
FUTURE OF PERSONAL PERFORMANCE



Introducing the Future of Personal Performance

VSP Global Innovation Center and CB Insights present the Futurist Report series to highlight the technologies, partnerships, and startups shaping our future.

In this second installment, we are taking an inside look into cutting-edge technologies and startups shaping the **Future of Personal Performance**.

Why Performance? Proactive and preventive health has been an ongoing area of innovation and research for some time. Only in the last decade has the idea of self-optimization and biohacking reached mainstream consumers and patients.

Applications once only accessible to elite athletes, are now available to everyday consumers. Falling costs of premium health technologies and startup investments from major brands are leading to a growth in self-optimization tools to a broader segment. Concurrently, the efficiency and accuracy of biohacking and data-based tracking continue to garner attention across the tech and healthcare industries.

We examined several dimensions of personal performance: physical, cognitive, occupational, emotional, and social. The resulting **five transformative trends** showcase how personal performance is evolving and that **vision** is a common thread throughout. VSP intends to help foster innovation that leads to improved health and performance.

We are pleased to share our point of view on the **Future of Personal Performance**.

5 transformative trends of personal performance



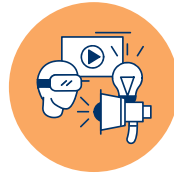
1 Consumers turn the dial on their quantified selves



2 The eye becomes a tool for more than 20/20 vision



3 Bio-boosting nutrition gets personal



4 Full-sensory immersion enables performance



5 Bionic technology powers superhuman capabilities

Dimensions of personal performance



PHYSICAL

Consumers seek to optimize their physical performance by adopting a variety of health behaviors — like exercising, making healthy nutritional choices, and abstaining from unhealthy habits — to reduce the risk of chronic disease and prevent injury.



COGNITIVE

Consumers seek to optimize their cognitive capabilities — like working memory, attention, concentration, processing speed, and decision-making — to improve quality of life, prevent age-related cognitive decline, and recover from injuries and pathologies.



EMOTIONAL

Consumers seek to optimize emotional performance to improve their ability to recognize, accept, manage, and control their thoughts and feelings in the face of stress, challenge, and change. In doing so, they hope to live more balanced, relaxed, resilient, and purposeful lives.



OCCUPATIONAL

Consumers seek to optimize their occupational performance to achieve a healthy work-life balance, make use of their skills and talents, improve productivity, fulfill professional goals, avoid workplace stress, and generally feel good about what they do for a living.



SOCIAL

Consumers seek to optimize their social performance to improve the quantity and quality of their interpersonal relationships (e.g., friendships, intimate relationships, familial relationships, and professional relationships) and make meaningful contributions to their communities.

Outline of transformative trends addressed

1. Consumers turn the dial on their quantified selves	2. The eye becomes a tool for more than 20/20 vision	3. Bio-boosting nutrition gets personal	4. Full-sensory immersion enables performance	5. Bionic technology powers superhuman capabilities
<ul style="list-style-type: none"> • Emerging technologies expand the breadth and depth of personal performance data. • Personalized coaching and biofeedback apps turn raw data into actionable insights. • Artificial intelligence (AI) pushes trainees in just the right way at just the right time. • Communal participation introduces accountability and competition to performance training. 	<ul style="list-style-type: none"> • The eye-brain connection is being leveraged to enable less invasive, earlier detection of brain afflictions. • AI-powered eye tracking allows people with disabilities to live more independently and affords productivity, ergonomic, and interpersonal benefits in the workplace. • Stroboscopic lenses are helping users improve their sensorimotor skills and improve performance. 	<ul style="list-style-type: none"> • The pandemic has driven increased demand for immunity-boosting nutrition products. • Stress-relieving and energy-boosting adaptogens are gaining traction. • Nutrition personalization is moving from consumer wants to biological needs. • The nootropics market is expected to grow 500% by 2024. 	<ul style="list-style-type: none"> • Immersive virtual reality (VR) is being used across multiple performance disciplines. • Light is being leveraged as a powerful stimulus. • Haptic feedback wearables boost mood and cognition. • Performance enhancements can be gained by selectively filtering out sensory stimuli. 	<ul style="list-style-type: none"> • New classes of wearables assist in overcoming the human body's sensorimotor limitations. • Wearable exoskeletons afford bionic physicality to users and productivity gains to manufacturers. • Early examples of brain-computer interfaces (BCIs) are emerging.

TRANSFORMATIVE TREND #1

Consumers turn the dial on their quantified selves



How are consumers turning the dial on their quantified selves?

“Quantified self” tools have become increasingly accessible, affordable, and easier to use over the last several years. Wearables, smart home equipment, at-home lab tests, and 3D scanners, for example, are all being incorporated into consumers’ daily lives to help them quantify their performance. Mass adoption of these technologies has subsequently led to an explosion in the breadth and depth of personal performance data.

Quantitative data is no longer enough. Consumer expectations are changing about how their quantified self data should be used and presented. They’re gravitating toward solutions that not only collect data but also interpret it for them, providing actionable insights about their strengths, weaknesses, and plans for improvement.

Continuous data collection and near-instantaneous, AI-powered data analysis are critical enablers of this experience. These features allow users, their coaches, and even their devices to make precise and optimally timed adjustments to users’ performance training regimens to enhance impact and improve outcomes. This iterative process is defining the new age of the quantified self movement.



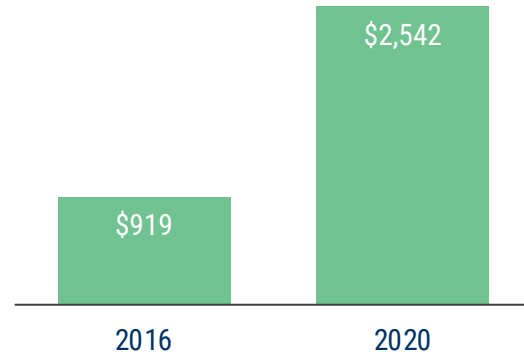
Health tracking technologies are finally approaching the mass-adoption sweet spot of accuracy, accessibility and cost, taking them from the preserve of self-tracking enthusiasts to a natural addition to consumers’ self-care routine.

Daniel Maggs
Co-founder & CEO, [Bisu](#)

Where is the momentum now?

