



JoyScore Experiment

Scientific & Medical Advisers

Tina Woods is overall strategic lead of the [JoyScore Experiment](#). Tina Woods is a mission-driven social entrepreneur and system architect bringing diverse stakeholders together in shared endeavours to improve health, working at the cross section of science, technology, investment and policy/government. She is Founder and CEO of [Collider Health](#) and [Business for Health](#) and with [Yukari Takehisa](#), co-founded [Longevity Rave](#), a collective of entrepreneurs, scientists, DJs and artists using the power of music, joy and connection to bring the generations together and celebrate humanity. She is Executive Director of the [International Institute of Longevity](#), combining her interest in taking the latest science and technology of longevity into the 'next frontier' of the Human Exposome to understand what drives human healthspan, resilience and flourishing. She is on the Steering Committee and Global Ambassador for Partnerships for the [Exposome Moonshot](#) - see here background on the [Human Exposome Project](#) linking human and planetary health.

Tina is working with the following experts:

[*Professor Dr. Eric Verdin*](#) is the President and CEO of the Buck Institute for Research on Aging – a pioneering biomedical research institute dedicated to ageing and age-related disease. His research focuses on the fundamental mechanisms of immune system evolution over time and the profound influence of nutrition and lifestyle interventions on these processes. His work demonstrates that 93% of longevity outcomes derive from modifiable factors: nutrition, sleep quality, exercise regimens, and lifestyle choices.

[*Joanna Benz*](#) is a visionary entrepreneur leading advancements in Europe's longevity healthcare sector. As a Founder and CEO of the Longevity Center Europe, and Founder and Co-President of the International Institute of Longevity, she has developed innovative clinics that emphasize personalized, preventive medicine, leveraging advanced diagnostics and biomarkers to foster healthy longevity. She is passionate about integrating evidence-based approaches in positive psychology, neuroplasticity, and lifestyle medicine to help clients thrive physically, mentally, and emotionally.

[*Prof Dr Michael Sagner*](#) is the Ageing Research at King's (ARK) Clinical Advisor in longevity and preventive medicine. He is a clinician and researcher specialising in sports medicine and preventive medicine, affiliated with Southeastern University Florida, Department of Health and Human Performance. He is a Certified Nutritionist and completed his MD at Technical University Munich. He specialises in Sports Medicine, Endocrinology and Preventive Medicine, and is. He is the Editor-in-Chief of *Longevity*, Lead Editor of *Lifestyle Medicine*, Fellow of the Royal Society of Medicine

and Fellow of the European Society of Preventative Medicine. He is medical advisor to [Enhanced Games](#).

[Dr Evelynne Bischof](#): Professor of medicine, MD, PhD, MPH, FEFIM; specialist in internal medicine. Longevity physician leading elite executives as longevity patients, integrating precision diagnostics of HLI, AI-based monitoring with deep aging analysis and individualized therapies towards healthy longevity, reversing biological age and achieving optimal performance. Clinician with over a decade of clinical practice experience in Switzerland, the USA and China. Professor of medicine with a research focus on healthy longevity, gerontology, precision medicine. Deeply passionate about next-generation medical technology, and the applications of AI for biomedical research and practice, digital health and innovative technology. A Harvard- and Columbia-trained physician, author of over 80 peer-reviewed papers and a frequent speaker at scientific and medical conferences.

[Dr Tamsin Lewis](#): Dr. Tam is a physician and longevity specialist with over two decades of clinical experience across hospital medicine, integrative health, and personalised prevention. Trained in both conventional and functional medicine, she brings a pioneering lens of bioharmony — recognising that physiology, psychology, and environment interact as one dynamic system. With a profound understanding of the nervous system and emotional health, she leads with curiosity, compassion, and conviction. Her approach is trauma-informed and motivational by design, grounded in the belief that vitality is not simply the absence of illness but the presence of energy, resilience, and joy in living.

[Toni Castells](#) is an independent artist and composer known for his eclectic and transcendental music that defies traditional boundaries and genres. His innovative approach has led to collaborations with renowned artists and performances at prestigious venues worldwide. In addition to his musical career, Castells is a PhD candidate in biomedical engineering, exploring the therapeutic potential of music. His research focuses on the effects of sound on heart rate variability and chronic stress, with a particular interest in music's role in psychedelic therapy for treating chronic depression. He also shares his expertise as a lecturer on Music Technology at the London College of Music and Imperial College London.

[Aleksandra Wingert](#), PhD candidate, Clinical Trials Coordinator, Centre for Psychedelic Research, Imperial College London. Background in clinical neuroscience.

[Christin Rauter](#) and [Leon Jean-Marie](#), known collectively as The Sound Nutritionist, have spent the past 15 years exploring the profound effects of sound and music on human physiology and psychology. Their work explores the massive impact of frequencies, vibrations, and spatial acoustics on the nervous system, cognitive function, and emotional well-being. By blending principles from neuroscience and holistic healing, they have developed innovative sonic experiences that support relaxation, mental clarity, and personal transformation. Through research, practical application, and collaboration with leading wellness and corporate organizations, they continue to refine their understanding of sound's potential to enhance both physical and mental health.

