Swell Sound Treatments: A Neuroscience Study

Sound as a New Wellbeing Revolution

Sound is scientifically proven to have far-reaching impacts on our brain, body, and emotional, cognitive and behavioural responses.

As research continues to emerge, it’s become clear that using sound in an intentional way is one of the most promising new wellbeing solutions for modern society.

Sound in Environments

While we have some control over what we hear, we experience sound in every environment we place ourselves in. From sirens on the street, to the wind hitting the trees, children playing, and the music in public and private spaces, these create the soundscapes of our lives. These include those from biological sources (e.g., bird vocalisations), geophysical sounds (e.g., wind and rain), and anthropogenic sounds (including noise from road and air traffic) (2).

Each unique component carries properties that are capable of generating powerful reactions in the human body and brain, which inform how we feel, interact and behave in our everyday environments (1). For example, the frequencies, tones and beats per minute within soundscapes are shown to directly impact human physiology including heart rate (3), brainwaves (4), as well as behavioural metrics like mood (5), emotion (6) and stress levels (7).

The sounds in our surroundings can be described as a soundscape, the acoustic version of a landscape (1).

Sound in Environments

Positive soundscapes can boost wellbeing (8). Natural sounds in specific, including birdsong (9), and pink noise (8) are shown to have a restorative impact including the increase of alpha waves in the brain. These impacts are tied to theories like Stress Recovery Theory (11) and Attention Restoration Theory (12) which demonstrate the role natural environments have on restoration. Studies have shown listening to nature sounds even through digital methods boosts psychological wellbeing, cognition and relaxation (13). Natural soundscapes play a role in urban environmental sustainability because they offer reduced exposure to adverse effects of noise to which urban populations are highly exposed (14).

Negative soundscapes including noise pollution and anthropogenic sounds have negative impacts on wellbeing including elevated heart rate, blood pressure and reduced psychological wellbeing (15). Over half (16) the population globally lives in urban areas, and these environments are becoming louder. Nature contact is often limited, so positive soundscapes for wellbeing is more important than ever.

The Power of Sound Experiences

Recent studies continue to prove the power of music for wellbeing, across therapeutic, restorative and attentional (20) aspects of human health. This has given rise to intentional sounds - those created to support the human nervous system, emotional states, brainwave signatures and subjective wellbeing levels. Sound-based apps like Wavepaths and Endel have previously proven the impact of their therapeutic and consumer-level apps on relaxation (21) and focus (20) states. Other studies have uncovered that sound alone is often more powerful than visual modalities (23), as well as for deep relaxation (24), while the active use of sonic elements like binaural beats are still being explored for their use across a range of mental states (22).

In response to this new wave of sound and health research, sound treatments using specific frequencies, melodic components, healing and nature sounds, are rising in popularity (5) and have wide reaching application across a range of environments, from hospitals (10) to spas, mobile apps (20) and home entertainment systems, demonstrating a potential for a new type of therapeutic treatment that provides greater access and caters to a broader and more diverse audience.

Nature Connection

Disconnection from nature is shown to have direct impacts on subjective wellbeing, measured levels of stress, as well as our daily environmental sustainable actions (17). Finding effective solutions to enhance nature connection is a fundamental aspect of modern wellbeing on personal (18) and societal (19) levels.

Research Question

Does Swell Sound Treatment drive relaxation and nature connection to support health and wellbeing in listeners?

About Swell

Swell Sound Treatment harnesses the power of sound to deliver transformative experiences, centred around health and well-being. It delivers sound treatments which combine field recordings, music composition, and sound therapy with ground-breaking technology.

Swell is Made from 3 Components:

Sounds of Nature
HiFi field recordings (recordings of nature at 48khz WAV)

Music Compositions
Tried and tested techniques to evoke different emotions

Sound Therapy Techniques
Different frequencies, intervals and tunings to impact the listener in different ways