Performance optimization isn't achievable without data. Consumers are increasingly adopting self-tracking practices to make concerted behavior changes that can improve their performance.

Annual funding to quantitative performance companies (\$M)¹



Consumer adoption of performance self-tracking tools (2013 vs. 2020)²

	2013	2020
Measure fitness and health improvement goals (e.g., exercise, diet, weight, sleep)	17%	42%
Monitor health issues (e.g., blood sugar, blood pressure, breathing, mood)	15%	28%

77%

of consumers say their use of performance tracking tools changed their behavior significantly.²



Personal performance is increasingly quantifiable

Companies that are expanding the breadth and depth of how performance data is collected.

PHYSICAL

WHOOP™

Wearable fitness tracker

orreco

Bioanalytical blood tests

RightEye

Eye tracking

ActivTrak

Cloud software

mindstrong

Digital phenotyping

TONAL

Digital weights

TEMPO

3D body scanning

dreem

Sleep tracking headband

SMART
CAP

Fatigue-sensing headband

binah.ai

Video-based facial tracking

movano

Glucose monitoring
smartwatch

AKILI

Video game

amazon

Wearable productivity
tracker*

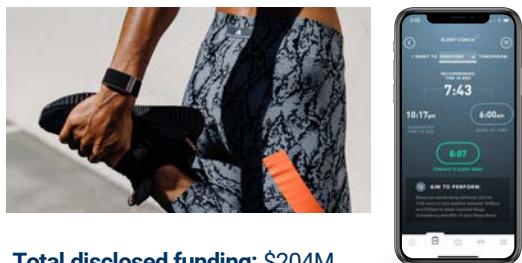
MINDLABS

Stress-sensing headband

Performance data is actionable

Actionable data insights prompt physical, behavioral, cognitive, and emotional modifications.

WHOOP™



Total disclosed funding: \$204M

Latest round: Series E, October 2020

- Using wearable-collected performance data, **WHOOP's** "Sleep Coach" suggests optimal bed and wake times to improve recovery.
- The "Strain Coach" instructs users how long and hard to work out to meet their specific performance goals.

orreco

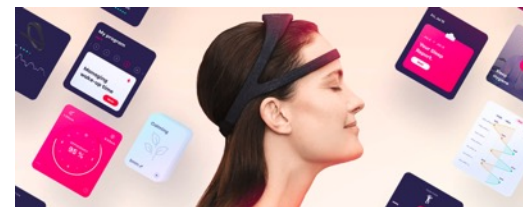


Total disclosed funding: \$7.3M

Latest round: Series B, January 2021

- **Orreco's** blood tests provide immediate insight on athletes' physical state and response to training load.
- Using this data, the platform delivers personalized training, nutrition, and recovery recommendations to help athletes stay in their peak performance zones.

dreem



Total disclosed funding: \$58M

Latest round: Series A, June 2018

- **Dreem** is focused on improving users' quality and quantity of sleep.
- The company's solution combines a clinically accurate sleep-tracking headband with personalized, actionable behavior change recommendations and biofeedback-driven relaxation techniques.

Performance training is responsive

Digital interfaces use individuals' performance metrics to adaptively adjust training regimens with AI.

TONAL



Tonal's digital weight system gets smarter as users get stronger.

- Through a full-body baseline assessment, Tonal learns how much weight a user can lift and then sets weights for each move and workout.
- Making thousands of calculations per second, Tonal automatically increases weights as users need it.

AKILI



Akili Interactive's EndeavorRx is an FDA-approved attention training video game for children with ADHD.

- The game actively monitors users' second-by-second progress.
- Its adaptive AI algorithms automatically adjust the 'dose' to individuals' needs over time.

PositScience®



PositScience's brainHQ is a scientifically validated brain training platform.

- Its online exercises target specific cognitive functions like attention, processing speed, memory, communication, navigation, and reasoning.
- Using AI, the exercises adapt in difficulty as users progress, so they're continually training at a level where they're most likely to see results.

Quantified communities keep users motivated

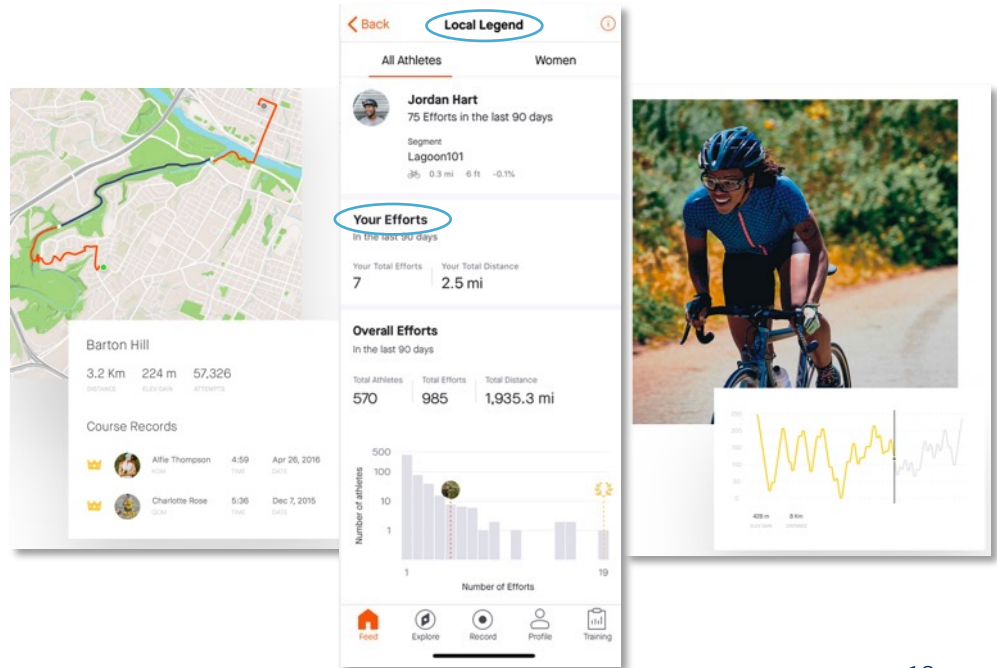
Communal participation introduces accountability and competition to performance training.

