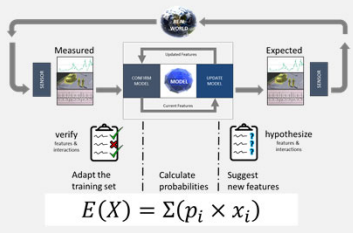
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## Power of Causal Modeling

- Priors can predict outcomes
  - Optimization functions can help to identify most likely outcomes
- Manipulating priors can create alternative outcomes
  - Allowing you to simulate the possible effects of those priors
- Adapt and update the priors based on experiential evidence
- Algorithms become self sustaining



$$E(X) = \sum(p_i \times x_i)$$

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## Model Nutritional Intake

Measure	Unit	Target	Actual	% of Target	Days
Polyunsaturated Omega 3					
1. Polyunsaturated (g/day)	g	10-15	12.5	125%	10
2. Polyunsaturated (g/day)	g	10-15	12.5	125%	10
3. Polyunsaturated (g/day)	g	10-15	12.5	125%	10
4. Polyunsaturated (g/day)	g	10-15	12.5	125%	10

- Problem:
  - Food logs are inaccurate and constant blood work is inconvenient, expensive, and invasive
- Baselineing the athlete:
  - Initial biomarker test to determine micronutrient levels
  - Initial survey to create personality profile
- Periodic updates on simple markers:
  - Saliva tests for subset of biomarkers (e.g. Testosterone, C-Reactive Protein, Cortisol, SHBG)
  - Gamified survey questions focused on the effects of nutrition (mood, energy level, body composition changes) and not specific dietary questions
- Interventional tests:
  - Tied to performance during conditioning
    - Did you hit a wall and why
    - Both physical and psychometric

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## Why include psychometric data?

- Ensure quality of self-reported data
- Behaviors need to be tied to actual diet
  - Diet affects how you feel
    - Energy levels
    - Sleep patterns
    - Mood
  - Many effective ways to measure mood (PANAS for example)
  - Effective AI programming can tie mood to biomarkers to infer actual diet based on patterns of behavior
- Ensure cognitive engagement in surveys by gamifying questions
- For example, moving questions on the screen and scoring how many questions they can stop and answer
- Measuring response time for each question is a good way to monitor engagement and honesty

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Psychometric testing

**Onboarding**

- HEXACO Personality (psyML 24 items)
- Profile of mood states (PANAS)
- Attention (Digit Span Forward)
- Memory (California Verbal Learning adaptation)
- Executive Functioning (Tower of Hanoi adaptation)
- IQ estimate (Raven's Progressive Matrices adaptation)

**Intermittent**

- Emotional Light Bar (8 colors)
- Reaction Time (press button when you see any dot)
- Simple Decision Making (press button when you see the red dot)
- Complex Decision Making (press button if red dot after blue)
- Working Memory (n-back test)

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**Greatest positive relationship with testosterone**  
(nutritional values reflect >10 hour fast)

1. Any type of victory
2. Leucine >130 µmol/L
3. Isoleucine >65 µmol/L
4. Methionine >20 µmol/L
5. Valine >220 µmol/L
6. LDL Cholesterol above 95 mg/dL
7. Correcting heavy metal toxicities
8. Alpha-tocopherol 6-11 mg/L
9. Cessation of a Ketogenic program
10. C Reactive Protein <.2mg/L

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**Greatest negative relationship with testosterone (nutritional)**

1. Elevated Vanilmandelate + Elevated Cortisol
2. Elevated Cd + Zn deficiency
3. AA/EPA ratio >45:1 + low DPA
4. Elevated Carboxymethyllysine (AGEs)
5. Cu/Zn ratio >1.5/1
6. HDL Cholesterol >70 for men or >90 for women
7. Elevated urinary 2-Methylhippurate + low Glycine + pyroglutamate outside 32-80 mcg/mg creatinine
8. ≥4 foods with IgG4 antibodies >2,000ng/ml
9. Elevated Cortisol-to-DHEA ratio
10. Low DHA/Omega 6 ratio (spatial tasks affected)

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Greatest negative correlation with testosterone

# 1. Ownership of a Tesla

Relevant literature

- 1) Effects of electromagnetic field exposure on plasma hormonal and inflammatory pathway biomarkers in male workers of a power plant.
- 2) *Int Arch Occup Environ Health*. Wang Z, et al, Jan 2016. Vol 89(1): 33-42
- 3) Low frequency electromagnetic fields long-term exposure effects on the testicular histology, sperm quality, and testosterone levels of male rats.
- 4) *Asian Pacific J of Reproduction*. Bahaadini A, Jafari SM, Sept 2015. Vol 4(3): 195-200.
- 5) Effect of electromagnetic field exposure on the reproductive system.
- 6) *Clin Exp Reprod Med*. Gye MC, Park CJ, Mar 2012. Vol 39(1): 1-9.
- 7) Effects of extremely low frequency electromagnetic fields on testes in guinea pig.
- 8) *J Biol Sci*. Farkhad SA, Zare S, Hayatgeibi H, Qadiri A, Dec 2007. Vol 10(24): 4519-4522
- 9) Influence of 50 Hz magnetic field on sex hormones and other fertility parameters of adult male rats. *Bioelectromagnetics*. Al-Akhras MA, Darmani H, Elbetieha A, Feb, 2006. Vol 27(2): 127-131

