

Viability of Transformative Technology to Support Trauma Recovery, Resilience Building, & Healthy Stress Management in Community- Based Settings

By: Jessee Steele, Seth Saeugling, & Camilla Dohlman

ABOUT
ROI

📍 Rural Opportunity Institute

The Rural Opportunity Institute (ROI), based in Tarboro, North Carolina, is a social innovation lab that designs solutions built around the needs of individuals and families in rural Eastern NC.

Our goal is to end generational cycles of trauma and poverty by preventing adverse childhood experiences (ACEs) and toxic stress.

We are working towards creating a system that builds the capacity of rural communities to support people's healing from adversity to achieve health, safety, connection, and self-determination for current and future generations.

To learn more about our work, visit www.ruralopportunity.org



REPORT

Table of Contents

- 01** **Introduction**
PART I
- 06** **The Opportunity**
PART II
- 10** **Technology Overview**
PART III
- 17** **Technology Profiles**
PART IV
- 39** **Methods**
PART V
- 43** **Appendix**
PART VI
- 47** **Bibliography**
PART VII

Introduction



The Challenge

Punitive responses to trauma, toxic stress, and ACEs that result in intergenerational trauma, unjust isolation, and obstacles to healing.

ROI knows that people are not to blame for the trauma and stress that impacts them and that resilience is an inner strength in humans, regardless of background. Often when people are coping with stress or ACEs, they are met with punishment, isolation, and silencing. These are pervasive responses across society—found in schools, work places, family structures, and the carceral system. These responses lead to people being criminalized and excluded from safe environments and supportive services, precisely when they are most in need of support. The human body and brain are wired to heal and connect, but environmental and institutional forces often create blockages that prevent this healing process from taking place.

In addition to preventing healing from trauma, unsafe environments can produce the conditions necessary for ACEs to occur, threatening positive early development. Abuse and neglect are keystone examples of ACEs. These experiences can severely hinder healthy child development, and can lead to maladaptive coping strategies and poor impulse control. Early ACEs research found a positive association between the number of ACEs experienced and the likelihood of mental illness, alcoholism, and illicit drug use—all of which may result in incarceration and punishment that further prevents healing.

Past research also suggests that toxic stress affects the development of self-regulation and executive function skills (i.e., the ability to plan, focus attention, remember instructions, and juggle tasks). Such abilities are fundamental for success in schools and the workplace, and for building supportive relationships. Without these skills, people are more likely to be left behind and labeled as inherently flawed. Rather than responding to someone who experiences ACEs with supportive and healing environments, our society responds by further punishing, isolating, and condemning the person.

ROI recognizes that at its core, this problem is deeply systemic and can only be fully resolved through institutional restructuring. Cycles of trauma can be disrupted through replacement of punitive responses with restorative ones. Thus, this report aims to identify safe, effective, and easy-to-use technologies for community and grassroots organizations that want to facilitate trauma-informed healing experiences, build resilience, and promote healthy stress management for their constituents.

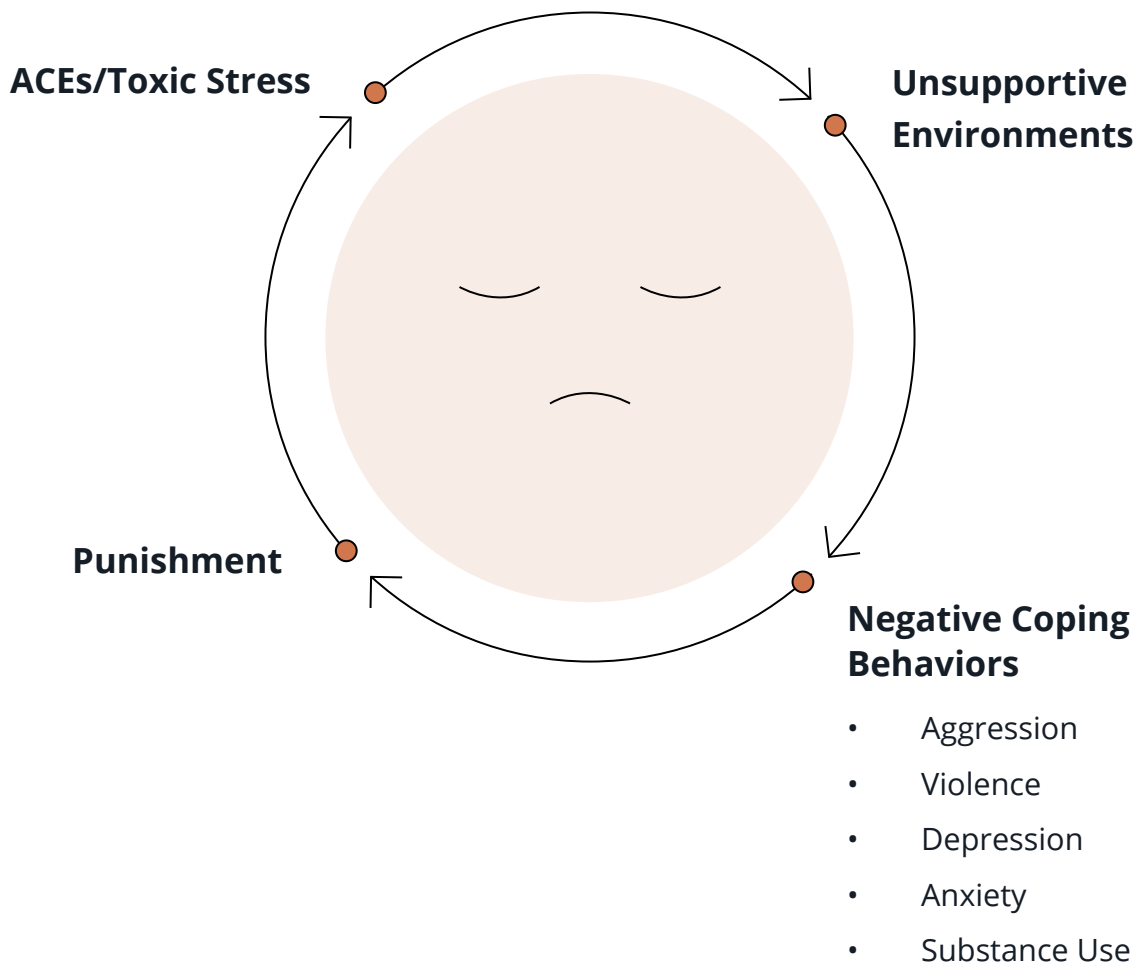
THE CHALLENGE

Cycle of Trauma

The human body and brain are wired to heal and connect, but environmental and institutional forces often create blockages that prevent this healing process from taking place.

Our hope is that community leaders can find creative ways to interrupt the cycle of trauma, to become less punitive, and to promote healing when responding to people under intense stress (aka being “trauma-informed”).

The goal is to break the negative cycle that results from ACEs and toxic stress, shown below.



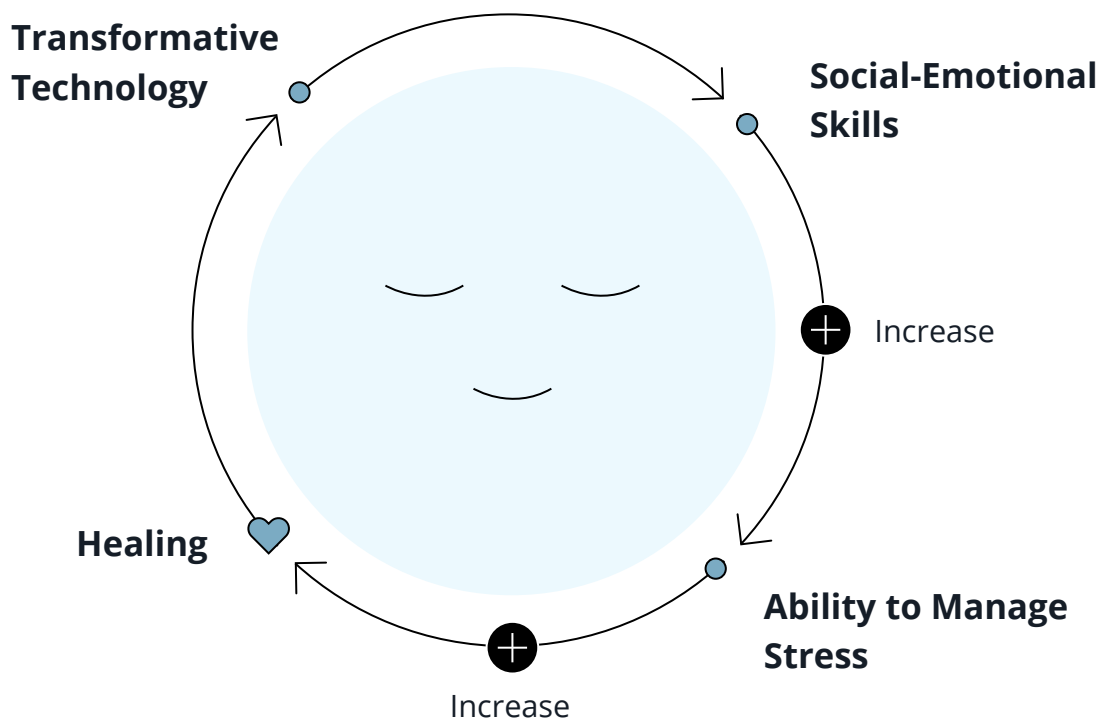
The Solution

Using Transformative Technologies as tools for organizations to replace punitive solutions with restorative ones, to support healing from trauma, and to develop healthy stress management among constituents.

Transformative Technology

Transformative Technology is “tech that can facilitate positive mental health, emotional well-being, and enhanced human thriving.” In other words, these technologies are evidence-based hardware and software that can produce reliable and positive changes in the human experience.