STRAVA

Total disclosed funding: \$180M

Latest round: Series F, November 2020

- **Strava** is a social fitness mobile app for runners and cyclists.
- The app syncs with users' phones, GPS watches, and other fitness gear to record performance metrics related to their activities.
- Through the Strava feed, users share their activity and performance data, view community rankings, and interact with others.
- The app's Segments and Local Legends features motivate users by benchmarking their performance to others'.



TRANSFORMATIVE TREND #2

The eye becomes a tool for more than 20/20 vision



How can the eye be used for more than 20/20 vision?

The eye's intimate connection with the brain – and the brain's connection to the rest of the sensorimotor system – means the human eye is capable of a lot more than just vision.

- *It acts as an early warning system* for the rest of the body, helping detect potential health or performance issues when they're easier to remedy.
- *It serves as an extension of the brain*, enabling people to communicate through gaze alone.
- *Its connections with the brain and the body can be "strength trained"* through the manipulation of visual stimuli.

In recent years, medical practitioners, patients, consumers, athletes, and enterprises have grown to appreciate technologies that take advantage of these capabilities.

AI and computer vision are at the forefront of this movement, enabling everything from real-time eye-tracking to high-resolution retinal imaging.



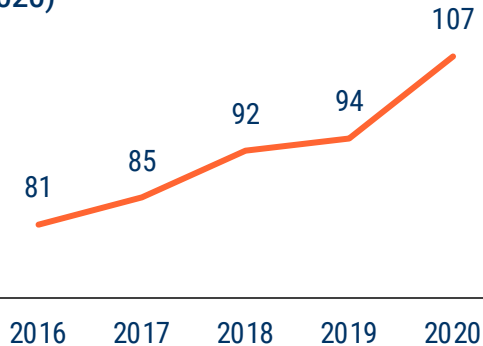
When you combine AI with the technologies that are being developed to gather health information it becomes an easy way for the eye to be the gateway, or entry-point, to the health of the body. Further, many patients are very receptive of newer technologies and want to play an active role in their health, while ODs are communicating and collaborating more with primary care providers. All this leads to improved eye and overall health.

Richard Soden, OD
Director, Health Care Development
Clinical Professor
State University of New York
College of Optometry

Where is the momentum now?

Eye-as-a-tool is an active area of scientific research and tech development, as evidenced by patent filing and research publication growth. Startup funding, on the other hand, is still in early stages.

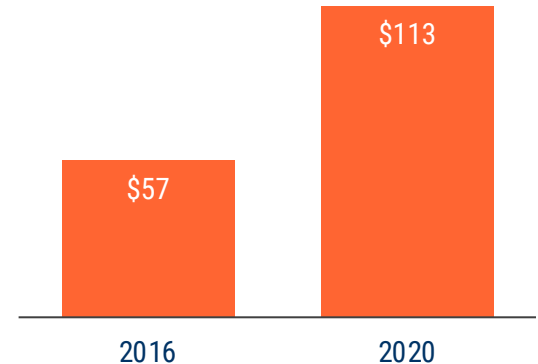
Number of scientific research articles published on eye-as-a-tool technologies (thousands, 2016 – 2020)¹



Number of patents filed regarding eye-as-a-tool technologies, by decade²

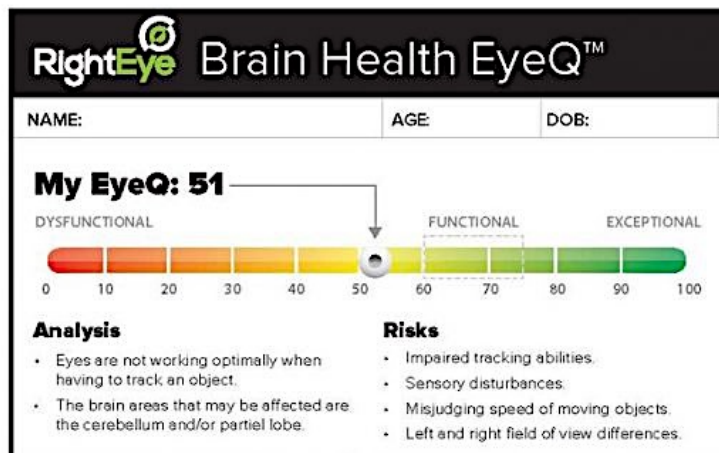


Annual funding to companies in the space (\$M)²



Assessing brain health through the eye

The eye-brain connection can be leveraged to enable less invasive, earlier detection of brain afflictions.



BRAIN INJURIES



Biomarker: Eye movements
Condition: Concussion



Biomarker: Eye movements
Condition: Concussion



Biomarker: Blink reflex
Condition: Concussion

NEURODEGENERATIVE CONDITIONS



Biomarker: Eye movements
Condition: Parkinson's

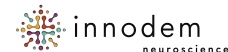


Biomarker: Retinal chemistry
Condition: Alzheimer's



Biomarker: Lens chemistry
Condition: Alzheimer's

AUTOIMMUNE DISEASES



Biomarker: Eye movements
Condition: Multiple sclerosis

NEUROPSYCHIATRIC ILLNESSES

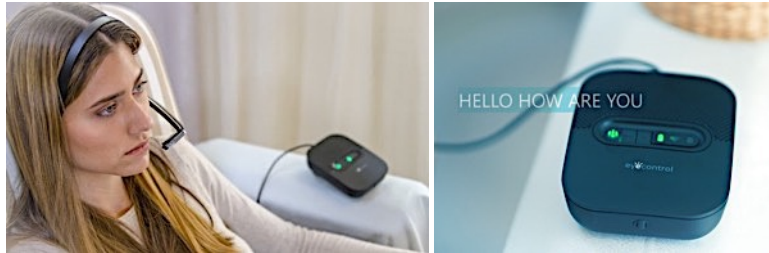


Biomarker: Eye movements
Conditions: Schizophrenia, bipolar disorder, depression

Using the eye as a communication tool

AI-powered eye tracking allows people with disabilities to live more independently.