Methodology

Participants: 10

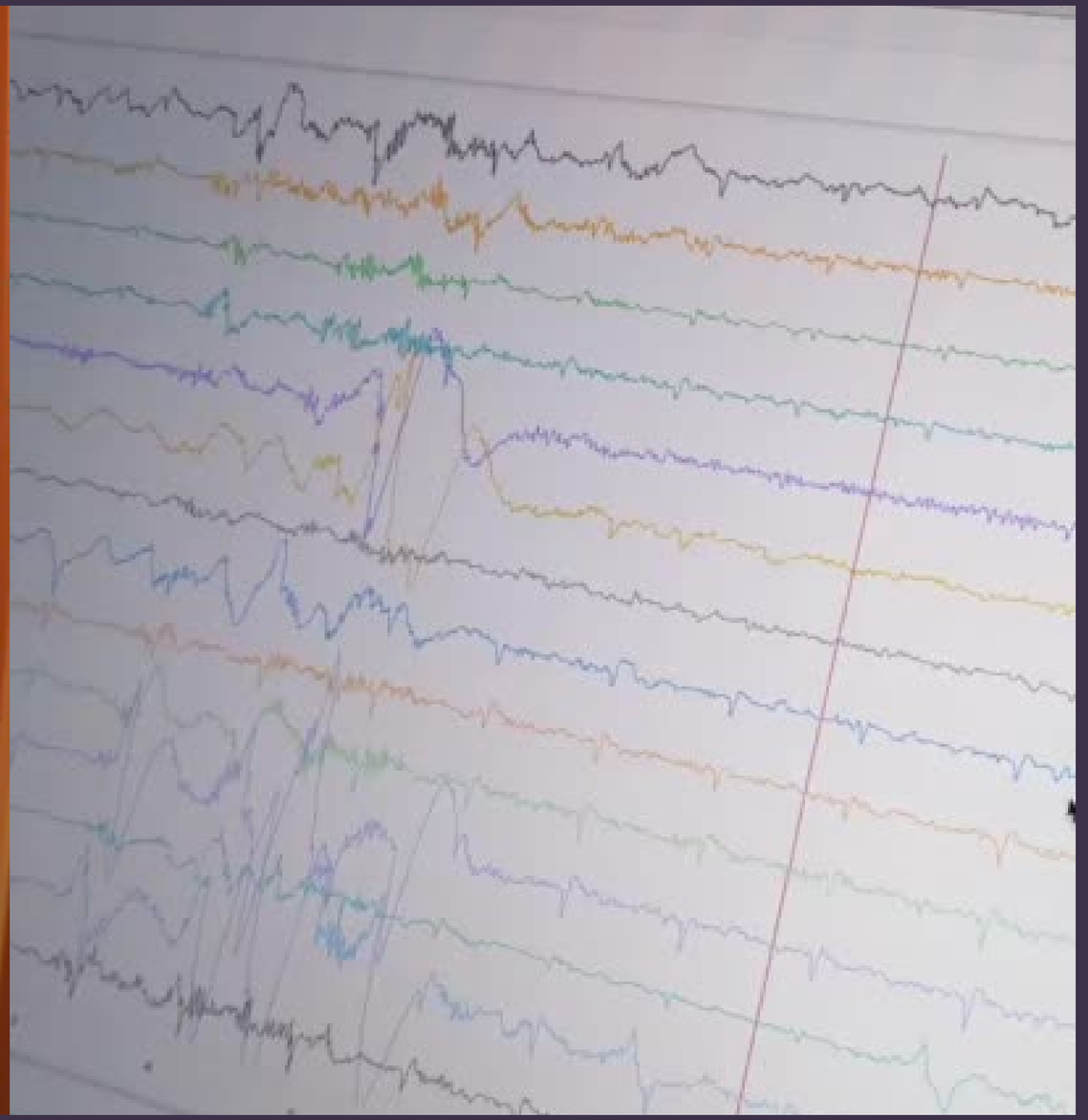
Measurements: Heart Rate, EEG, Relaxation, Mood, Nature Connection

Environment: Custom Designed Immersion Room

The custom-designed listening room was recreated to mimic a relaxing spa-like environment.

The within-subjects study recorded EEG and Heart Rate data from 10 participants in a custom-designed immersive listening room. Each participant underwent a Swell Sound Treatment for 15 minutes, as well as normal urban noise sound for 5 minutes through the Genelec speaker system, while EEG* and Heart Rate data was collected in additional to behavioural data including self-reported relaxation, mood and nature connection. All measures were taken at three distinct intervals throughout the experiment; baseline; noise condition; Swell condition.

***EEG data was collected from 10 participants using the Emotiv EpocX 14-channel headset. All EEG data of participants were pre-processed (Butterworth filter 0.5-50 Hz, Re-ref to the average, ICA to detect Eye and Muscle artefacts), then transformed into frequency dimension to look at the power (squared amplitude) at different brainwave rhythms (method used: fast Fourier transform (FFT)). We looked at the boost of Power (squared amplitude) in Alpha brainwave rhythm (8-14 Hz) as a measurement of relaxation, mindfulness, and restoration.**