[Dr Shama Rahman](#) is a neuroscientist, neurodesigner and AI practitioner with an expertise in AI/human collaborative systems, creative strategist and technologist, artist and entrepreneur. She is

currently an Innovation Fellow at the University of Edinburgh, within Design Informatics and Edinburgh Futures Institute. Her R&D interests and expertise are at the confluence of designing AI tools, interventions and experiences for impact in enhanced innovation, cognitive augmentation, and healthy ageing with the lens of ethical neurodesign and responsible AI.

Dr [Carina Kern](#) is the CEO of LinkGeivity an AI-powered biotech company driving innovation in drug discovery for aging and resilience loss. She is renowned for her pioneering work on aging mechanisms and lifespan extension, including a new Blueprint Theory of Aging, which takes an integrative approach to understanding aging, combining evolutionary theory, genetics, molecular mechanisms and medicine, and is used to structure LinkGeivity's AI. Her research has led to the development of a first-in-class necrosis inhibitor targeting cellular degeneration (Anti-Necrotic™), with exciting potential as a breakthrough treatment for aging.

Prof [Fenna Sillé](#), PhD, MS, is an immunologist studying the exposome, assessing how a lifetime of physical, chemical, biological, and psychosocial factors interact with the genome and impact human health. Guided by the motto “ [a healthy environment = healthy people](#),” Dr. Sillé investigates how the exposome shapes immunity and disease across the life course. Focusing on early-life and chronic exposures—especially arsenic and heavy metal mixtures—her work examines impacts on vaccine responses, infection and cancer risk, and neuroinflammatory pathways tied to neurodevelopmental and neurodegenerative outcomes. She also leads a study characterizing the [exposome in relation to childhood asthma in Baltimore City](#).

[Gerome Guiot](#) works at the intersection of health, strategy and investments with a focus on age-related diseases, healthspan and longevity. He is passionate about breaking silos and challenging consensus. His interests include the improvement of measures of health and aging, the quantification of the impact of behavioral changes to health via lifestyle changes or better adherence to treatment, and the quantification of the importance of psychological and emotional wellbeing. Gérôme is currently a Strategic Initiatives Director at LVMH and an advisor to the International Institute of Longevity.

Community & Tech Partners

The following community partners and technology companies are supporting the JoyScore Experiment:

[Frontier Tower](#), San Francisco (December 2025 MVP): Longevity lead. [Laurence Ion](#)
Frontier Tower is a self-governed community lab in frontier tech space with a constellation of longevity and biotech pioneers and innovative arts & music artists.

[Infinita, Roatan](#), Honduras (February/March 2026 study): Community Lead [MacSue Jacques](#)
A community that brings together researchers, entrepreneurs, and citizens for a living experiment in how societies can advance health and human potential through freedom to innovate. The JoyScore Experiment is being scaled up as part of the longevity community convening for the Longevity Biomarkers Competition (see [here](#)).

[Playa.ai/Burning Man](#): Project Lead [Alex Azzi](#)

The JoyScore Experiment forms part of the plans of the [Playa AI Foundation](#) to build on an open-source, community-governed foundation model that utilises data ethically gathered from the unique environment of Burning Man to capture human insights and emotional presence that are missing from current AI. This effort forms a critical 'peak experience' cohort for the JoyScore Experiment, researching how we can encode the human spirit and dignity into the next generation of intelligence.

[AWEAR](#): Founder & CEO [Antonio Forenza](#)

Creators of single-ear neurotechnology that makes real-world EEG feasible for synchrony, emotion and cognitive state measurement.

[Bleo](#): Co-founders [Richard Skaife](#) and [Toby Sorabjee](#)

A new wearable tracking health, sleep & activity in style with smart rings and bands, seamlessly connected to The Longevity AI.

[Humanity Health](#): Co-founders [Peter Ward](#) and [Michael Geer](#)

A leading biological age and healthspan platform with millions of data points from real users.

[Rejuve.ai](#): CEO [Jasmine Smith](#) and Data Scientist [Macsue Jacques](#)

A decentralised AI-driven wellbeing app supporting emotional tracking and EMA research.

[OpenCures](#): CEO [Kevin Perrott](#)

Citizen scientist lab geared to create preventive and personalized medicine, supporting human trials and real world evidence data to achieve this.

[The Sound Nutritionist](#): Co-founders [Christin Rauter](#) and [Leon Jean-Marie](#)

Specialists in psychoacoustics, sound texture, and sensory nourishment.

[Neurocreate](#): Founder & CEO [Dr Shama Rahman](#)

A pioneering neurodesign agency that bridges neuroscience and creativity through an inclusive approach to unlocking peak human potential and fostering creativity and well-being.

[Deleón Omics](#), Founder & CEO Chad Pozarycki

Deleón Omics provides advanced metabolomic profiling and recovery modelling, enabling quantification of metabolic stress and adaptive capacity from non-invasive biospecimens. In the JoyScore Experiment, Deleón supports deep phenotyping of stress–recovery dynamics associated with psychosocial and sensory exposures.

[AgeRate](#) Founder & CEO Cole Kirschner

AgeRate delivers DNA methylation–based biological age and resilience metrics using next-generation epigenetic algorithms. Within the JoyScore Experiment, AgeRate serves as a longitudinal anchor, linking cumulative joy and social exposome exposure to established markers of biological ageing.

[GlycanAge](#) Founder & CEO Nikolina Lauc

GlycanAge specialises in glycan-based biomarkers of immune ageing and inflammation, derived from immunoglobulin glycosylation patterns. In the JoyScore Experiment, GlycanAge enables exploration of how sustained joy, connection, and recovery relate to immune system ageing trajectories.