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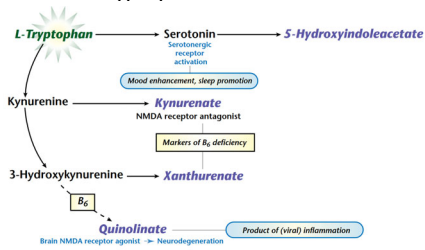
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## Tryptophan Metabolism




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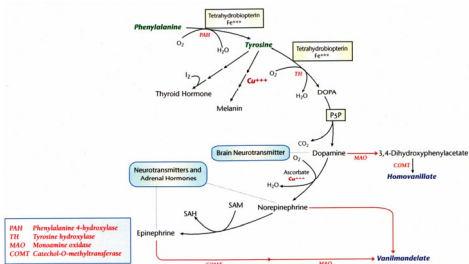
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## Catecholamine production




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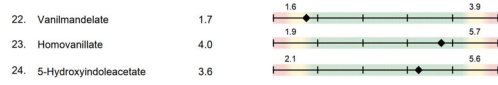
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### Tibetan Monk




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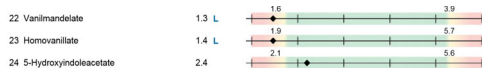
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### Tier 1 Operator




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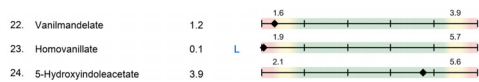
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### Elite eSports athlete




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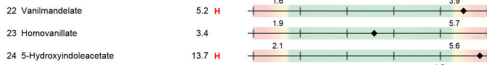
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### Elite Skydiver – 12 hours pre-event



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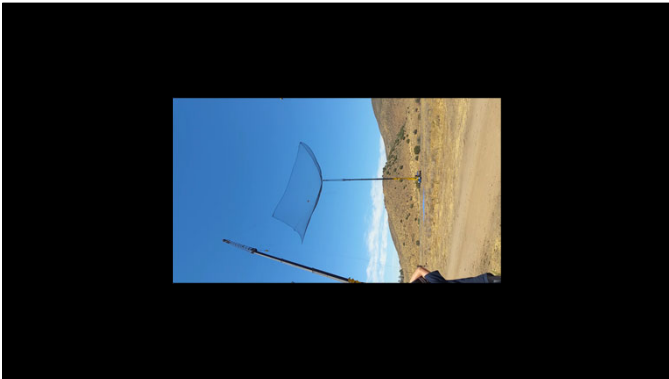
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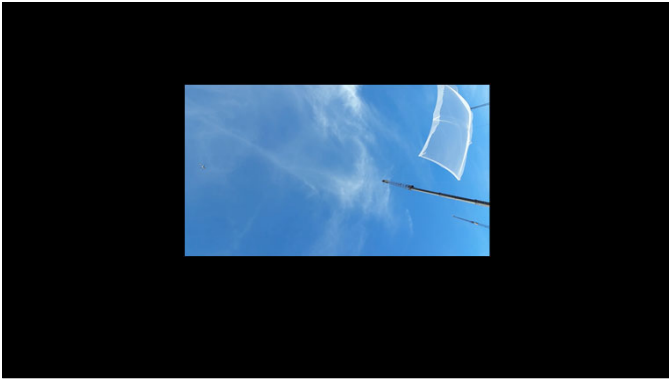
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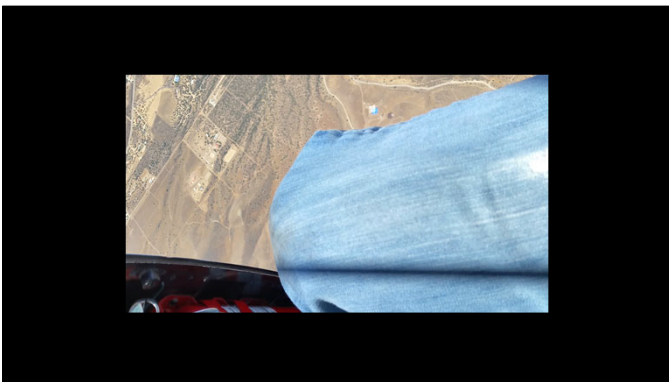
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### “Digital Luke” AI Simulation 14 days Post Event

Vanilmandelate	(null)
Homovanillate	(null)
5-Hydroxyindoleacetate	5.3 ng/dl

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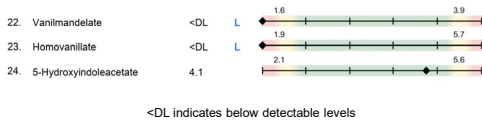
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### Luke’s test results – 14 days Post Event



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Micronutrients of most interest in cognitive pathways

- P5P (active form of B6)
- Tyrosine
- NAC
- Omega 3s, especially DPA and DHA
- Lignoceric Acid
- Taurine
- Vitamin C
- CoQ10
- Magnesium
- Vitamin D

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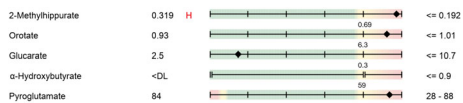
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**Solvent exposure – Previously elite gamer**



**Common sources of xylene exposure**

- Cigarette and marijuana smoke
- Gun cleaning solvents
- Household solvents
- Disc Brake cleaner, degreasers
- Dry Erase Markers, Sharpies
- New car, new paint, new carpet, memory foam
- New neoprene rubber materials
- Some air fresheners/fabric sprays
- Pesticides (i.e. Raid ant spray)
- Concrete and hardwood floor sealant

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Christopher Talley  
 Founder/CEO  
 Precision Food Works

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