Due to a rapid increase in the affordability and development of technology, Transformative Technology continues to produce new solutions that can improve people’s health. Transformative technology products that have emerged in the last decade have the potential to radically transform how grassroots organizations and other community-based settings respond to trauma



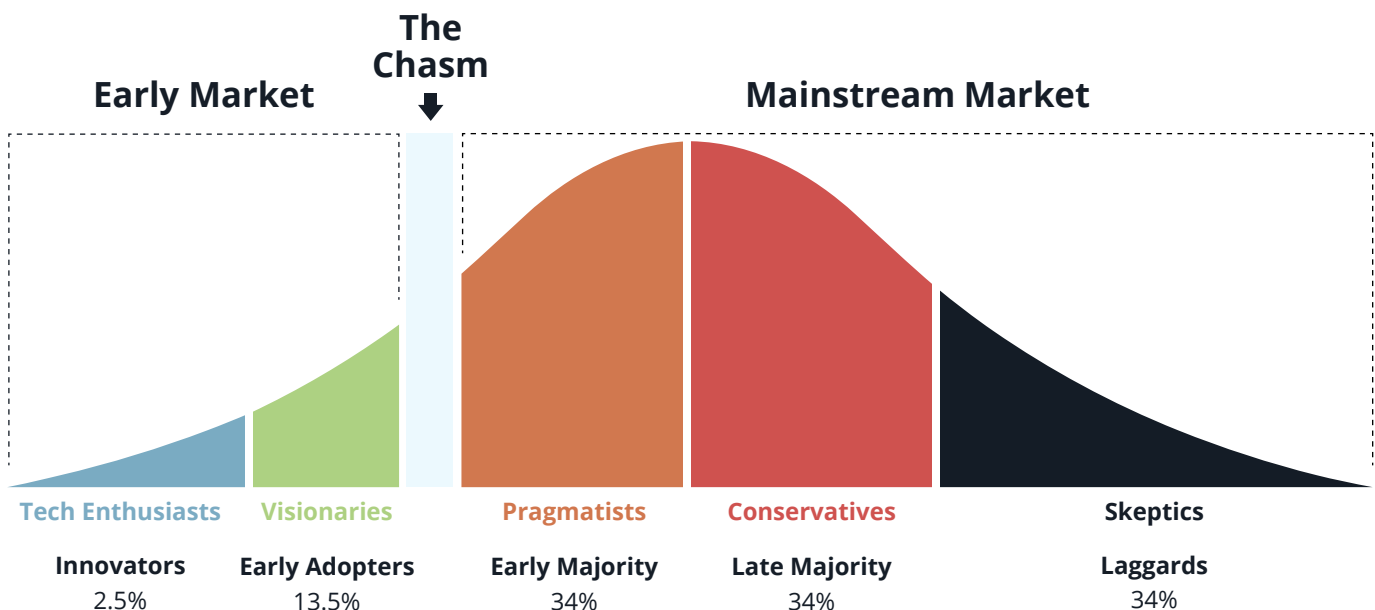
THE SOLUTION

Crossing The Chasm

Technology can be a gap-widening force that inherently privileges an already privileged class. Those who can afford technologies have access to new tools to improve their — and grow their pre-existing wealth, while those who don't have access fall further behind. This evaluation of Transformative Technology focuses on collecting information relevant to grassroots organizers interested in bringing technology solutions to their communities—especially in rural, majority African American communities, like the community that ROI serves.

As detailed by Geoffrey Moore in his novel, *Crossing the Chasm*, the majority of people who are currently accessing Transformative Technologies are “Innovators” and “Early Adopters.” These broad groups are typically characterized by CEOs, high-performing athletes, and other wealthy elites. Transformative Technology brands certainly know this too; their landing pages are riddled with ads for corporate consumers and discounts for businesses. Certain brands even advertise their products as having all of the productivity benefits of caffeine with none of the anxiety and insomnia.

In other words, Transformative Technologies are inherently neutral: they can be used by corporations as an excuse to extract more labor out of their employees or as tools to heal from toxic stress. It is critical to recognize that although Transformative Technologies help facilitate the healing process, their application doesn't justify the upkeep of harmful organizational practices. If an employee is stressed because their boss selectively mistreats them, the solution is not just telling the employee to use a biofeedback breathing device to manage their stress. This tension between individual action and collective change is central when considering whether Transformative Technologies are appropriate in an organization's trauma-informed policies. This report seeks to define clear pathways that individuals and organizations can take to bring Transformative Technologies to the “Mainstream Market” in community-based settings.



The Opportunity



Transformative Tech

Making Transformative Technologies accessible to communities and users that often do not access them.

The Goal

Our goal at ROI is to get the best institutional practices and policies into the hands of grassroots community leaders who run programs that serve vulnerable and isolated community members. We believe the information contained in this report—and in the Transformative Technology field more broadly—can support trauma recovery, resilience building, and healthy stress management.

Innovation

ROI defines innovation as “delivering new value in the eyes of your customer/user.” We are driven by the idea of smashing disparate worlds together, combining the deep assets of one community with the tools and resources of another one. We believe there is an opportunity for the most promising Transformative Technologies to reach new potential audiences, especially in more grassroots and community-based settings.



Potential Audience

Original Intended Audience



- ✓ Fortune 500 CEOs
- ✓ Olympic, professional, and collegiate athletes
- ✓ NASA Astronauts
- ✓ The US Military (Army, Navy, Air Force, Coast Guard, Marine Corps, and Space Force)
- ✓ Top academic researchers
- ✓ High-stress employees
- ✓ White-collar employees
- ✓ People diagnosed with PTSD
- ✓ Corporations interested in higher productivity workforce
- ✓ Independent consumers who can finance their own purchase and have time to use their device
- ✓ Predominantly White or light-skinned populations

Potential Audience



People under chronic stress that could be currently served through:

- ✓ Public school system
 - Alternative learning programs
 - Alternatives to suspensions
 - In-school suspension
- ✓ Department of Social Services
 - Foster care
 - Adoption services
 - Child protective services
 - Elderly protective services
- ✓ Health Department
 - Young parents
 - Clients with stress-related health challenges
- ✓ Federally Qualified Health Center (FQHC)
 - Clients with stress-related health challenges
- ✓ Places of worship
- ✓ Recreation centers
- ✓ Boys & Girls Clubs
- ✓ Rehabilitation centers

What You Can Do

Potential next steps for community organizers looking to pilot and use these Transformative Technologies.



1 Get In Touch

We'd love to partner and work together. If you run a community-based program, especially in the rural southern United States, and would like to pilot any of the technologies in this report, towards the goal of supporting people's healing from trauma, please send us an email:

info@ruralopportunity.org

Subject Line: Transformative Technology

More info can be found at **ruralopportunity.org**

- 2 Survey community members to better understand their needs and how Transformative Technology could play a part in promoting improved health and wellbeing
 - After surveying community members, determine which technology will best align with the needs of community members
- 3 Survey community members to ask input on a selection of technologies with brief descriptions of each
- 4 Allow individual people and organizations to do small pilot tests of different technologies to see impacts and results on a small scale, before having to commit to a bigger program
- 5 Perform a trial run of the technology
 - If feasible and ethically appropriate, evaluate the effectiveness of the technology by comparing results in a group using the technology to a group that is similar demographically and is not using the technology
- 6 Expand the program with continued experimental infrastructure for continued program evaluation

Technology Overview



Technologies Profiled

Of 48 different Transformative Technologies that were identified, 18 have been profiled in detail for this report in alphabetical order, with no preference or priority given to any one technology.















These are the technologies profiled:

- | | | | |
|-----------|------------------------|---|---|
| 01 | Airo |  |  |
| 02 | Apollo |  |  |
| 03 | Core |  |  |
| 04 | Cove |  |  |
| 05 | Doppel |  |  |
| 06 | FeelZing |  |  |
| 07 | Hapbee |  |  |
| 08 | Happify |  |  |
| 09 | Healium |  |  |
| 10 | HeartMath InnerBalance |  |  |
| 11 | Lief Therapeutics |  |  |
| 12 | Mendi |  |  |
| 13 | Muse | | |
| 14 | NeoRhythm | | |
| 15 | Sana | | |
| 16 | Sensate | | |
| 17 | TouchPoint | | |
| 18 | TRIPP | | |

Quick Glance

Benefits Provided & Challenges Addressed

Below is a table that shows which technologies provide specific benefits and which technologies address specific challenges.

Challenges Addressed		Helpful Technology		
 	Improves attention	Mendi		
 	Improves awareness of body & mind sensations	Airo		
 	Improves brain function (oxygen flow in the prefrontal cortex)	Lief Therapeutics Mendi		
 	Improves focus	Core Doppel FeelZing Hapbee	Healium HeartMath Mendi Muse	NeoRhythm Sana TouchPoint TRIPP
 	Improves happiness	Happify		
 	Improves memory	Mendi		
 	Improves mental speed	Mendi		