[Healome One](#) Founder & CEO Nikhil Yadala

Healome is a voice and text AI Powered habit tracking to improve clinical treatment efficacy and protocol adherence, serving the platform to discover causal relationships with aging endpoints.

[Willowwave](#): Founder & CEO, Alba Tottemocha

Willowwave turns sound into a tool for human transformation. Grounded in neuroscience and psychoacoustic research, their soundscapes restore nervous system coherence and reprogram subconscious beliefs, aligning you with the state you want to live in.

All advisers and partners have signed up to the multi-stakeholder open science collaboration agreement [here](#).

Scientific Rationale

The JoyScore is a new scientific measure designed to quantify how joy, connection, synchrony, and emotional uplift affect our brains, bodies, and long-term health. It is being developed because the science is now unequivocal: human connection is one of the strongest predictors of longevity — with loneliness increasing mortality risk as much as smoking 15 cigarettes a day.

It is being designed as the world's first open-science study to build this new metric — one intended to become as mainstream and actionable as step count, sleep score, or heart-rate variability.

Chronic loneliness and social isolation elevate inflammation, accelerate biological aging, erode cognition, and increase all-cause mortality. As AI and digital platforms mediate more of our lives, we risk increasing social disconnection and dehumanisation.

We are designing JoyScore within the [human exposome](#) framework: the totality of environmental, social, and behavioral exposures that shape healthspan. Recent advances in aging biology, including the Blueprint Theory and necrosis-centered frameworks^{[1][2]}, emphasise that healthspan loss arises from cascades triggered by environmental, behavioral, and psychosocial exposures. Chronic social disconnection and stress act as upstream triggers that amplify inflammatory, mitochondrial, and autonomic dysregulation, increasing vulnerability to degenerative pathways.

The [JoyScore Experiment](#) is designed to quantify and intentionally reshape the 'social exposome'—a modifiable exposure layer that may buffer or attenuate these cascades. An abstract (see [here](#)) has been submitted for the [Global Exposome Summit](#) in April 2026.

Epigenetic aging measures provide one of the most mature biological readouts of the exposome, capturing how social, behavioural, and environmental experiences are written into long-term biological regulation.

[Longevity Rave](#) is the first use case being tested in the JoyScore Experiment, and reframes immersive group dance as an intervention for healthspan and longevity. By intentionally designing the social-sensory environment (sound, light, space, touch norms) through a Longevity Rave intervention we aim to train the collective nervous system toward safety, synchrony, and recovery.

Raves are living laboratories where music, movement, light, and touch align physiology, brain activity, emotion, and belonging. In an age of AI-driven techno-isolation, we position raves as counter-technology that restores human connection and preserves what makes us human.

Longevity Rave is being designed as a structured, evidence-based approach to health and wellbeing, where rhythmic synchrony acts as a biological mechanism for connection, stress recovery, and long-term resilience.

Commercial Rationale

While the longevity industry has poured billions into molecules, wearables, scans, and biological age clocks, one truth has been overlooked: the experiences that make us feel alive — movement, dance, synchrony, community, joy — are not “soft” factors. They are measurable biological regulators. The JoyScore aims to bring these human experiences into the centre of health science.

The experiment will generate early models for how JoyScore could be applied. Imagine if...

- 20 minutes of group dancing improved your emotional state and physiological recovery *more* than an hour of solitary cardio on a stationary bike?
- Wellness studios, spas, retreats, hotels and music venues used JoyScore to design experiences that measurably improve your health and wellbeing
- Big Tech starts to build “joy-optimised” content backed by biomarkers and informed with JoyScores
- A new category, ‘JoyTech’, emerges with evidence-based experiences, environments and tools reimbursable by insurers if they produce high JoyScores

Longitudinal biological validation (e.g. epigenetic aging trajectories) enables JoyScore to function not only as an engagement or wellbeing metric, but as a credible proxy for cumulative healthspan-relevant exposure.

See [here](#) the commercial application of JoyScore across industry verticals.

Conceptual Framework

The JoyScore Experiment integrates biomarkers operating on different temporal scales: high-frequency experiential and neural measures (EMA, EEG), medium-horizon stress-recovery signals (metabolomics), and long-horizon ageing markers (epigenetics and glycomics). This layered approach enables internal cross-validation, reducing reliance on any single modality and strengthening inference about how psychosocial exposures become biologically embedded over time.

Revised Three-Layer Model

The JoyScore Experiment organises measurement across three integrated layers that distinguish *inputs, mediators, and outcomes* — where joy and wellbeing are both *drivers of experience* and *meaningful endpoints*. This structure deliberately differentiates means (exposures and mechanisms) from ends (joy, purpose, resilience, and ageing trajectories).

Layer 1 — Context & Exposures (Inputs)

This layer captures the environmental, social, behavioural, and sensory conditions that shape human experience and the social exposome. These inputs include:

- Social context (alone vs collective, familiarity, social density)
- Sensory exposures (music, rhythm, tempo bands, light, space)
- Routine and rhythm (sleep timing, circadian alignment)
- Behavioural exposures (movement intensity, hydration, substance use)
These represent the designed exposures that JoyScore aims to quantify and optimise.