eyecontrol

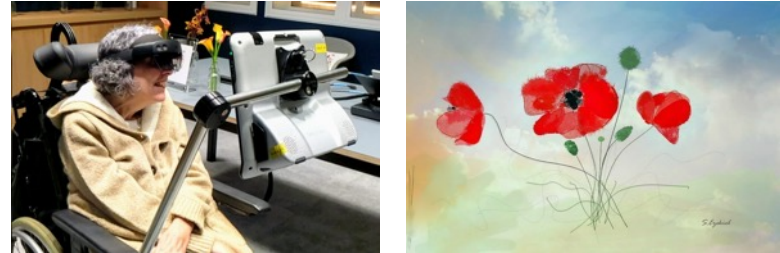


Total disclosed funding: \$11M

Latest round: Series A, August 2020

- **EyeControl** offers a wearable and screenless assistive communication device.
- AI-powered eye-tracking technology enables ventilated patients and individuals who cannot speak to communicate using only eye movements.

tobii



Market capitalization: \$6.9B

Annual revenue: \$1.4B (2020)

- Through its Dynavox business, **Tobii** develops eye-tracking tools, communication apps, and speech-generating devices to help individuals with disabilities and special needs communicate.
- UK-based painter Sarah Ezekiel (above), who lives with ALS, uses Dynavox technology to perform her craft with her eyes.

Enhancing occupational performance

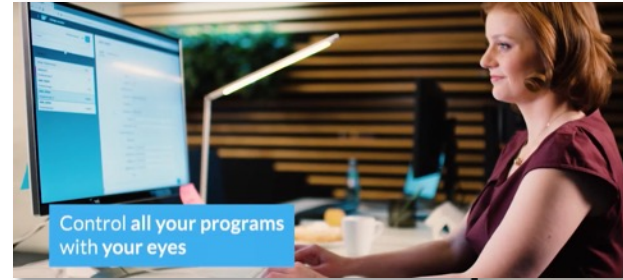
AI-powered eye tracking affords productivity, ergonomic, and interpersonal benefits in the workplace.

4tītoō

Total disclosed funding: \$3.6M

Latest round: Unattributed, October 2020

- **4tītoō** develops human-machine interaction software incorporating gaze/eye tracking, gesture, and voice recognition.
- **NUIA Productivity+** reduces daily mouse usage through eye control and AI. This leads to efficiency gains and improvements in ergonomics and user experience.
- **NUIA Full Focus** is a smart, gaze-driven solution that intuitively helps users maintain eye contact in video conference meetings to build trust and professional credibility.



Using the eye to gain a competitive edge

Stroboscopic lenses help users train more than just their vision.



Total disclosed funding: \$5.3M

Latest round: Unattributed - III, September 2019

- **Senaptec** develops proprietary software and hardware systems that can assess, analyze, and improve users' sensorimotor skills.
- The company's **Strobe eyewear**, for example, manipulates visual stimuli to strengthen connections between the eye and other sensory systems.
- By alternating between clear and blocked vision, Strobe forces the brain to fill in the gaps and anticipate movement. This sharpens and streamlines vision, in turn improving eye-hand coordination, movement, balance, and reaction time.



Senaptec Strobe



Senaptec Quad Strobe



Steph Curry, 6-time NBA All-Star



“In using the technology, it can make you aware of these skills that will allow you to go be a better hitter, or pass-catcher, or thrower. These younger kids now have a better shot at being good at whatever they want to be.”

Jarvis Landry, 5-time NFL Pro-Bowler

TRANSFORMATIVE TREND #3

Bio-boosting nutrition gets personal



What is bio-boosting nutrition?

Bio-boosting nutrition refers to functional foods, beverages, and ingredients – as well as biologically-personalized supplements and meal plans – that offer health benefits *beyond just nutritional value*. Increasingly, consumers are turning to these products and services as a way to take their health and wellness into their own hands.

Unwilling to wait for a one-size-fits-all prescription, consumers are tailoring their nutrition to meet their individual needs in real time. Whether the goal is to boost cognition, immunity, hydration, or mood (for example), consumers can incorporate distinct bio-boosting substances into their diet as they need them.

The Covid-19 pandemic, in particular, has driven a notable spike in demand for specific classes of supplements, like those with immune-boosting ingredients (e.g., Vitamin D), stress-relieving adaptogens (e.g., ashwagandha), and brainpower-boosting nootropics (e.g., L-theanine).

Biology-driven personalization (i.e., using bioanalytical lab tests to inform supplementation) is also gaining traction as the supplement landscape grows more complex, the number of first-time supplement users grows, and consumers increasingly gravitate toward “quantified self” solutions over time.

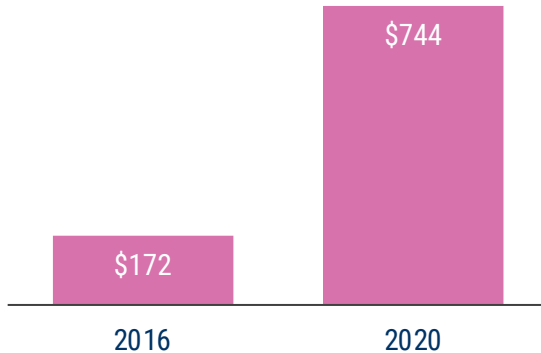
“Eye care professionals have been using nutraceuticals to improve patient outcomes for years, but new technology is enabling custom formulations to meet unique needs. Whether we’re treating dry eye, AMD, or other ocular issues, a customized approach allows us to recommend the right vitamin and nutrient levels for each patient. It’s no longer a ‘one size fits all’ approach thanks to continued product innovation and increased consumer demand.

Dr. Valerie Sheety-Pilon, O.D.
Vice President,
Eye Care Solutions at VSP Global

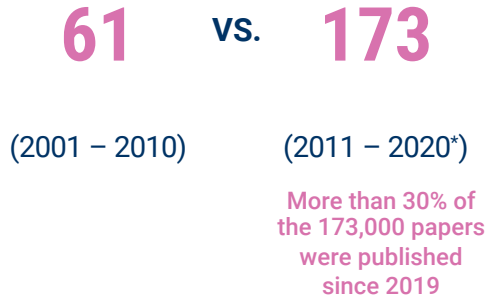
Where is the momentum now?

The supplements space is experiencing a renaissance, as evidenced by the rising level of VC funding, scientific research, and market growth.