*Continued on next page

TECHNOLOGIES PROFILED

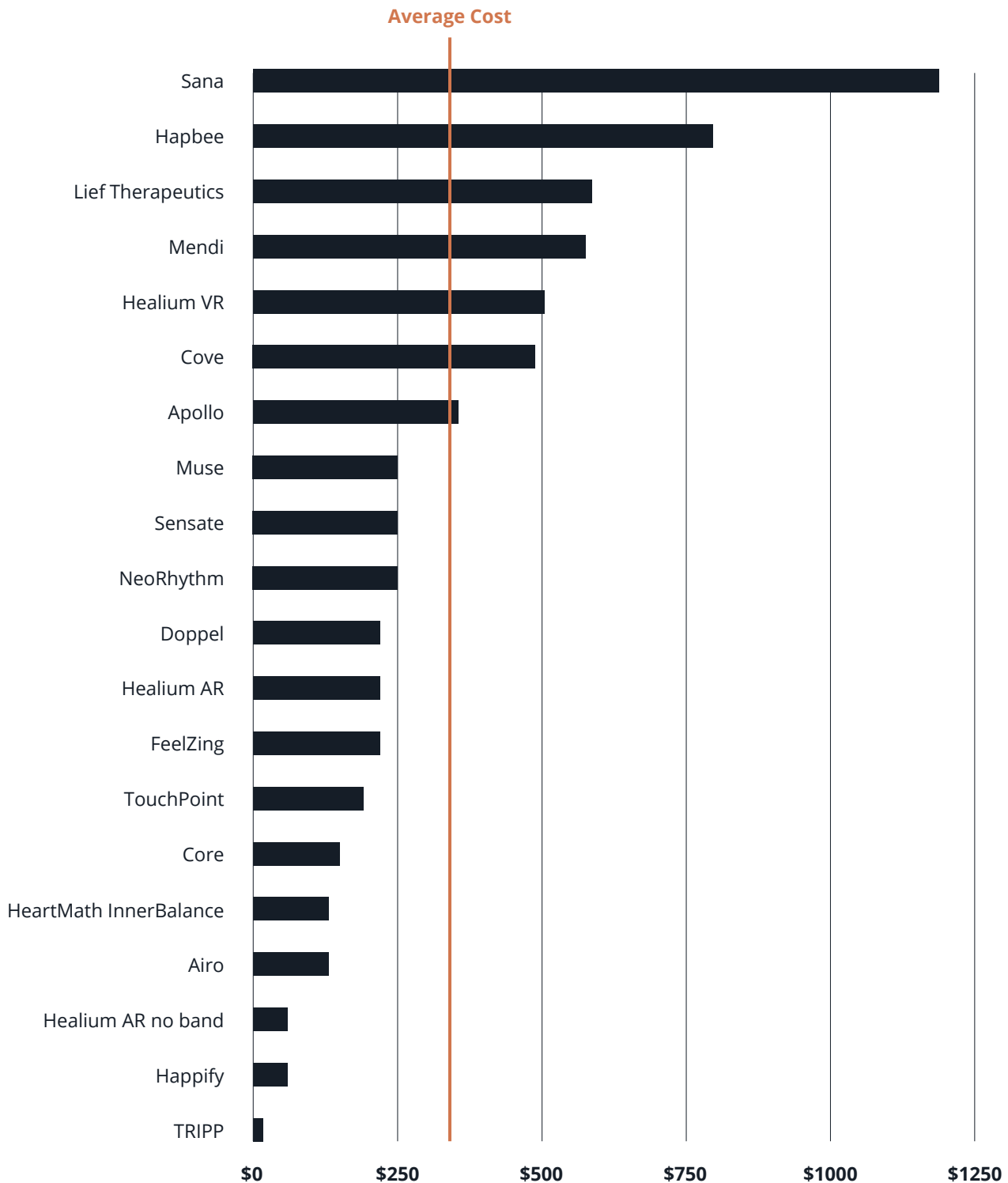
Quick Glance

Challenges Addressed		Helpful Technology	
 	Improves mood	FeelZing Healium Muse NeoRhythm	Sana Sensate TouchPoint
 	Improves resilience	Apollo Core Doppel Hapbee	Happify HeartMath TRIPP
 	Improves sleep	Apollo Cove Muse	Sana TouchPoint
 	Reduces anxiety	Apollo Core Doppel Hapbee	Happify Healium HeartMath Muse Sensate TRIPP
 	Reduces depression	Apollo Happify	
 	Reduces perception of pain	NeoRhythm Sana	
 	Reduces stress	Every technology listed in this report	
 	Reduces substance misuse	Sana	

Price Comparison

Price Per Person (\$USD)

Subscription services scaled for a year of costs



TECHNOLOGIES PROFILED

Ranking

Below is a rating system for each profiled technology. While a rubric was followed when assigning marks, these scores are not entirely prescriptive of which technology is best for every setting. Rather, the star ratings take into account whether the product could feasibly and effectively be implemented and evaluated in a community-based setting. For more information on how these technologies were rated, please refer to the Methods section at the end of this report.

★ Full Star
 ☆ Half Star
 ☆ No Star

Technology	Measurability	User-Friendliness	Experimental Support	User Barrier To Entry	Long-Term Impact	Price (Per Person/Device)	Total Rating
Airo	★	★	☆	★	★	\$130-\$200	★★★★☆
Apollo	☆	☆	★	★	☆	\$349	★★★★☆☆
Core	★	★	☆	★	☆	\$149-\$219	★★★★☆☆
Cove	☆	★	★	☆	☆	\$490	★★★★☆☆
Doppel	☆	★	★	★	☆	\$219	★★★★☆☆
FeelZing	☆	★	★	★	☆	\$216	★★★★☆☆
Hapbee	☆	★	☆	★	☆	\$799	★★★★☆☆
Happify	★	☆	☆	★	★	\$59.40	★★★★☆
Healium	★	★	★	★	☆	\$60-\$504	★★★★☆

*Continued on next page

TECHNOLOGIES PROFILED

Ranking

★ Full Star ★ Half Star ☆ No Star

Technology	Measurability	User-Friendliness	Experimental Support	User Barrier To Entry	Long-Term Impact	Price (Per Person/Device)	Total Rating
HeartMath	★	★	★	★	★	\$129-\$499	★★★★★
Lief Therapeutics	★	★	★	☆	★	\$588	★★★★☆
Mendi	★	★	☆	★	★	\$578	★★★★☆
Muse	★	★	★	★	☆	\$250	★★★★☆
NeoRhythm	☆	★	★	★	☆	\$249	★★★★☆
Sana	☆	★	★	★	☆	\$1188	★★★★☆
Sensate	☆	★	☆	★	☆	\$249	★★★★☆
TouchPoint	☆	★	★	★	★	\$190	★★★★☆
TRIPP	☆	★	☆	★	☆	\$315	★★★★☆

Technology Profiles



TECHNOLOGY PROFILES

Airo

airohealth.com



A wristband that measures heart rate variability to notify users when they enter a state of stress. This technology aims to gently inform users of what triggers their stress through phone notifications and what activities help reduce one’s stress. The associated app visualizes trends in heart rate variability and provides guided exercises for users to destress.



Cost

\$129.99 (marked as a discount from \$200.00)



What challenge does it address?

Airo attempts to address chronic stress by providing users information about their stress triggers in the form of somatic data. It has also been used to complement therapy experiences and help accelerate therapy-based healing processes.



How does it address this challenge?

By notifying users when they enter a point of stress, users are able to learn what their individualized stressors are. With the proper information, users can then structure their days and activities to avoid chronic stress. Built-in activities help users immediately reduce their stress and increase their resilience.

02

TECHNOLOGY PROFILES

Apollo

apolloneuro.com



A wrist or ankle band that vibrates at specific frequencies to alter parasympathetic nervous system activity. Different vibrational settings allow users to select whether they would like to feel more energized or relaxed.



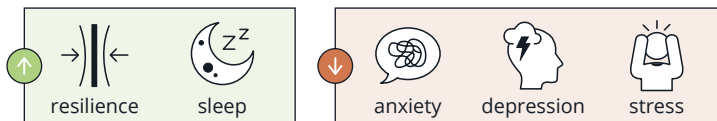
Cost

\$349 per person



What challenge does it address?

Chronic stress is the result of excess “fight-or-flight” survival responses from the sympathetic nervous system. Apollo seeks to rebalance the sympathetic and parasympathetic nervous system in order to improve insomnia, anxiety, and depression—even claiming to better chronic pain, memory loss, metabolic disorders, and cardiovascular disease. Their claims are based on past research which suggests that people with lower heart rate variability are more likely to develop chronic health conditions. Apollo has also been tested independently within the University of Pittsburgh for efficacy, although results haven’t been published in peer-reviewed journals.



How does it address this challenge?

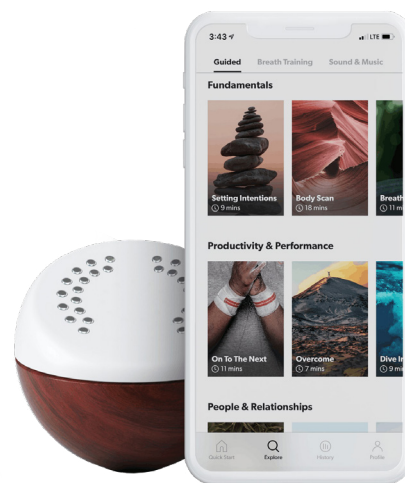
Selectively applying known frequencies allows Apollo to influence parasympathetic and sympathetic nervous system activity. The measurable result is an improvement in heart rate variability.

03

TECHNOLOGY PROFILES

Core

hellocore.com



A handheld wooden sphere that tracks heart rate variability in order to improve users' meditation experiences. An accompanying app grants feedback on users' meditation data. Paid subscriptions are also available to gain access to daily-updated meditations, biofeedback breath training, and even soundscapes.



Cost

\$149 per person

\$219 per person, including 12 months of subscription content

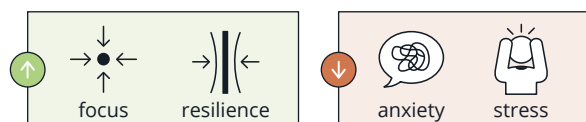
\$69.99 per year for subscription

Other options for corporate one offs



What challenge does it address?

Core claims to boost user morale, decrease stress, sharpen focus, bolster creativity, and improve resiliency. Their website does not cite any empirical evidence to show that Core is associated with improved —, but their strategy is based on past research that suggests increasing heart rate variability has numerous health benefits.



How does it address this challenge?

Core addresses chronic stress by supporting users in the development of consistent meditation habits. Depending on which option is chosen, the Core wooden sphere can either vibrate alongside one's breathing or vibrate once it detects the users' focus drifting via an increase in heart rate.

Cove

feelcove.com



A wearable subscription device that mimics affective touch in order to reduce stress and improve sleep simultaneously. It comes with a companion app that lets users manually track their changes in sleep and stress, while setting reminders to use Cove.



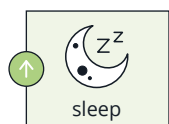
Cost

\$490 total (\$45 a month)



What challenge does it address?

Cove seeks to reduce chronic stress, improve sleep quality, and develop resiliency within users. Multiple clinical trials have demonstrated that Cove improves sleep quality, reduces insomnia, and decreases symptoms associated with high stress. Cove also emphasizes the fact that these clinical trials did not find any associated side-effects. It is unclear whether these trials have undergone peer-review or official publication based on their website.



How does it address this challenge?

Cove relies on modifying the body's sense of interoception, which is its ability to internally monitor heart rate, hunger, breathing patterns, and more. Previous studies have shown that when interoception is compromised, people are more susceptible to chronic stress and exhaustion. Calming physical contact—called affective touch—has been shown to activate the insula, which is a critical component in the interoceptive pathway. Cove mimics affective touch to improve interoceptive capabilities and thereby reduce experiences of chronic stress and insomnia.

Doppel

feeldoppel.com



A wristwatch that discreetly vibrates at specific rhythms to induce desired mental states within a user. The companion app allows users to select whether they would like to feel relaxed, calm, focused, alert, or energized; users can also create their own rhythms.



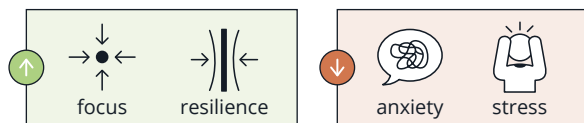
Cost

\$219.00



What challenge does it address?