Layer 2 — Joy Mechanisms (Mediators)

Joy itself is conceptualised not merely as an exposure but also as a mechanism of action. This layer includes experiential and psychosocial processes that translate exposures into enduring psychological and physiological regulation:

- Affective uplift and vitality: how experiences influence momentary positive affect
- Belonging and social safety: felt security, trust, and co-regulation
- Meaning & purpose: forward-looking motivation, desire for future engagement, and life narrative coherence
- Emotional regulation & recovery: capacity to return to calm after stimulation
These mediator constructs are captured using validated experience sampling alongside neural and biochemical proxies.

Layer 3 — Joy Outcomes (Ends)

Joy outcomes encompass both subjective wellbeing and long-term resilience signals. These are the *goals* of intentional exposome design and inform what we aspire to influence:

- 'Joie de vivre' / psychological flourishing: meaning, hopefulness, agency, prosocial engagement
- Resilience & recovery: stability of affect and restored regulation after stimulation
- Biological ageing and deep phenotyping proxies: epigenetic and glycomic signals that reflect cumulative exposures over longer horizons

By structuring the model this way, we clarify that joy is both a mediator linking designed exposures to adaptation and an outcome in its own right — with measurable relevance to healthspan and resilience.

This study adopts an exposome framework to healthspan research, informed by emerging necrosis-centered and Blueprint theories of aging, which emphasise that cumulative environmental, behavioural, and psychosocial exposures act as upstream triggers for biological cascades of undesirable pathways (ie pathological pathways or patho-pathways for short) associated with inflammation, mitochondrial stress, and neuroendocrine dysregulation, amongst others, that ultimately functional decline.

Within this framework, the JoyScore Experiment is designed to quantify the social and psychosocial exposome and its proximal biological correlates, focusing on mechanisms that plausibly influence recovery, resilience, and vulnerability to degenerative processes.

Why Epigenetics & Glycomics Matter for the JoyScore Experiment

Epigenetics and glycomics offer complementary views on *how exposures accumulate and manifest biologically over time*.

Epigenetics (AgeRate) quantifies DNA methylation patterns that correlate strongly with long-term ageing processes, inflammation, metabolic stress, and immune ageing. Changes in these patterns represent the *biological memory* of cumulative environmental, lifestyle, and psychosocial exposures.

Glycomics (GlycanAge) captures the structure and relative abundance of immunoglobulin glycans — sugar moieties on key immune proteins — which reflect systemic immune regulation, inflammatory tone, and biological ageing. Glycan profiles change more slowly and integrate signals across immune, metabolic, and stress pathways.

Neither epigenetic nor glycomic measures are designed to detect acute shifts from a single event, but each serves as a validated biological anchor that can be tested for association with JoyScore trajectories over time. By integrating these slow-moving biomarkers with high-temporal-resolution psychosocial and neural measures, the JoyScore Experiment bridges the *lived experience of wellbeing* with *deep biological signatures* of resilience and ageing.

Epigenetic measures derived from AgeRate are not expected to shift acutely in response to single events; rather, they provide a validated record of cumulative psychosocial, behavioural, and environmental exposures, enabling JoyScore trajectories to be tested against longer-horizon biological ageing signals.

JoyScore trajectories will be examined for association with established biological aging markers, including epigenetic age estimates (AgeRate), rather than treated as direct causal modifiers within the timeframe of the study.

This integrative approach enhances scientific rigor and increases the relevance of JoyScore for policymakers, employers, cities, and commercial partners seeking credible measures of wellbeing that go beyond subjective satisfaction or engagement proxies.

Longevity Rave as the first Use Case

Scientific studies consistently show that high-energy dancing significantly boosts mood, reduces stress, and enhances emotional wellbeing. Dancing triggers the release of endorphins, dopamine, oxytocin, and serotonin, which are associated with feelings of pleasure, social bonding, and stress relief. Dance interventions have been proven to reduce symptoms of depression and anxiety, enhance quality of life, and build psychological resilience.

Dance is a powerful form of aerobic exercise, improving cardiovascular fitness, metabolic health, and overall physical resilience. Studies have linked regular dancing with lower resting heart rate, improved blood pressure, and decreased levels of inflammatory markers like CRP. Longitudinal studies suggest that frequent dance activity can reduce all-cause mortality, particularly cardiovascular death.

The reference list in the Appendix backs up our concept.

In alignment with necrosis-centered and Blueprint models of aging, we treat synchrony-related measures as *proximal mediators* linking psychosocial exposure to downstream healthspan-relevant pathways, rather than as endpoints in themselves.

Informed by the evidence, we're exploring a tiered tempo architecture grounded in entrainment science:

- ≈60 BPM — relaxation/alpha entrainment, trust-building and intimacy blocks.
- 100–120 BPM — natural gait range; maximizes inclusive group synchrony and ease of movement (walking pace).
- 120–130 BPM — rave sweet spot; sustains energy and collective synchrony, linked to endorphin/oxytocin bonding.
- 130–140 BPM — peak-energy blocks, used sparingly to avoid crowd fragmentation.

This aligns with studies showing that movement synchronizes most easily around walking cadence (~100–120 BPM) with measurable effects on social closeness, and that synchronized group dance (commonly ~120 BPM in electronic genres) elevates bonding and pain thresholds.

Music catalogue pillars are structured as follows:

- CONNECT (120–130 BPM): group synchrony & euphoria for raves/group classes.
- FLOW (100–115 BPM): inclusive movement, warm-up and between-peak recovery.
- CALM (60–80 BPM): recovery, trust-building, breath entrainment and closing rituals.
- PEAK (130–135 BPM): short, high-energy climaxes that retain synchrony.