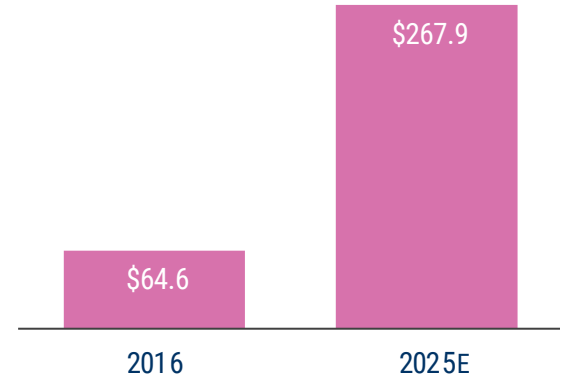
Annual funding to bio-boosting supplement companies (\$M)¹



Thousands of scientific research papers published about precision nutrition, by decade²



Global functional food and beverage market size (\$B)¹



Consumers flock to immune boosters amid Covid-19

The pandemic may have caused an abrupt spike in demand, but consumers' growing awareness of the immune system's role in performance could provide a longer-term tailwind for the space.

65% of consumers are currently worried about their immunity.¹

69% take supplements to support their immune health.¹

45% are consuming more immune-boosting food and beverage products than they did before Covid-19.²

vive
organic



In July 2020, immunity-boosting startup Vive Organic raised \$13M in Series B funding — bringing its total funding to \$26M.

- Vive is known for its cold-pressed and plant-powered ready-to-drink wellness shots made from organic and non-GMO super-herbs.

DSM



In March 2021, global nutrition company Royal DSM launched ampli-D, a fast-acting form of vitamin D, for use in dietary supplements.

- ampli-D allows consumers to boost vitamin D levels 3x faster and more effectively than with other vitamin D products on the market.³
- Vitamin D plays a fundamental role in supporting the immune system. However, vitamin D deficiency is a prevalent health issue, affecting 80%+ of the global population.³

Adaptogenic ingredients are gaining traction

Botanicals and prebiotics offer consumers a natural, convenient way to combat mental and physical stress.

Major brands are investing in adaptogen-enriched beverage R&D.



Total disclosed funding: \$23M

Latest round: Series B, April 2019

- **HUM Nutrition** offers vitamins targeting specific beauty and lifestyle concerns. Its formulations are designed so users can combine them in several ways based on their individual needs.
- HUM's "**Calm Sweet Calm**" gummies feature popular adaptogenic ingredients ashwagandha (stress reliever) and L-theanine (mood booster).



OLIPOP draws from the latest and most credible microbiome and digestive health research for its propriety "OLISMART" blend and formula composition. OLIPOP is also engaging in additional clinical research with Purdue and Baylor College of Medicine and will be participating in a landmark human clinical trial studying dietary intervention for human microbiome and digestive health outcomes.

Ben Goodwin

Cofounder, CEO & Formulator, Olipop

Consumers get a boost through bio-personalization

Personalization shifts from what consumers want to what their bodies need for peak performance.

VIOME

Total disclosed funding: \$85M

Latest round: Series C – II, February 2021

- **Viome** blends readings from blood, urine, saliva, and stool samples to develop profiles of an individual's biochemistry and microbiome.
- Using AI, Viome leverages these Health Intelligence profiles to provide users with personalized diet recommendations (via a mobile app) and formulate individualized nutrition supplements.



1 A Health Intelligence Test kit is shipped every 6 months.

2 The information from the sample is decoded by Viome's Lab, Transactional Science, and AI teams.

3 Results and recommendations are shared via the app and a personalized formula is prepared.

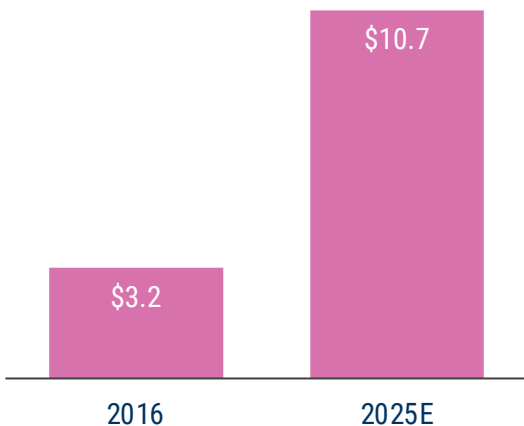
4 Precision supplements, probiotics, and prebiotics are delivered monthly.



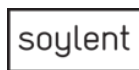
Nootropics give users a mental edge

Nootropics are ingredients that have brain-boosting benefits, like improved alertness, creativity, concentration, and memory.

Global nootropics market size (\$B)¹



Examples of brands that launched their first nootropic products in the last year (January '20 – January '21)*