Doppel seeks to provide a non-distracting alternative to music—a tool that can empower users to modify their mental state through vibrational rhythm. Primarily, one clinical trial has demonstrated that Doppel tangibly reduces stress within people before public speaking, as measured via lower skin conductance and self-reported anxiety levels.



How does it address this challenge?

A user's nervous system syncs with slower vibrations to experience more restfulness and less stress, while users are imbued with more energy when faster vibrations are used. This work is based on principles in physiological entrainment, in which respiratory or cardiac cycles may match specific rhythms that result in changes in mood.

06

TECHNOLOGY PROFILES

FeelZing

feelzing.com



A cranial, four-time-use patch that utilizes electrical signals to improve focus and mental clarity via neurostimulation. It requires no connection with other digital devices, like phones. Patches are purchased on a subscription basis.



Cost

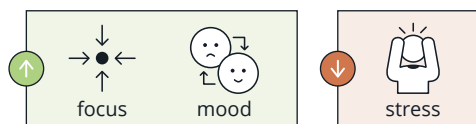
\$20 for one four-time-use patch

\$18 per four-time-use patch if on monthly subscription



What challenge does it address?

FeelZing provides a non-chemical method of improving energy and mental acuity. Other stimulants, like caffeine, may conjointly cause anxiety and insomnia. For people interested in maximizing their productivity, FeelZing offers a non-invasive option to improve focus, alertness, and clarity. The parent company, Thync, has produced four research studies detailing the efficacy of their neurostimulation techniques one of which has been published in a highly reputable, peer-reviewed journal (Tyler et al., 2015).



How does it address this challenge?

Like many other Transformative Technologies, FeelZing functions by balancing the parasympathetic and sympathetic nervous systems. Specifically, electric waveforms are sent to the autonomic nervous system to achieve this goal.

TECHNOLOGY PROFILES

Hapbee

hapbee.com



A headband that gives users the capability to select and enjoy a given mental state, ranging from alertness to deep relaxation. It is accompanied by an app that users can use to select which mental state they would like to experience.



Cost

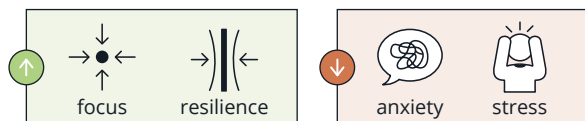
\$299.00 (discounted from \$379) + \$19 monthly

\$799.00 (discounted from \$999) for permanent ownership



What challenge does it address?

Hapbee allows users to have control over their desired mental state to make completing certain tasks easier. Preliminary trials have revealed that only 75% of new users could feel anything when using Hapbee, but all users who went through an onboarding process could feel a distinct difference between Hapbee's various signals. Clinical trials have not been conducted to determine whether Hapbee effectively induces the mental states it claims to induce.



How does it address this challenge?

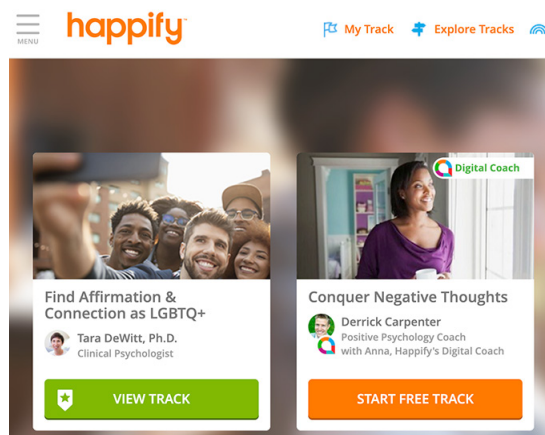
Hapbee uses ultra-low radio frequency energy technology to produce desired feelings in the body: happiness, alertness, focus, relaxation, calmness, and sleepiness. The device generates these sensations by delivering precise low-power electromagnetic signals. A companion app allows users to select which mode they would like in real-time.



TECHNOLOGY PROFILES

Happify

happify.com



An online community and software that operates under the belief that happiness is a skill that can be honed. The program features personalized tracks with activities to foster wellness, alongside periodic feedback to help users keep tabs on their mental state. A free version is available, but many features are locked behind a paid subscription service.



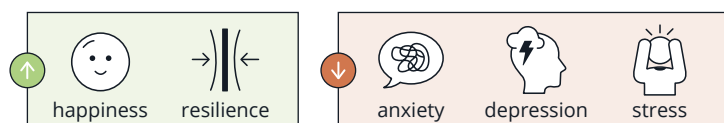
Cost

\$59.40 for one year if on the 2 year plan



What challenge does it address?

Many people are dissatisfied with their lives and are unsure of how to find the good in life. Happify seeks to help coach people into taking ownership over their emotional lives. These principles are grounded in over 450 research articles.



How does it address this challenge?

Happify uses six key methods to help guide users in improving their satisfaction with life: savoring the present, thanking those who matter, aspiring towards meaningful goals, giving to oneself, empathizing with others, and incorporating physical activity. Each track consists of evidence-based strategies to meet that track's goals. For example, the "Conquering Negative Emotions" track uses techniques from Cognitive Behavioral Therapy, Behavioral Activation, Positive Psychology, Psychoeducation, and Acceptance & Commitment Therapy. By including mini games, AI conversations, and feedback, users are able to not only practice happiness but also make informed decisions based on their data.

TECHNOLOGY PROFILES

Healium

tryhealium.com



A Virtual Reality (VR) and Augmented Reality (AR) software that visualizes users' brain waves and heart rate to help improve mood, reduce anxiety, and increase focus during meditation. Healium comes with an optional electroencephalogram headband that allows for more advanced biometrics to be measured and viewed.



Cost

Healium Pro Subscription: Oculus Quest 1-2 | Pico Goblin: \$29.00 / month

BrainLink Lite EEG Headband: \$156.00

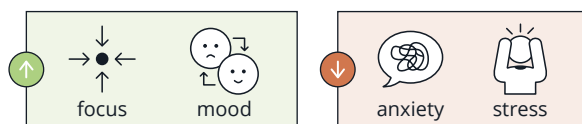
Augmented Reality App: \$4.99 per month

For business, government, & enterprise: \$99.00 (unclear which products included)



What challenge does it address?

Healium poses the question: "How can you learn to control your stress if you can't SEE your mood states?" They believe that learning how to reduce one's chronic stress via somatic methods is made easier by having real-time, visual feedback. Clinical trials show that Healium effectively increased user immersion into meditation, reduced anxiety as measured by quantitative EEG, improved mood, and elevated empathy.



How does it address this challenge?

Healium uses VR and AR to visualize users' calmness based on brain activity and heart rate. It is unclear through what mechanism VR/AR improves meditation experiences; one possible explanation is increased gamma activation in cranial areas associated with empathy and emotional response. One of the clinical studies using Healium found that when AR was combined with their neurofeedback headband, there was no significant change found in magnitude of mood improvement. When the AR experience was combined with neurofeedback, however, users reported higher engagement and immersion.

TECHNOLOGY PROFILES

HeartMath InnerBalance

heartmath.com/the-inner-balance



A sensor clip that can be attached to the user's finger or ear lobe, paired with an app that shows the user the real-time state of their autonomic nervous system. This solution measures heart rate variability and provides guided meditations to increase the health of the nervous system over time.



Cost

InnerBalance Bluetooth for Android & iPhone: \$159

InnerBalance Lightning for iPhone / iPad: \$129

InnerBalance app: \$0

HeartMath emWave Pro: \$499

(measures impact with pre/post state of nervous systems)

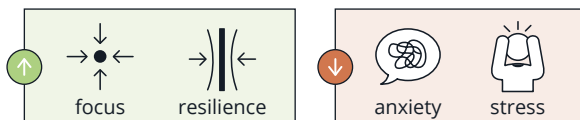
To date, ROI has used this technology in partnership with schools, a county jail, & a youth development center.

For more info visit:
ruralopportunity.org/biofeedback-program



What challenge does it address?

HeartMath's solution has been used by many healthcare professionals to treat a range of symptoms including: anxiety, exhaustion, substance use, ADHD, PTSD, chronic pain, headaches, hypertension, eating disorders, epilepsy, constipation.



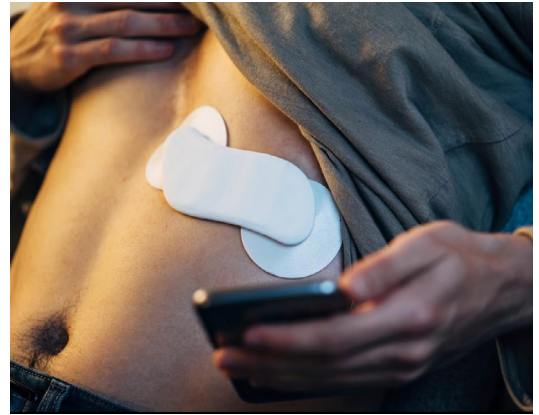
How does it address this challenge?

Heart rate variability is a measure of the variation in time between each heartbeat. This variation is controlled by the autonomic nervous system (ANS). It regulates heart rate, blood pressure, breathing, and digestion. The ANS is subdivided into two large components, the sympathetic and parasympathetic nervous system, also known as the fight-or-flight mechanism and relaxation response. The InnerBalance sensor/app gives the user real-time feedback on their heart rate variability and uses guided breathing to support the user in regulating their nervous system. Through practice, the user can shift their nervous system into a state of coherence, potentially leading to health benefits.

TECHNOLOGY PROFILES

Lief Therapeutics

getlief.com



A discrete, wearable device that measures heart rate variability to notify users when they have entered a state of stress. It is intended to provide real-time intervention to help calm users. The service is provided on a subscription basis, with one perk being inclusion of an 8-week program with mindfulness coaches. An associated app allows users to view their current and historical heart rate variability and beats per minute.



Cost

\$49.00 for device rental, guided lessons, and sticker refills

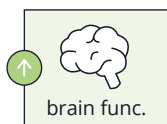
\$99.00 for all of the above + personal Lief HRV coaches

**This is the ONLY featured Transformative Technology that has options to be covered by insurance.*



What challenge does it address?

Lief Therapeutics has been proven in clinical trials to reduce anxiety below clinical levels. The device is intended to improve user resilience and reduce anxiety.



How does it address this challenge?