Data Collection Protocol

Study volunteers had to meet strict eligibility criteria and sign the consent form [here](#).

Phase 0 MVP Hypothesis (Frontier Tower)

The Phase 0 San Francisco feasibility pilot (n=20) conducted in December 2025 established signal detection, operational feasibility, and parameter stability.

The MVP assessed:

- EEG state shifts / neural entrainment to music
- EMA affect and connection changes
- GDF15 pre/post trajectories
- NO strip change pre/post
- Changes in metabolites/metabolomics

See the piece written up by Longevity Technology in [Joy Gets Measured](#).

Phase 1 Longitudinal Cohort (Roatan, Honduras)

Findings from Phase 0 will inform Phase 1 study in Roatan Honduras (n=40–80) in February/March 2026 with in key areas such as effect size estimation, assay validation, protocol refinement, refined block timing, larger EEG subgroup, and expanded biomarker schedule. The goal is a publishable scientific study and a scalable blueprint.

In addition to Phase 0 data capture we will also measure:

- IMU-based movement synchrony (PLV)
- Cardiac coupling via ECG
- HRV recovery slopes
- Inter-brain synchrony (ISC/ITPC)

Phase 1 will extend the design to a longitudinal framework, enabling repeated exposure measurement, recovery slope analysis, and attribution modeling.

Data Collection Matrix

Psychosocial Exposure Measures

Psychosocial exposures are captured using brief, repeated ecological momentary assessments (EMA) to characterize real-time variation in social experience and emotional state. Core domains include:

- Connection and belonging
- Positive affect and emotional uplift
- Perceived stress and calm
- Recovery capacity following stimulation

EMA prompts are administered at baseline, immediately following structured music exposure, and post-event, with optional repeated sampling in extended cohorts. These measures form the core JoyScore exposure variables, representing modifiable social and emotional conditions that may influence biological stress pathways.

Confounding behavioral exposures—including caffeine intake, sleep duration, hydration, and acute illness—are logged to support interpretability and downstream modeling.

Neural and Physiological Mediators

Neural State and Entrainment

Neural activity is recorded using wearable single-ear EEG (Awear device) during structured music exposure blocks.

Analyses focus on:

- Spectral power changes (alpha, beta, theta bands)
- Beat- and rhythm-related neural entrainment
- Within-subject phase consistency across exposure conditions

Precise timestamping is used to align EEG data with musical stimuli, enabling state-specific analysis of neural responses to curated auditory environments.

Autonomic and Vascular Proxies

Where available, resting heart rate and recovery dynamics are collected to assess autonomic regulation. Nitric oxide bioavailability is assessed using saliva-based test strips before and after the intervention as an exploratory proxy for vascular responsiveness and stress-related endothelial signaling.

Blood and Saliva Biomarkers

Low-volume dried blood microsamples (Neoteryx Mitra[®], 20 µL) are collected at baseline and immediately following structured music exposure. Biomarker selection prioritizes analytes with demonstrated feasibility in microsampled blood and relevance to acute stress and recovery physiology:

- GDF15: a marker of mitochondrial stress and systemic load, analyzed as a pre- to post-exposure trajectory
- Inflammatory markers (e.g., hsCRP where feasible): included primarily to characterize baseline distributions and longer-term recovery in extended cohorts

Saliva samples may be collected for exploratory analysis of neuroendocrine markers, including cortisol and oxytocin, interpreted cautiously due to known assay variability.

Downstream Functional Proxies

Downstream proxies relevant to healthspan include:

- Sleep architecture and recovery metrics (where wearable data are available)
- Brief mood and energy scales (e.g., POMS subscales)
- Composite physiological or recovery indices generated by partnered platforms

These measures are not treated as direct indicators of degeneration but as functional outputs reflecting short-term recovery and system-level responsiveness.

Analytical Strategy

Analyses emphasize within-subject change and recovery trajectories rather than absolute biomarker values. Primary models examine associations between psychosocial exposure intensity (JoyScore variables), neural and physiological mediators, and short-term functional outcomes, adjusting for key confounders. Extended cohorts enable modeling of exposure–response relationships and recovery slopes over time.

Other considerations

A general medical checkup and assessment of disease load could be warranted in certain situations (for example, bereavement, divorce, work burnout), noting that psychological stress can be a major factor in conditions like cardiovascular disease, stroke, etc that is often underestimated - but the literature shows strong trends.

Detailed Measurement Matrix

Phase 1 is explicitly designed to produce a dataset enabling attribution modeling of how psychosocial exposures interact with biological pathways across time.