THE N U E
C O



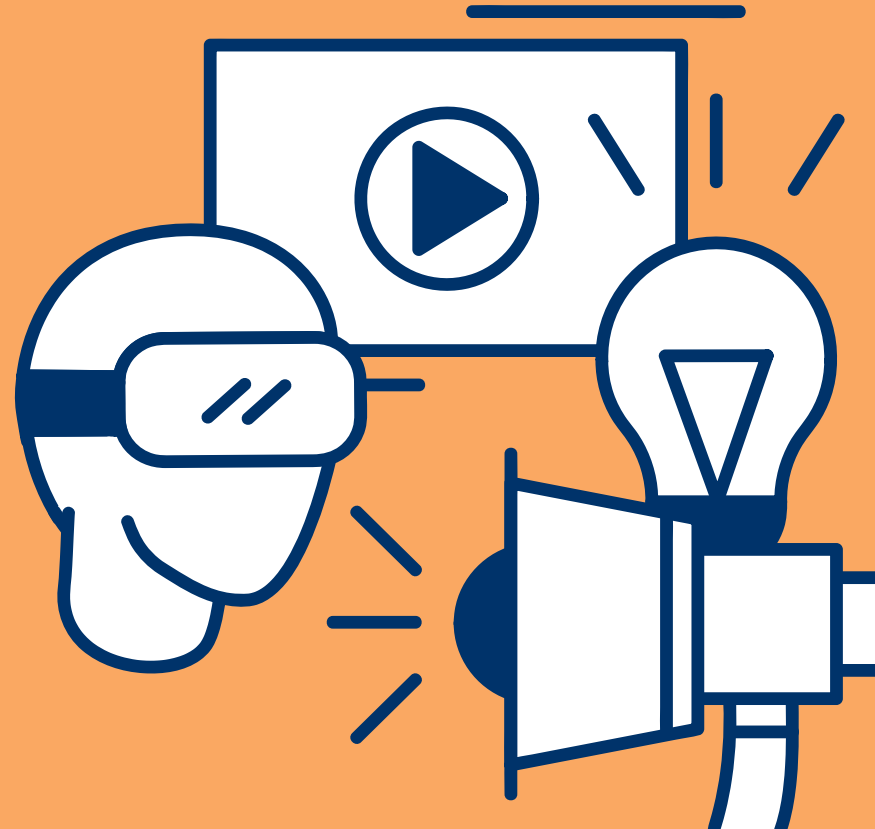
Total disclosed funding: \$11M

Latest round: Series A, June 2019

- **The Nue Co** offers subscription-based nutritional supplement plans tailored to specific health needs (e.g., energy, gut health, immunity, skin, sleep, etc.).
- Its cognitive supplement features several nootropic ingredients including citicoline, bacopa monnieri, lion's mane mushroom, *Rhodiola rosea*, and *Ginkgo biloba*.

TRANSFORMATIVE TREND #4

Full-sensory immersion enables performance



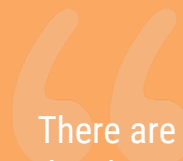
How is full-sensory immersion enabling performance?

Immersive technology manipulates one's sensory environment – by enhancing, distorting, or removing external stimuli (e.g., light, sound, temperature, pressure, etc.) to produce specific effects.

From VR fitness studios that make exercise more entertaining to sensory deprivation chambers that induce an elevated state of relaxation, immersive technology is fundamentally transforming the personal performance landscape.

The growing popularity of these approaches suggests consumers value the performance optimization *experience* just as much as its outcomes. Additionally, a growing body of evidence supports the role of sensory-mediated technologies in improving performance outcomes.

Whether the result is a direct consequence (e.g., exposure to UVB light boosts the body's vitamin D production, strengthening the immune system) or indirect consequence (e.g., users become more engaged, pushing themselves further or longer than they would otherwise) of sensory information, immersive technologies are proving to be valuable performance enhancement tools.



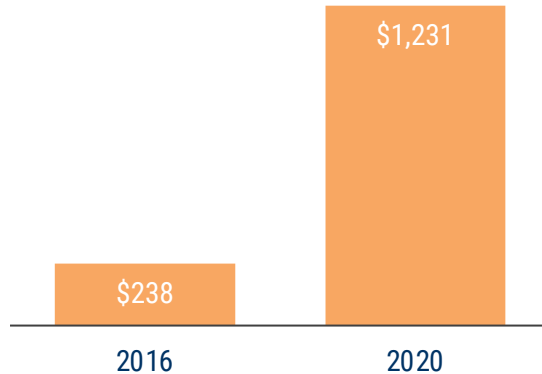
There are a lot of exciting developments taking place right now in immersive technologies and sensory stimulation. Given the connection between the eyes and the brain, we're particularly interested in exploring the use of light spectrums to help improve a person's health and well-being.

Earnie Franklin
Chief Operating Officer, VSP Global

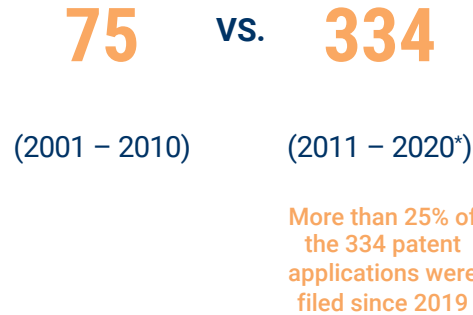
Where is the momentum now?

Immersive technology startups collected more than \$1B in funding in 2020, over 5x the amount raised in 2016. Technological innovation and corporate interest in the topic is accelerating.

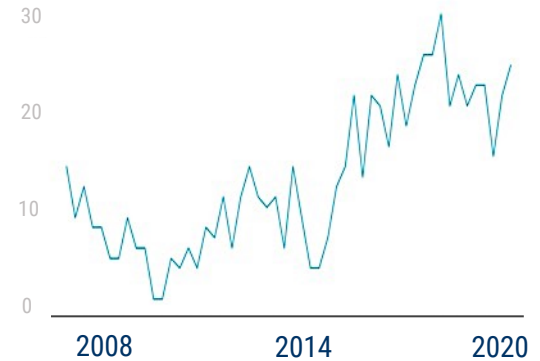
Annual funding to immersive technology companies (\$M)



Number of patents filed related to immersive technology, by decade



Earnings call mentions related to immersive technology (Q1'08 – Q4'20)



VR technology enables multisensory immersion

The technology is being used across multiple performance disciplines.

PHYSICAL



At-home fitness

AppliedVR

Pain management



NEURO REHAB VR

Physical therapy

COGNITIVE



Cognitive training

mindmaze

Stroke rehabilitation



Attentiveness training
for individuals with ADHD

OCCUPATIONAL



Employee training

Mursion

Workplace training



Surgical training

EMOTIONAL

oxfordvr

Psychotherapy

nevaro

Mindfulness training



Stress reduction

SOCIAL



Combating elderly
social isolation

Spatial

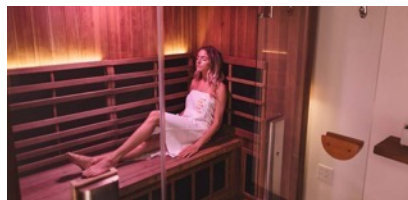
Workplace collaboration



Social skills training for
individuals with autism

Light proves to be a performance enhancer

From boosting mood to preventing migraines, light is being leveraged as a powerful sensory stimulus.



Consumers are upgrading from normal to infrared and chromotherapy saunas, making performance optimization a soothing, multisensory ritual.