When one's heart rate variability dips below their set levels, the device begins its "auto dosing" program. A participant's heart rate variability is raised by syncing one's breath with their heartbeat and the vibrations of Lief. Over time, the threshold for minimal heart rate variability increases, thereby training the user's body to increase to a higher baseline heart rate variability. As past studies have shown, higher HRVs are indicative of stronger, more resilient nervous systems, reducing impacts of chronic stress and anxiety.

TECHNOLOGY PROFILES

Mendi

mendi.io



A headband that measures oxygen flow in the prefrontal cortex in order to help users train their brain and ability to shift between mental states. Combined with a smartphone app, Mendi allows users to control a game using their brain activity. This process provides a time-efficient and non-invasive method to train one's focus, memory, attention, and mental speed. It is currently in production and has not been released publicly.



Cost

Currently 40% off for one: \$299

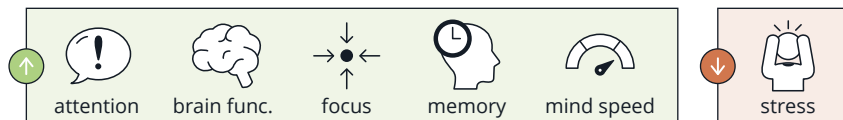
Currently 42% off for two: \$578

Normal prices: \$499 per device



What challenge does it address?

Mendi primarily seeks to increase affordability and accessibility to neurofeedback brain-training, a tool used by astronauts, elite athletes, CEOs, and people with expectation of high performance. A preliminary study by Stockholm University found that Mendi may provide an easily scalable and mobile measure of brain activity on par with bulky lab equipment.



How does it address this challenge?

Rather than using an electroencephalogram, Mendi relies on functional Near-infrared spectroscopy (fNIRS) to measure brain activity. By matching this technology with a game that responds to specific brain use, Mendi aids users in learning how to control their brain. The product is based on the principle that our brain is like any other muscle in our body and needs to be exercised.

TECHNOLOGY PROFILES

Muse

choosemuse.com



An electroencephalogram-based headband that tracks heart rate variability, breathing, movement, and brain activity in order to improve users' meditation and sleep quality. It is accompanied by an app that allows users' to access their biofeedback data and write digital journal entries. The headband comes in two variations: Muse 2 and Muse S, the latter is only intended to improve sleep. A yearly subscription is available for 500+ guided meditations.



Cost

Muse 2: \$249.99 per person

Muse S: \$349.99 per person

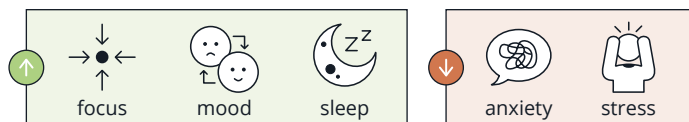
Subscription: \$94.99, though it has been sighted on sale for \$47.50 (5/31/2021)

Corporate Program: For teams 10+, there may be discounts available. Fill out the form here: choosemuse.com/corporate



What challenge does it address?

A non-invasive aid for depression, anxiety, and insomnia by improving meditation and sleep quality. Muse is intended to help users train their nervous system to improve resilience, focus during the day, and rest at night. It is used regularly in academic and clinical trials as a mobile electroencephalogram.



How does it address this challenge?

Muse offers brain, posture, breathing, and heart-based biofeedback meditations. When meditating, the device uses EEG sensors to track whether you are calm or if your mind is drifting. These brain signals are then translated into a soundscape; for example, wearers may hear a peaceful rainforest when they are in deep meditation, but they will be met with verbose thunderstorms if their mind wanders. This helps clarify when the mind is actually resting and serves as a nudge to let oneself relax.

TECHNOLOGY PROFILES

NeoRhythm

omnipemf.com



An electromagnetic headband that reduces user perception of pain, deepens meditation, and improves general well-being. It comes with an associated app that allows users to select which setting they would like to use.



Cost

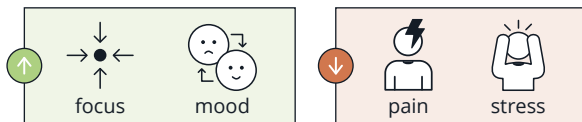
Singular: \$299 (currently 42% off, normally \$519)

Duo pack \$498 (currently 52% off, normally \$1,038)



What challenge does it address?

NeoRhythm seeks to help users destress, focus, energize the body, improve insomnia, and reduce chronic pain. Different audiences who have found benefits include, but are not limited to: brain injury survivors, people with chronic pain, yoga practitioners, people recovering from muscle strain, and more.



How does it address this challenge?

NeoRhythm promotes the natural physical recovery process with 360-degree targeted electromagnetic stimulation (PEMF). By restoring a baseline of cellular electric charge, the body is equipped to repair itself. Furthermore, past research displays that PEMF therapy is a safe and effective way to encourage the brain to mimic the electric signals the device provides. Different wavelengths are available for different desired experiences, ranging from deep relaxation to pain reduction.

TECHNOLOGY PROFILES

Sana



sana.io

An eye-mask and headphone combo that measures heart rate variability to provide personalized audio-visual stimulation for accelerated physical recovery and restfulness. The device is accompanied by an app that allows users to track their data and journal about their day.



Cost

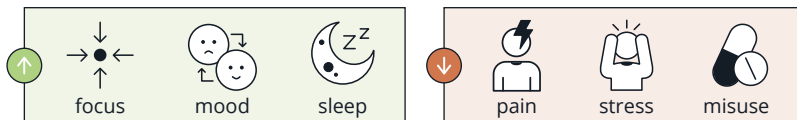
If paid monthly: 3 months (\$447 total), 6 months (\$774 total), 18 months (\$1,782 total); retain ownership over the rental sana device once over)

If paid all upfront (20% off): 3 months (\$425 total), 6 months (\$696 total), 18 months (\$1,425 total)



What challenge does it address?

Sana is intended to promote physical recovery and a deep, meditative-like state of mind. Sana has been piloted in multiple clinical trials to improve wellness of people associated with various health concerns. A study examined patients with fibromyalgia who were resistant to traditional treatments and found that their perception of pain/anxiety was significantly reduced. 85% of participants elected to continue use of their Sana device post-trial. In another study, those recovering from opioid dependency who used Sana felt less withdrawal than those who used a placebo.



How does it address this challenge?

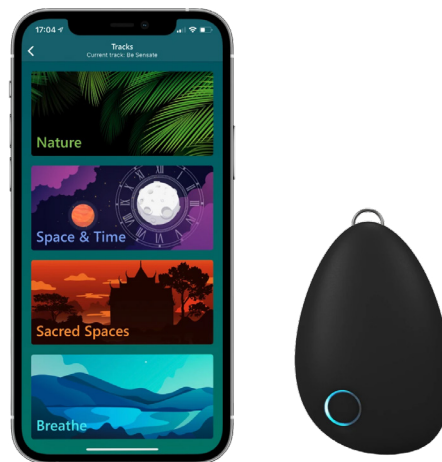
Based on a user's heart rate variability, Sana provides specific audio-visual stimulation (AVS) aimed at balancing activity on the left and right hemispheres of the brain. This balance across the brain purportedly leads to a restful state of mind, akin to that experienced by deep, effective meditation. A neurofeedback approach allows Sana to respond to the body with specific AVS in which the brain will synchronize with the provided stimulations.

6

TECHNOLOGY PROFILES

Sensate

getsensate.com



A handheld device that combines vibration and soundscape to improve heart rate variability and user resilience against stress. A companion app allows users to select their desired soundtrack that they'd like to play while resting with Sensate.



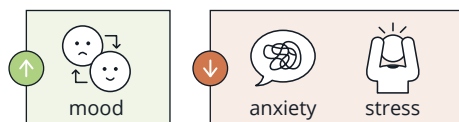
Cost

\$249 for Sensate2



What challenge does it address?

Sensate seeks to empower people to take control over their own mental health using preventive strategies. The device purportedly demonstrates that it can increase heart rate variability in its participants. Anecdotally, users with Parkinson have self-reported that Sensate helped them manage their stress and anxiety, though no clinical trial has been conducted.



How does it address this challenge?

While using Sensate, users are encouraged to lie on their back in a room with dim lighting, placing the device on their sternum. Sensate then emits infrasonic waves that target the vagus nerve of the autonomic nervous system.

TECHNOLOGY PROFILES

TouchPoint

thetouchpointsolution.com



A flexible wearable device that reduces stress and anxiety, improves sleep, and clarifies users' focus. The device requires placement of two components on both the left and right side of one's body, but the exact placement is adaptable. TouchPoint advertises their product as one that instills behavioral shifts that lead to long-term improvements in well-being.



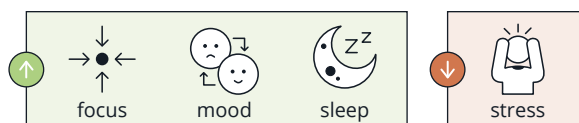
Cost

TouchPoint sells many products that allow users to customize their device.
\$189.99 each for Calm, Kids, and Sleep
(each are different products that must be purchased independently)



What challenge does it address?

TouchPoint has been clinically proven to reduce stress and anxiety, improve sleep, and improve focus. It has been used to help those with autism manage sensory overload and reductions in frustration. Significant stress/anxiety reduction benefits have also been observed within Parkinson's patients. TouchPoints have expanded their technology to be used within eye movement desensitization and reprocessing (EMDR) therapy. Reduction in physiological arousal and distress then facilitates the resolution of cognitive stress, as used in EMDR.



How does it address this challenge?

TouchPoints uses bi-lateral alternating stimulation tactile (BLAST) technology. BLAST works by shifting your brain from the "fight or flight" sympathetic nervous response to the calm parasympathetic nervous system. Unlike other products, TouchPoints is less concerned with activation of the sympathetic nervous system for improvements in alertness and energy, which may indicate that it is most applicable to those with chronically overexpressed sympathetic nervous systems.

TECHNOLOGY PROFILES

TRIPP

tripp.com



A VR and augmented reality subscription software that uses the combination of the two (dubbed “XR”) to help users become more calm, focused, and emotionally resilient. The TRIPP software is available for common VR devices, like Oculus and Playstation VR, and comes with a companion app with space for journaling. Media—ranging from games to guided meditations—are added daily. Individual VR experiences can also be designed via uploaded media.



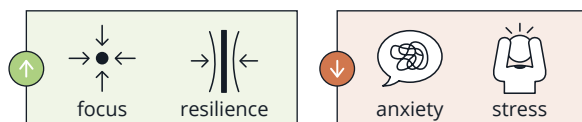
Cost

Hardware: \$300 for an Oculus VR headset
Software: \$14.99 per year



What challenge does it address?