Layer	Domain	Measure	Method / Partner Tech	Timing	Expected Direction (↑ ↓ ↔)	Interpretation
Exposure	Social exposome	JoyScore EMA (connection, joy, meaning, purpose, recovery)	Rejuve.ai	Daily; post-session	↑	Core psychosocial exposure & flourishing index
Exposure	Context/confounders	Sleep, caffeine, alcohol, substances, illness	EMA tags + logs	Daily	—	Controls confounding exposome inputs
Mediator	Neural state	EEG spectral features & rhythm entrainment	AWEAR	During music & synchrony modules	State-dependent	Neural responsivity to designed exposures
Mediator	Mitochondrial stress	GDF15	Mitra DBS + lab partner	Baseline; weekly; post-events	↓	Stress-recovery load
Mediator	Metabolic resilience	Urine amino-acid metabolomics	Deleón Omics	Repeated over 4–6 weeks	Normalization	Biochemical response to psychosocial exposure

Mediator	Recovery dynamics	Recovery Margin; clearance constants	Deleón Omics (wearable-fused)	Weekly model outputs	↑	Personalised recovery capacity
Mediator	Epigenetic aging	Biological Age (epigenetic clock)	AgeRate	Baseline + end; optional follow-up	↓	Long-horizon anchor reflecting cumulative exposure history; used to validate JoyScore trajectories rather than detect acute intervention effects.
Mediator	Preventative health profile	Functional longevity panel	Eveda	Baseline + end	↑	Contextualised resilience pathways
Mediator	Glycomic ageing	GlycanAge Score & Glycan Age Index	GlycanAge	Baseline + end; optional follow-up	↓	Immune & inflammatory ageing signature
Outcome proxy	Psychological flourishing	Meaning/purpose; vitality; hope	EMA + validated scales	Daily/weekly	↑	Joie de vivre & psychosocial resilience
Outcome proxy	Sleep & autonomic recovery	Sleep architecture; resting HRV RMSSD	Wearables (agnostic)	Nightly	↑	Physiological recovery proxy
Outcome proxy	Composite resilience index	Integrated multi-modal score	Analytic synthesis	Programme duration	↑	Cross-domain adaptation signal

Note: “Expected direction” arrows refer to hypothesised *beneficial change* (e.g., ↓ biological age acceleration; ↑ joy & resilience). All interpretive statements are phrased conservatively to reflect research aims, not clinical claims.

IRB Executive Summary

Study Title: The JoyScore Experiment: Measuring Joy, Meaning, and Social Connection as Components of the Human Exposome

Purpose and Scientific Rationale

The JoyScore Experiment investigates whether joy, meaning, social connection, and emotional recovery can be reliably measured as components of the human exposome and whether these experiential states are associated with markers of resilience and healthy aging. Social disconnection and chronic stress are established risk factors for morbidity and mortality; however, there is currently no validated metric that quantifies positive psychosocial exposures such as joy, belonging, and purpose in a way that is measurable, repeatable, and biologically interpretable. This study aims to validate **JoyScore** as a multidimensional measure of psychosocial wellbeing and to examine its relationship with neural, physiological, and biochemical indicators.

Study Design

This is a **non-interventional, observational, within-subject study** incorporating repeated measures. Participants will take part in structured experiential sessions (e.g., music-based collective experiences and comparator activities) and complete ecological momentary assessments (EMA). Data collection includes self-report measures, wearable-based neural recordings, and minimally invasive biological sampling. The study is designed to distinguish between **measurement validation** and **exploratory associations**, without making clinical or therapeutic claims.

Participants

Participants are adults (≥18 years) capable of providing informed consent. Exclusion criteria include acute illness, contraindications to wearable sensors, or inability to comply with study procedures. Participation is voluntary, and participants may withdraw at any time without penalty.

Procedures and Data Collected

Participants will complete:

- **Ecological Momentary Assessments (EMA):** joy, positive affect, belonging, meaning/purpose, emotional recovery, and contextual variables (sleep, hydration, caffeine, alcohol).
- **Neural measurements:** non-invasive EEG recordings during selected experiential sessions.

- **Physiological and biochemical measures:** minimally invasive samples (e.g., dried blood spots, saliva, or urine) to assess stress-recovery markers and exploratory immune or aging proxies.
- **Optional longitudinal follow-up:** to examine longer-term associations with biological aging indicators.

No deception is used.

Risks and Risk Mitigation

Risks are **minimal** and include mild discomfort from wearable devices or biological sample collection. There is a small risk of fatigue or emotional discomfort during experiential sessions. Risk mitigation includes trained staff oversight, optional breaks, clear withdrawal rights, and conservative interpretation of exploratory biomarkers. No psychoactive substances are administered or encouraged.

Benefits

Participants may gain insight into their wellbeing patterns and contribute to research aimed at understanding positive psychosocial factors in health and aging. There is no guarantee of direct personal benefit.

Data Protection and Confidentiality

All data will be pseudonymized and stored on secure, access-controlled systems. Identifiable information will be kept separate from research data. Data will be used for research purposes only and handled in accordance with applicable data protection regulations.

Ethical Considerations

This study adheres to the principles of respect for persons, beneficence, and justice. The research focuses on observation and measurement rather than intervention, and all analyses are pre-specified to reduce bias. Findings will be reported in aggregate to protect participant privacy.

Summary

The JoyScore Experiment is a low-risk, ethically sound study designed to validate a novel psychosocial measurement framework and explore its relationship to resilience and healthy aging. The study employs non-invasive methods, transparent analysis plans, and robust safeguards to protect participants while advancing knowledge in exposome and wellbeing science.

See the Appendix for full OSF registration text.

Appendix

OSF PREREGISTRATION

Study Title

The JoyScore Experiment: Measuring Joy, Meaning, and Social Connection as Components of the Human Exposome

Research Questions

1. Can JoyScore be validated as a coherent, sensitive, and interpretable construct capturing joy, meaning, belonging, and recovery?
2. Do structured social–sensory experiences produce measurable changes in JoyScore and its underlying mechanisms?
3. Are repeated JoyScore-positive exposures associated with favourable short-term recovery dynamics and longer-term biological resilience proxies?