- Infrared therapy can improve circulation, speed oxygen flow, and help the body eliminate harmful toxins.
- Red light therapy stimulates cellular mitochondria to support cell rejuvenation, battle inflammation, and boost collagen production.
- Color therapy uses distinct wavelengths of visible light to elicit specific health benefits, like improvements in energy, mood, or neuromuscular relaxation.



In May 2020, SOLIUS raised \$12M in Series B financing from Human Longevity, Inc.

- The company's narrow-band ultraviolet B (UVB) light kiosks stimulate production of vitamin D at 10x the rate of the sun using 100x less UV energy.
- Vitamin D plays an important role in preventing sickness, fighting disease, and supporting mental health.



No Ordinary Light

Even when you have a migraine, Allay's uniquely soothing band of light helps you get back to reading, working, and being yourself.



Founded by Prof. Rami Burstein, a Harvard neuroscientist, Allay aims to help those who suffer from light sensitivity and headaches.

- Dr. Burstein discovered that a very specific narrow band of green light generates negligible electrical signals in the eye and brain.
- This differentiates from the rest of the visible light spectrum, which produces much larger signals and causes irritation for those with light sensitivity.

Tactile stimuli go beyond “skin-deep” benefits

Haptic feedback wearables offer a multitude of performance benefits.

Feelmore
Labs



Total disclosed funding: \$20M

Latest round: Unattributed VC, November 2019

- **Feelmore Labs'** wearables produce subtle vibrations to tune the nervous system and help people feel and perform better every day.
- Its first product, Cove, is designed to reduce stress and improve sleep.

APOLLO



Total disclosed funding: \$9.5M

Latest round: Seed, June 2020

- Using physiological and environmental data, **Apollo** first identifies users' stress baseline.
- Then it automatically delivers tailored vibration patterns to help the body and brain adapt to stress in real time.

halo
neuroscience



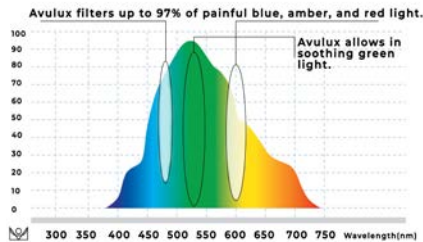
Total disclosed funding: \$25M

Latest round: Loan, April 2020

- **Halo's** brain-stimulating headphones aim to enhance performance on cognitive tasks for both the healthy and impaired.
- Halo's assets were acquired by Flow Neuroscience in February 2021.

Removing sensory stimuli enhances performance

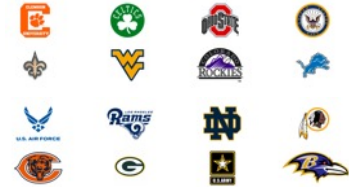
Performance benefits can also be gained by selectively filtering out sensory stimuli.



- Avulux's patented Migraine & Light Sensitivity Glasses use a nanomolecular lens technology to filter out the most painful light known to trigger pain and migraine attacks in those with photosensitivity.
- This allows people with migraines or photophobia to perform better on the job and in their daily lives.



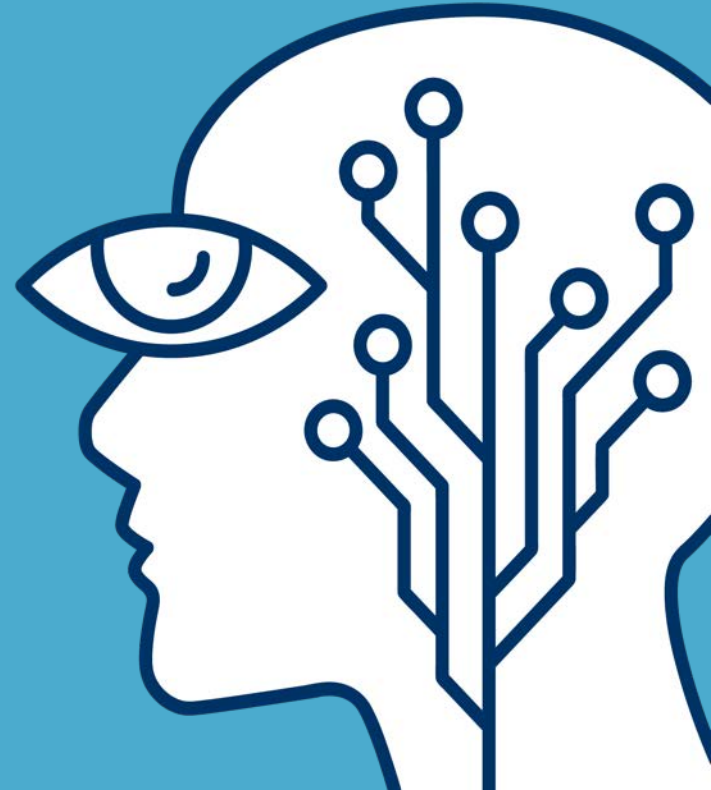
Used by...



- **Float therapy, or restricted environmental stimulation therapy (REST)**, has become a popular method to synchronize one's body, mind, and emotions and, accordingly, enhance performance and recovery.
- Inside float tanks — like those developed by Superior Float Tanks — users are cut off from all external stimuli (e.g., sound, sight, gravity), allowing both the body and the brain to enter their optimal resting states.
- Studies suggest REST has several health and wellness benefits like muscle relaxation, sleep enhancement, pain reduction, and stress and anxiety alleviation.

TRANSFORMATIVE TREND #5

Bionic technology powers superhuman capabilities



How are bionics powering superhuman capabilities?

Bionic technology (bionics) refers to electronic/electromechanical devices that interface with the body to restore natural, biophysiological capabilities (for those with impaired or lost functionality) or to enhance performance beyond one's biophysiological limits.

Bionics are a unique class of performance enhancement tech because the technology itself (as opposed to the body) is responsible for the performance gains. From artificial retinas ("bionic eye") to cochlear implants ("bionic ear") to robotic extremities ("bionic hand") or exoskeleton suits, these devices effectively act as replacements and extensions of the human body. Though there's typically some training required to operate them effectively, bionics afford more immediate performance gains than many other methods.

Bionics can also produce tangential benefits for the brain and body. For example, use of a bionic leg may improve one's posture, which in turn could reduce fatigue and improve focus on the job, boost mood and self-confidence, and enhance social aptitude.