TRIPP attempts to develop resiliency, sharpen focus, and induce calmness. TRIPP has had clinical trial protocols developed to investigate whether their specific software may improve holistic well-being of hospital-bound patients struggling with terminal illness. Past research suggests that VR may result in lower pain-perception, decreases anxiety and depression, and increased well-being. However, there is no existing literature on whether VR can be used for perioperative stress reduction and relaxation. Other research trials involving TRIPP seek to learn whether it can be used to improve addiction recovery, anxiety, and depression.



How does it address this challenge?

TRIPP is diverse in its tools used to meet its end goals, but all of them exist within a digital platform. Their software uses a combination of games, visual/auditory landscapes, and guided meditations to improve overall well-being. Their website does not detail specific underpinnings to how their formula produces the desired end result, but it links to past research which suggests their methods are evidence-based.

TECHNOLOGY PROFILES

Accessibility & Assumptions of Use

The table below details major assumptions affiliated with the use of each technology. This is not representative of all possible accessibility concerns.


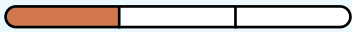
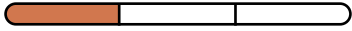






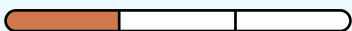

✗ = Requires **Blank** = Does Not Require

Technology	Smartphone w/Bluetooth	Internet Access	Able-Hearing	Able-Seeing	Able-Feeling
Airo	✗	✗		✗	
Apollo	✗	✗			✗
Core	✗	✗	✗		✗
Cove	✗				✗
Doppel	✗				✗
FeelZing					
Hapbee	✗				
Happify		✗		✗	
Healium	✗	✗	✗	✗	
HeartMath				✗	✗
Lief Therapeutics	✗				
Mendi	✗	✗		✗	
Muse	✗	✗	✗		
NeoRhythm	✗	✗			
Sana	✗		✗	✗	
Sensate	✗	✗	✗		✗
TouchPoint					✗
TRIPP	✗	✗	✗	✗	

TECHNOLOGY PROFILES

Meditation Apps Summary

Below is a listing of meditation-related apps currently on the Transformative Technology market. The rating system presented here is far less thorough than that provided for the products profiled above; however, ratings were granted based on the same tenets.

App Name	Price	Description	Viability for Use in Community Setting
<u>Apple Watch Breathe App</u>	Free	Guided breathing app.	 LOW MEDIUM HIGH
<u>Aura</u>	\$95.04 / year	Meditation app.	 LOW MEDIUM HIGH
<u>Breethe</u>	\$20 lifetime membership	Meditation app.	 LOW MEDIUM HIGH
<u>Buddhify</u>	\$4.99 on apple; \$2.99 on google	Meditation app.	 LOW MEDIUM HIGH
<u>Calm</u>	\$69.99 / year	Meditation app. Highly popular.	 LOW MEDIUM HIGH
<u>Headspace</u>	\$69.99 / year	Meditation app. Highly popular.	 LOW MEDIUM HIGH
<u>InsightTimer</u>	\$59.99 / year, but they have a free version	Meditation app.	 LOW MEDIUM HIGH
<u>Journey</u>	\$29.99 / year	Multimedia app that allows users to make diary entries associated with images, Google maps, and calendars.	 LOW MEDIUM HIGH
<u>Samsung Galaxy Breathe App</u>	Free	Guided breathing app.	 LOW MEDIUM HIGH
<u>Simple Habit</u>	\$89.99 / year or \$299.99 lifetime	Meditation app.	 LOW MEDIUM HIGH
<u>Wellness Coach</u>	Free for small businesses	Digital platform intended to improve employee —.	 LOW MEDIUM HIGH

What You Can Do

Potential next steps for community organizers looking to pilot and use these Transformative Technologies.



1 Get In Touch

We'd love to partner and work together. If you run a community-based program, especially in the rural southern United States, and would like to pilot any of the technologies in this report, towards the goal of supporting people's healing from trauma, please send us an email:

info@ruralopportunity.org

Subject Line: Transformative Technology

More info can be found at **ruralopportunity.org**

- 2 Survey community members to better understand their needs and how Transformative Technology could play a part in promoting improved health and wellbeing
 - After surveying community members, determine which technology will best align with the needs of community members
- 3 Survey community members to ask input on a selection of technologies with brief descriptions of each
- 4 Allow individual people and organizations to do small pilot tests of different technologies to see impacts and results on a small scale, before having to commit to a bigger program
- 5 Perform a trial run of the technology
 - If feasible and ethically appropriate, evaluate the effectiveness of the technology by comparing results in a group using the technology to a group that is similar demographically and is not using the technology
- 6 Expand the program with continued experimental infrastructure for continued program evaluation

Methods



Research Overview

We surveyed 48 different Transformative Technologies and conducted thorough profiling for 18 of them.

Transformative Technologies

The original pool was sampled via a report from Nfluence Partners, titled “State of the Market Wellness Technology Q4 2020 Report,” that highlighted high-potential technologies. This list was supplemented by products that were scouted independently and had been shared with ROI through different partners, often over email, between 2017-2021. From the original sample, 12 products were identified as highly similar meditation apps and grouped into their own category. We chose technologies for in-depth profiling by determining if they have the potential for high impact in community applications. Many of the technologies were struck out early because they were either not applicable to promote healthy stress management or because of obstacles preventing comprehensive profiling of the product. We thus arrived at our final selection of products through multiple layers of objective and subjective filtering.

For each technology, we collected directly listed costs from their websites. To determine price per person, we assumed that each person would receive one device (if there was hardware). If the product is subscription-based, prices were scaled up for a year’s length on the company’s cheapest option. These data were then transferred into RStudio for visualization using the ggplot API.

The table below represents the rubric that was used to score the different technologies. These categories were chosen as important requirements for assessing technologies in a community context. For organizers to know whether or not their program was effective, their tool must have a method to measure its impact. Ideally, a technology should have a strong basis in clinical and/or academic trials, as shown via experimental support. It should also be accessible and easy to use, not requiring a strong learning curve or special prerequisites. Lastly, a good Transformative Technology should not require permanent use of itself; rather, it should develop lifelong physiological, psychological, or habitual responses.

Ranking Info Key

Definitions and conditions for each rating.

Criteria	☆ 0 (No Star)	☆ 0.5 (Half Star)	★ 1 (Full Star)
Measurability	<p>No Measurement: The technology does not record any measurement and does not allow users to self-record</p>	<p>Low Fidelity Measurement: The technology allows users to self-record trackable measurements (i.e. feelings, number of hours, etc)</p>	<p>High Fidelity Measurement: The technology measures and tracks somatic indicators of progress relevant to the technology's goals</p>
User-Friendliness	<p>Unfit for General Consumers: Requires knowledge of niche skills or expertise</p>	<p>Low Fidelity Measurement: The technology allows users to self-record trackable measurements (i.e. feelings, number of hours, etc)</p>	<p>High Fidelity Measurement: The technology measures and tracks somatic indicators of progress relevant to the technology's goals</p>
Experimental Support	<p>Little to No Evidence: No official testing of product cited; no cited literature</p>	<p>Medium Evidence: The product has not completed trial, but is in process AND/OR the product cites relevant academic literature to support its claims</p>	<p>Strong Evidence: The product itself has been clinically or academically proven to effectively do its task. This science is backed by canon literature</p>
User Barrier to Entry	<p>High Barrier to Entry: Requires diagnosis or consultation to purchase device</p>	<p>Medium Barrier to Entry: Consumes a lot of time</p>	<p>Low Barrier to Entry: Doesn't consume a lot of time (≤ 30 minutes per day)</p>
Long-Term Impact	<p>Short-Term Impact: Provides temporary relief; improvement in — is contingent on continued use of the product</p>	<p>Potential Long-Term: Provides users the information necessary to make changes that have long-term outcomes but does not train them; may help promote habit</p>	<p>Long-Term Impact: Trains and teaches users to make long-term changes in their well-being that will persist if use of product is eventually discontinued</p>

RESEARCH OVERVIEW

Products Not Profiled

Transformative Technologies that were surveyed & researched but not selected for profiling in this report.

Criteria	Reason for Omitting
<u>Affectiva</u>	Media analytics company (no consumer products).
<u>Biostrap</u>	Fitness tracking wearable for elite athletes.
<u>Dark Noise</u>	Sound machine app.
<u>EMOTIV</u>	EEG sensor device for scientific research.
<u>Empath</u>	API for software; no actual consumer product.
<u>Endel</u>	AI sound machine.
<u>Feel</u>	Bluetooth haptic touch bracelet.
<u>FitBit</u>	Fitness tracking wearable for elite athletes.
<u>Floatworks</u>	Services only offered in their physical locations.
<u>Happiness</u>	No web presence.
<u>Inscape</u>	Soundscapes and home goods online store.
<u>Keiron</u>	Little web presence and no available products.
<u>Oura Ring</u>	Fitness tracking wearable for elite athletes & biohackers.
<u>PsyLaris</u>	Online platform intended for certified therapy providers using VR.
<u>Relax VR</u>	Virtual reality treatment for high-end Spas & Salons.
<u>Silentmode Powermask</u>	Eye mask with headphones for guided meditation.
<u>Vocalis Health</u>	Using vocal biomarkers to diagnose disease (only available for healthcare providers).
<u>Whoop</u>	Fitness tracking wearable for elite athletes.

Appendix



Quick Glance: By Technology

Benefits Provided & Challenges Addressed

This table show is sorted by technology, and shows all the challenges each specific piece of technology can address.