Study Design

This is a mixed-methods, longitudinal, within-subject study comprising:

- Repeated ecological momentary assessment (EMA)
- Structured experiential interventions (e.g. music-based collective experiences)
- Neural, physiological, and biochemical measurements
- Optional longer-horizon biological ageing and immune profiling

The study explicitly separates **measurement validation** from **intervention testing**.

Conceptual Framework

Measures are organised across three layers:

1. **Context & Exposures**
Social, sensory, behavioural, and environmental conditions (e.g. collective vs solitary)

context; music exposure; circadian timing).

2. **Joy Mechanisms (Mediators)**

Affective uplift, belonging/social safety, meaning/purpose, and emotional regulation/recovery.

3. **Joy Outcomes (Ends)**

Psychological flourishing and resilience outcomes, and longer-horizon biological proxies reflecting cumulative exposure.

Hypotheses

Aim 1 — Measurement Validation

H1 (Construct coherence):

JoyScore components (joy/affect, belonging, meaning/purpose, recovery capacity) will load onto a common latent construct within individuals across time.

H2 (Context sensitivity):

JoyScore will vary systematically with social and sensory context within individuals, independent of baseline wellbeing.

H3 (Convergent validity):

JoyScore will correlate with validated wellbeing constructs while remaining distinct from isolated physiological metrics.

Aim 2 — Intervention & Mechanistic Effects

H4 (Exposure → Joy mechanisms):

Structured social–sensory experiences will increase Joy Mechanism variables relative to baseline and comparator conditions.

H5 (Neural mediation):

Changes in Joy Mechanism variables will be associated with state-dependent EEG dynamics during exposure blocks.

H6 (Recovery mediation):

Higher JoyScore will predict improved short-term emotional and physiological recovery indicators.

Longitudinal & Biological Embedding

H7 (Stress-recovery trajectories):

Participants with higher cumulative JoyScore trajectories will show more favourable stress-recovery slopes (e.g. GDF15, metabolomic recovery metrics).

H8 (Immune & ageing proxies — exploratory):

Higher cumulative JoyScore exposure will be associated with favourable immune and biological ageing signatures (glycan-based and epigenetic measures) at follow-up.

Design & Sequencing

H9 (Sequencing effects):

Experiential phase order (e.g. CALM→FLOW→CONNECT→PEAK) will differentially influence peak JoyScore and post-experience recovery.

Generalisation

H10 (Beyond raves):

Validated non-rave psychosocial interventions will also increase JoyScore, supporting generalisability of the metric.

Sample Size Rationale

This study is powered for **within-subject detection of state change and trajectory estimation**, not population-level disease outcomes. Effect sizes will inform subsequent confirmatory trials.

Analysis Plan Overview

Primary analyses will use **linear mixed-effects models** with participant-level random effects. No interim hypothesis testing will be used to alter hypotheses.

HYPOTHESIS → VARIABLE → MODEL MAPPING

Hypothes is	Outcome Variable(s)	Predictor(s)	Model
H1	JoyScore components	Time (repeated)	Multilevel CFA / latent variable model

H2	JoyScore total	Context (collective vs solitary; music vs control)	`lmer(JoyScore ~ Context + (1
H3	JoyScore	Validated wellbeing scales	Pearson/Spearman + multilevel correlation
H4	Joy mechanisms (EMA)	Intervention condition	`lmer(EMA ~ Condition + (1
H5	EEG features	JoyScore change	`lmer(EEG_metric ~ JoyScore + (1
H6	Recovery EMA / sleep proxies	JoyScore	`lmer(Recovery ~ JoyScore + covariates + (1
H7	GDF15 slope / metabolomic recovery	Cumulative JoyScore	`lmer(Biomarker ~ JoyScore_traj + (1
H8	GlycanAge / epigenetic age	JoyScore trajectory	lm(FollowUpAge ~ BaselineAge + JoyScore)
H9	Peak JoyScore / recovery	Sequence order	`lmer(JoyScore ~ Sequence + (1
H10	JoyScore	Intervention type	`lmer(JoyScore ~ Intervention + (1

Covariates (where applicable):

sleep duration, time-of-day, hydration, caffeine, alcohol/substances, illness.

PRIMARY vs EXPLORATORY OUTCOMES TABLE (IRB-READY)

Category	Outcome	Status	Rationale
Psychological	JoyScore composite	Primary	Core construct under validation

Psychological	Meaning/purpose; belonging	Primary	Central to “joie de vivre” framing
Neural	EEG state dynamics	Primary (mechanistic)	Tests mediation
Recovery	Emotional recovery EMA	Primary	Resilience outcome
Biochemical	GDF15 trajectories	Secondary	Stress-recovery proxy
Metabolomic	Recovery Margin (Deleón)	Secondary	Mechanistic discovery
Immune ageing	GlycanAge	Exploratory	Long-horizon embedding
Epigenetic ageing	AgeRate	Exploratory	Validation anchor
Sleep/HRV	Rest-only metrics	Exploratory	Contextual support

Final IRB / OSF Summary Sentence

This preregistration specifies hypotheses, variables, and analytic plans in advance to distinguish measurement validation from intervention testing, minimise analytic flexibility, and support transparent, reproducible evaluation of joy, meaning, and social connection as components of the human exposome.