The technology is still in relatively early stages of development. The devices that are commercially available today are complex, expensive, and generally limited to assistive (as opposed to augmentative) applications. However, R&D efforts are accelerating, offering promise for less complex, more affordable, and more augmentative solutions in the future.

“What used to be science fiction is now a part of modern society. Whether heightening your perception of the physical world with sensors and support mechanisms, the digital world with augmented and virtual displays, or your own cognition powers with neurostimulation devices, we are entering an era where creative ingenuity takes the upper hand on biological limitation.

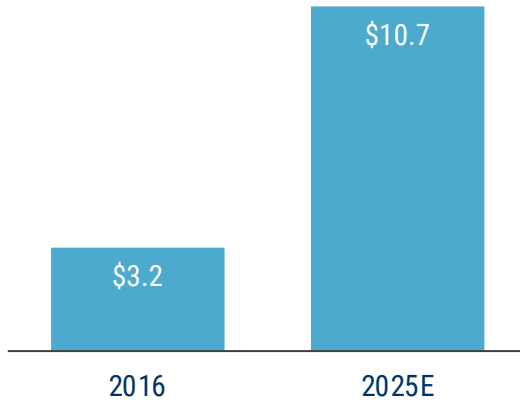
Zan Lowe-Skillern

Head of Healthcare & AR/VR, Israel Trade & Innovation Office, San Francisco

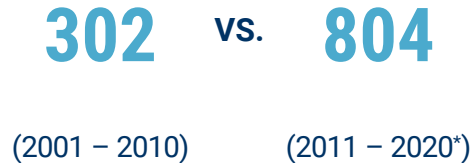
Where is the momentum now?

The market for bionic technology is large and growing. The topic is an active area of R&D, as evidenced by patent filing data and the rising volume of scientific research publications.

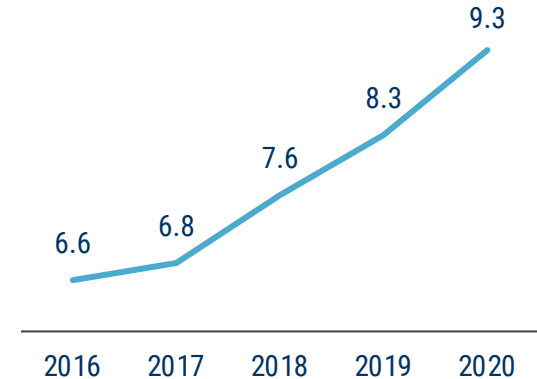
Global bionic device market size (\$B)¹



Number of patent filings related to performance-enhancing bionic technology, by decade¹



Thousands of scientific research articles published on bionic technology (2016 – 2020)²



Bionic wearables assist with sensorimotor limitations

New classes of wearables are being developed to aid the human body.

BIONIC VISION



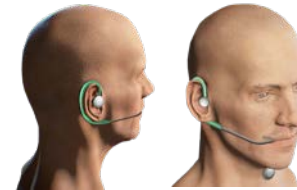
- **Mojo** is developing an AR contact lens to help people struggling with low vision.
- The Mojo Lens is discreet for the wearer, allowing a hands-free experience while delivering enhanced functional vision that can assist in mobility, reading, and more.
- The device received Breakthrough Device Designation from the FDA in January 2020.

BIONIC HEARING



- **Augmented Bionics** is developing a first-of-its-kind, non-surgical bionic ear that will enable hearing for those with severe hearing loss.
- The device will combine the convenience of a hearing aid with the functionality of a cochlear implant.

BIONIC VOICE



- **Laronix** is developing a first-of-its-kind smart wearable electronic voice prosthesis that gives voices back to larynx amputees.
- The device, naturally controlled by respiration, regenerates the missing "voice source" using a proprietary AI algorithm.
- Over time, it can be trained to reach a voice quality resembling the patient's own.

Wearable exoskeletons afford bionic physicality

From stroke survivors to combat soldiers, wearable exoskeletons are being used to augment users' mobility, strength, balance, and even productivity.



Total disclosed funding: \$86M

Latest round: Series C, September 2020

- **Sarcos** develops full-body, human-controlled exoskeleton robots for use across the public and private sectors.
- Its Guardian XO makes light work of heavy-duty tasks, empowering users to safely lift and manipulate up to 200 lbs. without fatigue or strain.
- The technology enables a single person to deliver the productivity of many, while significantly reducing the risk of occupational injury.



Maritime

Oil & Gas

Military & Defense

Industrial Manufacturing

Automotive

Construction

Aviation & Aerospace

Distribution & Warehousing

BCIs will enable truly seamless digital interactions

Early examples of brain-computer interfaces (BCIs) are emerging in gaming, though more complex applications are several years away.

NextMind



- **NextMind's** brain-sensing wearable opens new possibilities for gaming and human-computer interaction by instantly translating brain signals from a user's visual cortex into digital commands for any device.
- It began shipping its development kit in December 2020.

facebook



- In 2019, **Facebook** acquired BCI startup CTRL-Labs.
- The company is reportedly developing a new neural sensor that can read people's thoughts and convert them into actions, which could help users in holding virtual objects, typing, and controlling characters in video games.

NEURALINK



- Implantable BCIs, like those being developed by Elon Musk's Neuralink (and several other startups), aim to restore lost or impaired functionality for patients with disabilities by allowing them to control external machines with their thoughts.

About the producers



VSP Global Innovation Center

VSP Global is a health-focused vision care company that empowers human potential through sight.

The VSP **Global Innovation Center** is developing products, services, and experiences to help advance the eye care and eyewear industries and bring value to our members, doctors, and clients.

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Call to innovators

The trends highlighted in this report show how the future of personal performance is evolving the way we self-improve and manage our physical, cognitive, emotional, occupational and social dimensions. We believe these innovations will drive consumers to a higher level of performance and are just the beginning of what will become more mainstream.

VSP Global is constantly reimagining the way eye care and eyewear are delivered to the world. To deliver on this promise, the VSP Global Innovation Center is actively looking to collaborate with external partners, to develop and deliver life-improving products, experiences and services.

If you are actively working on solutions that impact the future, we'd love to talk.

Get in touch with us at globalinnovationcenter@vsp.com



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