Technology	Challenges Addressed	
Airo	 Improve awareness of body & mind sensations	 Reduce stress
Apollo	 Improve resilience Improve sleep	 Reduce anxiety Reduce depression Reduce stress
Core	 Improve focus Improve resilience	 Reduce anxiety Reduce stress
Cove	 Improve sleep	 Reduce stress
Doppel	 Improve focus Improve resilience	 Reduce anxiety Reduce stress
FeelZing	 Improve focus Improve mood	 Reduce stress
Hapbee	 Improve focus Improve resilience	 Reduce anxiety Reduce stress
Happify	 Improve happiness Improve resilience	 Reduce anxiety Reduce depression Reduce stress
Healium	 Improve focus Improve mood	 Reduce anxiety Reduce stress

*Continued on next page

Quick Glance: By Technology

Technology	Challenges Addressed	
HeartMath	 Improve focus Improve resilience	 Reduce anxiety Reduce stress
Lief Therapeutics	 Improve awareness of body & mind sensations	 Reduce stress
Mendi	 Improve brain function (oxygen flow in prefrontal cortex) Improve memory Improve attention Improve mental speed	 Reduce stress
Muse	 Improve focus Improve mood Improve sleep	 Reduce anxiety Reduce stress
NeoRhythm	 Improve focus Improve mood	 Reduce perception of pain Reduce stress
Sana	 Improve focus Improve mood Improve sleep	 Reduce substance misuse Reduce perception of pain Reduce stress
Sensate	 Improve mood	 Reduce anxiety Reduce stress
TouchPoint	 Improve focus Improve mood Improve sleep	 Reduce stress
TRIPP	 Improve focus Improve resilience	 Reduce anxiety Reduce stress

ACKNOWLEDGMENTS

Gratitude & Thanks

Thank you to Nichol Bradford, Co-Founder of Transformative Technology for pioneering the term and field of TransTech and for the main source material for this report, the Wellness Tech State of the Market.

Thank you for the contributions, hard work, and partnership that to made this report possible:

Jessee Steele, Duke University

Camilla Dohlman, MPH Student, University of NC-Chapel Hill

Seth Saeugling, Rural Opportunity Institute (ROI)

Sophie Vakalis, Graphic Designer

Partners

Duke's Office of University Scholars and Fellows

Summer of Service, Project Conserving Carolina, hosted by AmeriCorps

Benjamin N. Duke Scholars Program

The Eastern North Carolina Internship Program (ENCIP)

Funders

Anonymous Trust

Kate B. Reynolds Foundation

Z. Smith Reynolds Foundation

Jamie Kirk Hahn Foundation

Bibliography



BIBLIOGRAPHY

General Sources

Cicchetti, D., & Toth, S. L. (1995). A Developmental Psychopathology Perspective on Child Abuse and Neglect. *Journal of the American Academy of Child & Adolescent Psychiatry*, 34(5), 541–565. <https://doi.org/10.1097/00004583-199505000-00008>

Executive Function & Self-Regulation. (n.d.). Retrieved June 16, 2021, from <https://developingchild.harvard.edu/science/key-concepts/executive-function/>

Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., Koss, M. P., & Marks, J. S. (1998). Relationship of Childhood Abuse and Household Dysfunction to Many of the Leading Causes of Death in Adults: The Adverse Childhood Experiences (ACE) Study. *American Journal of Preventive Medicine*, 14(4), 245–258. [https://doi.org/10.1016/S0749-3797\(98\)00017-8](https://doi.org/10.1016/S0749-3797(98)00017-8)

IMF Survey: Technology Widening Rich-Poor Gap. (2007). Retrieved June 16, 2021, from <https://www.imf.org/en/News/Articles/2015/09/28/04/53/sores1010a>

Moore, G. A. (2001). *Crossing the chasm: Marketing and selling high-tech products to mainstream customers*. PerfectBound.

Wellness Tech State of the Market Q4 2020. (2021). Retrieved June 17, 2021, from <https://www.slideshare.net/secret/aGt56mH1YYANbj>

BIBLIOGRAPHY

Transformative Technology

Airo

Agelink, M. W., Boz, C., Ullrich, H., & Andrich, J. (2002). Relationship between major depression and heart rate variability. Clinical consequences and implications for antidepressive treatment. *Psychiatry Research*, 113(1-2), 139-149. [https://doi.org/10.1016/s0165-1781\(02\)00225-1](https://doi.org/10.1016/s0165-1781(02)00225-1)

Airo Health | Airo detects anxiety. (2019). Retrieved June 16, 2021, from <https://airohealth.com/>

Gorman, J. M., & Sloan, R. P. (2000). Heart rate variability in depressive and anxiety disorders. *American Heart Journal*, 140(4 Suppl), 77-83. <https://doi.org/10.1067/mhj.2000.109981>

Luft, C. D. B., Takase, E., & Darby, D. (2009). Heart rate variability and cognitive function: Effects of physical effort. *Biological Psychology*, 82(2), 164-168. <https://doi.org/10.1016/j.biopsycho.2009.07.007>

Tan, G., Dao, T. K., Farmer, L., Sutherland, R. J., & Gevirtz, R. (2011). Heart rate variability (HRV) and posttraumatic stress disorder (PTSD): A pilot study. *Applied Psychophysiology and Biofeedback*, 36(1), 27-35. <https://doi.org/10.1007/s10484-010-9141-y>

Apollo

Apollo Neuro | Wearable Touch Therapy for Stress Relief. (2021). Retrieved June 16, 2021, from <https://apolloneuro.com/>

Apollo Neuroscience studies: The research behind our results. (2021). Apollo Neuro. Retrieved June 16, 2021, from <https://apolloneuro.com/blogs/news/apollo-neuroscience-studies-the-research-behind-our-results>

Core

Core Meditation Trainer Device & App | Meditate Better. (n.d.). Retrieved June 16, 2021, from <https://www.hellocore.com/>

Cove

Buy Cove: A hug for your mind. (2021). Retrieved June 16, 2021, from <https://www.feelcove.com/product/cove/>

Cove: Less Stress. Better Sleep. Extensive research, impressive results. (2021). Retrieved June 16, 2021, from <https://www.feelcove.com/science/#eeg>

Doppel

Doppel | Feel calm and focused, naturally. (n.d.). Retrieved June 16, 2021, from <https://feeldoppel.com/>

T. Azevedo, R., Bennett, N., Bilicki, A., Hooper, J., Markopoulou, F., & Tsakiris, M. (2017). The calming effect of a new wearable device during the anticipation of public speech. *Scientific Reports*, 7(1), 2285. <https://doi.org/10.1038/s41598-017-02274-2>

FeelZing

Feelzing Energy Patch. (2021). Feelzing. Retrieved June 16, 2021, from <https://feelzing.com/>

Science of Neurostimulation | Thync. (2021). Thync Global, Inc. Retrieved June 16, 2021, from <https://thync.com/pages/neurostimulation>

Tyler, W. J., Boasso, A. M., Mortimore, H. M., Silva, R. S., Charlesworth, J. D., Marlin, M. A., Aebersold, K., Aven, L., Wetmore, D. Z., & Pal, S. K. (2015). Transdermal neuromodulation of noradrenergic activity suppresses psychophysiological and biochemical stress responses in humans. *Scientific Reports*, 5(1), 13865. <https://doi.org/10.1038/srep13865>

Hapbee

Fei, Y., Jin, Y., Zhao, X., Wang, Y., Qian, J., Su, L., & Chen, G. (2020). The Relative Permittivity Changes of EGF by 50 Hz MF Exposure Neither Affect the Interaction of EGF With EGFR Nor Its Biological Effects. *Bioelectromagnetics*, 41(3), 241–246. <https://doi.org/10.1002/bem.22249>

Hapbee Wearable Device—Choose How You Feel. (2020). Retrieved June 16, 2021, from <https://hapbee.com/>

Jia, C., Zhou, Z., Liu, R., Chen, S., & Xia, R. (2007). EGF receptor clustering is induced by a 0.4 mT power frequency magnetic field and blocked by the EGF receptor tyrosine kinase inhibitor PD153035. *Bioelectromagnetics*, 28(3), 197–207. <https://doi.org/10.1002/bem.20293>

Martínez, M. A., Úbeda, A., & Trillo, M. À. (2019). Involvement of the EGF Receptor in MAPK Signaling Activation by a 50 Hz Magnetic Field in Human Neuroblastoma Cells. *Cellular Physiology and Biochemistry: International Journal of Experimental Cellular Physiology, Biochemistry, and Pharmacology*, 52(4), 893–907. <https://doi.org/10.33594/000000062>

Massot, O., Grimaldi, B., Bailly, J.-M., Kochanek, M., Deschamps, F., Lambrozo, J., & Fillion, G. (2000). Magnetic field desensitizes 5-HT_{1B} receptor in brain: Pharmacological and functional studies. *Brain Research*, 858(1), 143–150. [https://doi.org/10.1016/S0006-8993\(99\)02486-5](https://doi.org/10.1016/S0006-8993(99)02486-5)

Sun, L., Chen, L., Bai, L., Xia, Y., Yang, X., Jiang, W., & Sun, W. (2018). Reactive oxygen species mediates 50-Hz magnetic field-induced EGF receptor clustering via acid sphingomyelinase activation. *International Journal of Radiation Biology*, 94(7), 678–684. <https://doi.org/10.1080/09553002.2018.1466208>

Wang, Y., Li, X., Sun, L., Feng, B., & Sun, W. (2016). Acid sphingomyelinase mediates 50-Hz magnetic field-induced EGF receptor clustering on lipid raft. *Journal of Receptors and Signal Transduction*, 36(6), 593–600. <https://doi.org/10.3109/10799893.2016.1147583>

Wu, X., Cao, M.-P., Shen, Y.-Y., Chu, K.-P., Tao, W.-B., Song, W.-T., Liu, L.-P., Wang, X.-H., Zheng, Y.-F., Chen, S.-D., Zeng, Q.-L., & Xia, R.-H. (2014). Weak Power Frequency Magnetic Field Acting Similarly to EGF Stimulation, Induces Acute Activations of the EGFR Sensitive Actin Cytoskeleton Motility in Human Amniotic Cells. *PLOS ONE*, 9(2), e87626. <https://doi.org/10.1371/journal.pone.0087626>

Wu, X., Du, J., Song, W., Cao, M., Chen, S., & Xia, R. (2018). Weak power frequency magnetic fields induce microtubule cytoskeleton reorganization depending on the epidermal growth factor receptor and the calcium related signaling. *PLOS ONE*, 13(10), e0205569. <https://doi.org/10.1371/journal.pone.0205569>

Healium

Human Performance Training with Neurofeedback Using AR & VR. (2020). Healium. Retrieved June 17, 2021, from <https://www.tryhealium.com/>

Tarrant, J. (2019). The Impact of Virtual Reality on Mood States Prior to Blood Donation. *Scholarly Journal of Psychology and Behavioral Sciences*, 2(5). <https://doi.org/10.32474/SJPBS.2019.02.000150>

Tarrant, J., & Cope, H. (2018). Combining frontal gamma asymmetry neurofeedback with virtual reality: A proof of concept case study. *NeuroRegulation*, 5(2), 57–57. <https://doi.org/10.15540/nr.5.2.57>