List of references

Synchrony, Dance, and Social Bonding

- Tarr, B., Launay, J., & Dunbar, R. (2016). Synchrony and exertion during dance independently raise pain threshold and encourage social bonding. *Biology Letters*, 12(10).
- Vicary, S., Sperling, M., von Zimmermann, J., Richardson, D., & Orgs, G. (2017). Joint action aesthetics. *PLoS One*, 12(7).

- Von Zimmermann, J., Vicary, S., Sperling, M., Orgs, G., & Richardson, D. (2018). The choreography of group affiliation. *Topics in Cognitive Science*, 10(1), 80–94.

Music Tempo, BPM, and Synchrony Effects

- Janata, P., Tomic, S., & Haberman, J.M. (2012). Sensorimotor coupling in music and the psychology of the groove. *Journal of Experimental Psychology: General*, 141(1), 54–75.
- Müller, V., & Lindenberger, U. (2011). Cardiac and respiratory patterns synchronize between persons during choir singing. *PLoS ONE*, 6(9).
- Stupacher, J., Witek, M.A.G., Vuust, P., Schroeder, N., & Keller, P.E. (2017). Dance music increases interpersonal closeness. *Frontiers in Psychology*, 8: 1906.
- Zamm, A., Debener, S., & Sebanz, N. (2021). The sound of synchronization: Tempo tuning and social connection. *Psychological Science*, 32(6), 942–954.

Neurobiology of Music & Synchrony

- Koelsch, S. (2014). Brain correlates of music-evoked emotions. *Nature Reviews Neuroscience*, 15, 170–180.
- Dikker, S., Silbert, L.J., Hasson, U., & Zevin, J.D. (2014). Synchrony in brain activity predicts group interaction quality. *Current Biology*, 24(23), 2843–2848.
- Bevilacqua, D., Davidesco, I., Wan, L. et al. (2019). Brain-to-brain synchrony and learning outcomes vary by student–teacher dynamics. *Journal of Cognitive Neuroscience*, 31(3), 401–411.

Dance, Neuroplasticity, and Biomarkers

- Rehfeld, K., Müller, P., Aye, N. et al. (2017). Dancing or fitness sport? The effects of two training programs on hippocampal plasticity and balance abilities in healthy seniors. *Frontiers in Human Neuroscience*, 11, 305.
- Kattenstroth, J.-C., Kalisch, T., Holt, S., Tegenthoff, M., & Dinse, H. (2013). Six months of dance intervention enhances postural, sensorimotor, and cognitive performance in elderly without affecting cardio-respiratory functions. *Frontiers in Aging Neuroscience*, 5, 5.

Social Connection, Healthspan, and Longevity

- Holt-Lunstad, J., Smith, T.B., Baker, M., Harris, T., & Stephenson, D. (2015). Loneliness and social isolation as risk factors for mortality: A meta-analytic review. *Perspectives on Psychological Science*, 10(2), 227–237.
- Haslam, C., Cruwys, T., & Haslam, S.A. (2014). The we’s have it: Evidence for the distinctive benefits of group engagement in enhancing cognitive health in aging. *Social Science & Medicine*, 120, 57–66.

- Epel, E., & Blackburn, E.H. (2017). *The Telomere Effect: A revolutionary approach to living younger, healthier, longer*. Grand Central Publishing.
- Launay et al. (2016). 'Group Music-Making Increases Social Bonding'. *Scientific Reports*.
- Durkheim (1912/2008). 'The Elementary Forms of Religious Life'—concept of collective effervescence as a health-promoting state.

Techno-Isolation, AI, and Cultural Risks

- Turkle, S. (2017). *Alone Together: Why we expect more from technology and less from each other*. Basic Books.
- Cacioppo, J.T., & Cacioppo, S. (2018). Loneliness in the modern age: An evolutionary theory of loneliness (ETL). *Advances in Experimental Social Psychology*, 58, 127–197.

Mental Health & Wellbeing Benefits

- Koch et al. (2019). 'Effects of Dance Movement Therapy and Dance on Health-related Psychological Outcomes'. *Frontiers in Psychology*.
- Fong Yan et al. (2024). 'Effectiveness of Dance Interventions Compared with Other Physical Activity'. *Sports Medicine*.
- Quiroga Murcia et al. (2010). 'Emotions Associated with Dance Movement'. *International Journal of Psychology*.

Physical Health & Longevity Benefits

- Merom et al. (2016). 'Dancing and Cardiovascular Risk in Older Adults'. *American Journal of Preventive Medicine*.
- Rehfeld et al. (2018). 'Dance training improves brain structure and balance'. *Frontiers in Human Neuroscience*.
- Keogh & Kilding (2021). 'Physical and Functional Benefits of Dance for Healthy Adults'. *Journal of Aging and Physical Activity*.

[1] Kern C, Bonventre JV, Justin AW, Kashani K, Reynolds E, Siew K, Davis B, Karakoy H, Grzesiak N, Bailey DM. Necrosis as a fundamental driver of loss of resilience and biological decline: what if we could intervene? *Oncogene*. 2025 Jul;44(24):1893-1904. doi: 10.1038/s41388-025-03431-y. Epub 2025 May 29. PMID: 40437182.

[2] Kern, C.; Faragher, R.; Woods, T.; Bonventre, J.; Jenkins, A.; Stebbing, J. The Architecture of Aging: How Ageing Drives Disease (Blueprint Theory). *Preprints* 2023, 2023101387. <https://doi.org/10.20944/preprints202310.1387.v4>