Tarrant, J., Viczko, J., & Cope, H. (2018). Virtual Reality for Anxiety Reduction Demonstrated by Quantitative EEG: A Pilot Study. *Frontiers in Psychology*, 9. <https://doi.org/10.3389/fpsyg.2018.01280>

Tarrant—2019—The Impact of Virtual Reality on Mood States Prior.pdf. (2019). Retrieved June 17, 2021, from <https://lupinepublishers.com/psychology-behavioral-science-journal/pdf/SJPBS.MS.ID.000150.pdf>

HeartMath InnerBalance

HeartMath. (2021). Retrieved June 16, 2021, from <https://www.heartmath.com/>

Marcelo Campos, M. D. (2019, October 22). Heart rate variability: A new way to track well-being. Harvard Health. <https://www.health.harvard.edu/blog/heart-rate-variability-new-way-track-well-2017112212789>

The Science of HeartMath. (2021). HeartMath. Retrieved June 16, 2021, from <https://www.heartmath.com/science/>

Lief Therapeutics

Caldwell, Y. T., & Steffen, P. R. (2018). Adding HRV biofeedback to psychotherapy increases heart rate variability and improves the treatment of major depressive disorder. *International Journal of Psychophysiology*, 131, 96–101. <https://doi.org/10.1016/j.ijpsycho.2018.01.001>

Chalmers, J. A., Quintana, D. S., Abbott, M. J.-A., & Kemp, A. H. (2014). Anxiety Disorders are Associated with Reduced Heart Rate Variability: A Meta-Analysis. *Frontiers in Psychiatry*, 5. <https://doi.org/10.3389/fpsy.2014.00080>

Goessl, V. C., Curtiss, J. E., & Hofmann, S. G. (2017). The effect of heart rate variability biofeedback training on stress and anxiety: A meta-analysis. *Psychological Medicine*, 47(15), 2578–2586. <https://doi.org/10.1017/S0033291717001003>

Huang, M., Shah, A., Su, S., Goldberg, J., Lampert, R. J., Levantsevych, O. M., Shallenberger, L., Pimple, P., Bremner, J. D., & Vaccarino, V. (2018). Association of Depressive Symptoms and Heart Rate Variability in Vietnam War–Era Twins: A Longitudinal Twin Difference Study. *JAMA Psychiatry*, 75(7), 705–712. <https://doi.org/10.1001/jamapsychiatry.2018.0747>

Lief Therapeutics. (2021). Retrieved June 16, 2021, from <https://getlief.com/>

Mendi

Högman, L., & Dravniknes, H. (n.d.). Validation of a consumer-grade functional Near-Infrared Spectroscopy device for measurement of frontal pole brain oxygenation – an interim report. 9.

Mendi: Real Brain Training - Anytime, Anywhere. (2021). Retrieved June 16, 2021, from <https://www.mendi.io/>

Muse

Armanfard, N., Komeili, M., Reilly, J. P., & Pino, L. (2016). Vigilance lapse identification using sparse EEG electrode arrays. 2016 IEEE Canadian Conference on Electrical and Computer Engineering (CCECE), 1–4. <https://doi.org/10.1109/CCECE.2016.7726846>

Bhayee, S., Tomaszewski, P., Lee, D. H., Moffat, G., Pino, L., Moreno, S., & Farb, N. A. S. (2016). Attentional and affective consequences of technology supported mindfulness training: A randomised, active control, efficacy trial. *BMC Psychology*, 4(1), 60. <https://doi.org/10.1186/s40359-016-0168-6>

Hashemi, A., Pino, L. J., Moffat, G., Mathewson, K. J., Aimone, C., Bennett, P. J., Schmidt, L. A., & Sekuler, A. B. (2016). Characterizing Population EEG Dynamics throughout Adulthood. *ENeuro*, 3(6). <https://doi.org/10.1523/ENEURO.0275-16.2016>

Karydis, T., Aguiar, F., Foster, S. L., & Mershin, A. (2015a). Performance characterization of self-calibrating protocols for wearable EEG applications. *Proceedings of the 8th ACM International Conference on Pervasive Technologies Related to Assistive Environments*, 1–7. <https://doi.org/10.1145/2769493.2769533>

Karydis, T., Aguiar, F., Foster, S. L., & Mershin, A. (2015b). Self-calibrating protocols enhance wearable EEG diagnostics and consumer applications. *Proceedings of the 8th ACM International Conference on Pervasive Technologies Related to Assistive Environments*, 1–2. <https://doi.org/10.1145/2769493.2769581>

Kovacevic, N., Ritter, P., Tays, W., Moreno, S., & McIntosh, A. R. (2015). 'My Virtual Dream': Collective Neurofeedback in an Immersive Art Environment. *PLOS ONE*, 10(7), e0130129. <https://doi.org/10.1371/journal.pone.0130129>

Muse—Meditation Made Easy. (2021). Muse. Retrieved June 16, 2021, from <https://choosemuse.com/>

NeoRhythm

Elektromagnetisches Stirnband soll Kopfschmerzen lindern – der BILD-Test. (2021). Bild.De. Retrieved June 16, 2021, from <https://www.bild.de/digital/internet/internet/elektromagnet-geraet-dieses-stirnband-soll-kopfschmerzen-lindern-72555348.bild.html>

Jerman, I., Dovč, P., & Ratajc, P. (2019). Influencing Relaxation by a Low Intensity Transcranial Pulsed Magnetic Stimulation Applying the Entrainment Model. *OALib Journal*, 6, 5741. <https://doi.org/10.4236/oalib.1105741>

Jerman, I., Dovc, P., & Ratajc, P. (2019). Enhancing Vigilance by Low Intensity Transcranial Pulsed Magnetic Stimulation Applying the Entrainment Model. *Open Access Library Journal*, 06, 1–23. <https://doi.org/10.4236/oalib.1105782>

OmniPEMF™ Official Site | NeoRhythm PEMF Wearable Device. (2021). Retrieved June 16, 2021, from <https://omnipemf.com/>

Sana

David.Putrino. (2021). Extended Home-use Trial of a Novel Device to Reduce Chronic Neuropathic Pain (Clinical Trial Registration No. NCT04280562). [clinicaltrials.gov. https://clinicaltrials.gov/ct2/show/NCT04280562](https://clinicaltrials.gov/ct2/show/NCT04280562)

For Medical Professionals. (2020). Sana Health. Retrieved June 16, 2021, from <https://www.sana.io/medical-professionals>

Sana Health. (2020). Retrieved June 16, 2021, from <https://www.sana.io/>

Sensate

Sensate | The shortcut to reduce stress & anxiety. (2021). Sensate. Retrieved June 16, 2021, from <https://www.getsensate.com/>

TouchPoint

Leal-Junior, E. C. P., Casalechi, H. L., Machado, C. dos S. M., Serin, A., Hageman, N. S., & Johnson, D. S. (2019). A Triple-Blind, Placebo-Controlled Randomized Trial of the Effect of Bilateral Alternating Somatosensory Stimulation on Reducing Stress-Related Cortisol and Anxiety During and After the Trier Social Stress Test. *Journal of Biotechnology and Biomedical Science*, 2(1), 22–30. <https://doi.org/10.14302/issn.2576-6694.jbbs-19-2784>

Serin, A. (2016). Applied Bi-Lateral Alternating Stimulation- Tactile (BLAST) Evidence from Quantitative Electroencephalogram. 5.

The Touchpoint Solution™ | Lifestyle Wearables for Relieving Stress – TheTouchPoint Solution™. (2021). Retrieved June 16, 2021, from <https://thetouchpointsolution.com/>

TouchPoints | Scientifically-Proven Stress Management. (2021). TheTouchPoint Solution™. Retrieved June 16, 2021, from <https://thetouchpointsolution.com/pages/research>

TRIPP

Research | Tripp | XR Wellness. (2021). Tripp. Retrieved June 16, 2021, from <https://www.tripp.com/research/>

Schrempf, M. C., Petzold, J. Q., Vachon, H., Petersen, M. A., Gutschon, J., Wolf, S., Sommer, F., Murnauer, M., & Anthuber, M. (2021). Virtual reality-based relaxation for enhancement of perioperative well-being and quality of life: Protocol for a randomised pilot trial. *BMJ Open*, 11(4), e044193. <https://doi.org/10.1136/bmjopen-2020-044193>

TRIPP: Fitness for your Inner Self | Tripp | XR Wellness. (2021). Retrieved June 16, 2021, from <https://www.tripp.com/>

BIBLIOGRAPHY

Meditation Apps

Aura—All-In-One App for Emotional Health & Sleep. (n.d.). Retrieved June 16, 2021, from <https://www.aurahealth.io//home-sleep2>

Breathe—Apps on Galaxy Store. (2018). Retrieved June 16, 2021, from <http://galaxystore.samsung.com/geardetail/com.samsung.watchface-breathe>

Breeth. (2021). Breeth. Retrieved June 16, 2021, from <https://breeth.com/>

Calm—The #1 App for Meditation and Sleep. (2021). Retrieved June 16, 2021, from <https://www.calm.com/>

Insight Timer—#1 Free Meditation App for Sleep, Relax & More. (2021). Retrieved June 16, 2021, from <https://insighttimer.com/>

Journey—Diary, Journal on the App Store. (2016). Retrieved June 16, 2021, from <https://apps.apple.com/us/app/journey-diary-journal/id1300202543>

Live, Interactive and Social Meditation Classes for your daily life by experienced coaches on your mobile. (2021). Wellness Coach. Retrieved June 16, 2021, from <https://www.wellnesscoach.live>

Meditation & Mindfulness App. (2021). Buddhify. Retrieved June 16, 2021, from <https://buddhify.com/>

Meditation and Sleep Made Simple—Headspace. (2021). Retrieved June 16, 2021, from https://www.headspace.com/?gclid=CjwKCAjw_JuGBhBkEiwA1xmbRQtjAViCMm-hj6vxqtWgcxUrkzzUsQ QbMEwCMfjTxWZM1A5Rz7pPhhoCi2oQAvD_BwE

Simple Habit | The Best Meditation App for Busy People. (2020). Retrieved June 16, 2021, from <https://www.simplehabit.com/>

Use the Breathe app. (2019). Apple Support. Retrieved June 16, 2021, from <https://support.apple.com/en-us/HT206999>