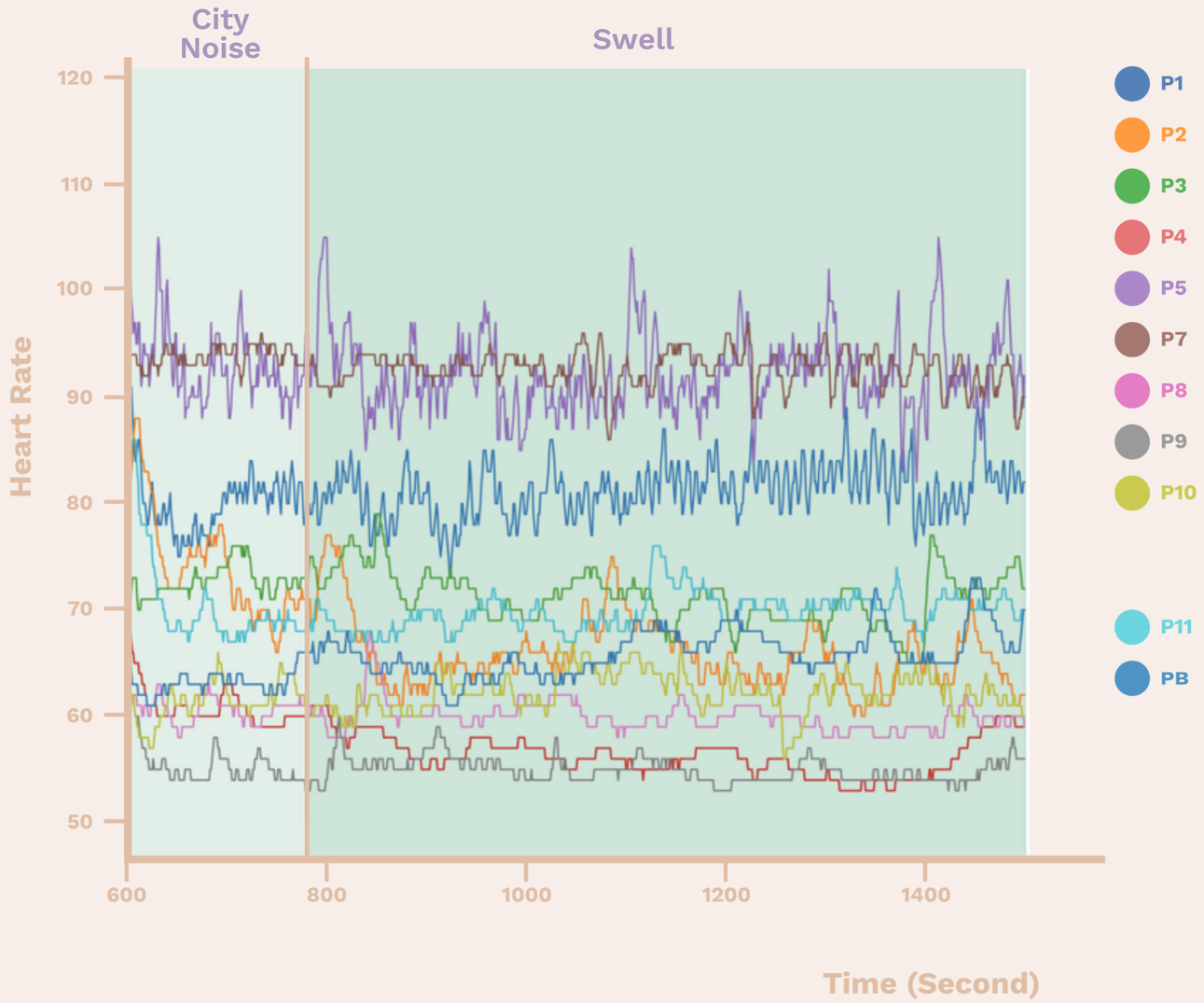
Finding 01

Swell makes people more relaxed, as shown with results across physiological, neural and subjective levels.

Swell reduced the heart rate of individuals during the sound treatment. This reduced in heart rate was even more significant when compared to average heart rates of those in normal urban environments (t=3.56, p=.052, p significant at .05).

Average of HR data collected at the 3 group intervals:

Baseline	74.14
City Noise	74.90
Swell	72.23

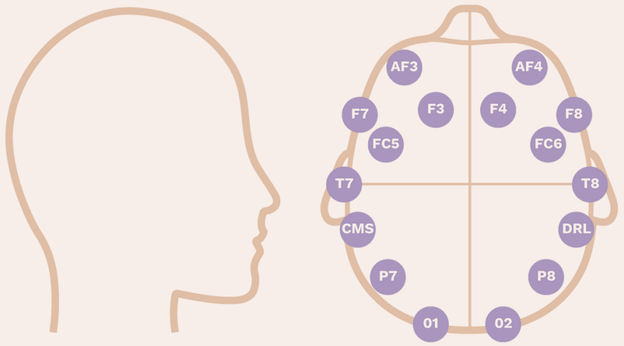


Finding 01

On a neural level, there was a visible boost of Alpha Power (8-14 Hz), the brainwave responsible for relaxation, creativity, and openness. This was observed throughout the duration of the Swell Sound Treatment.

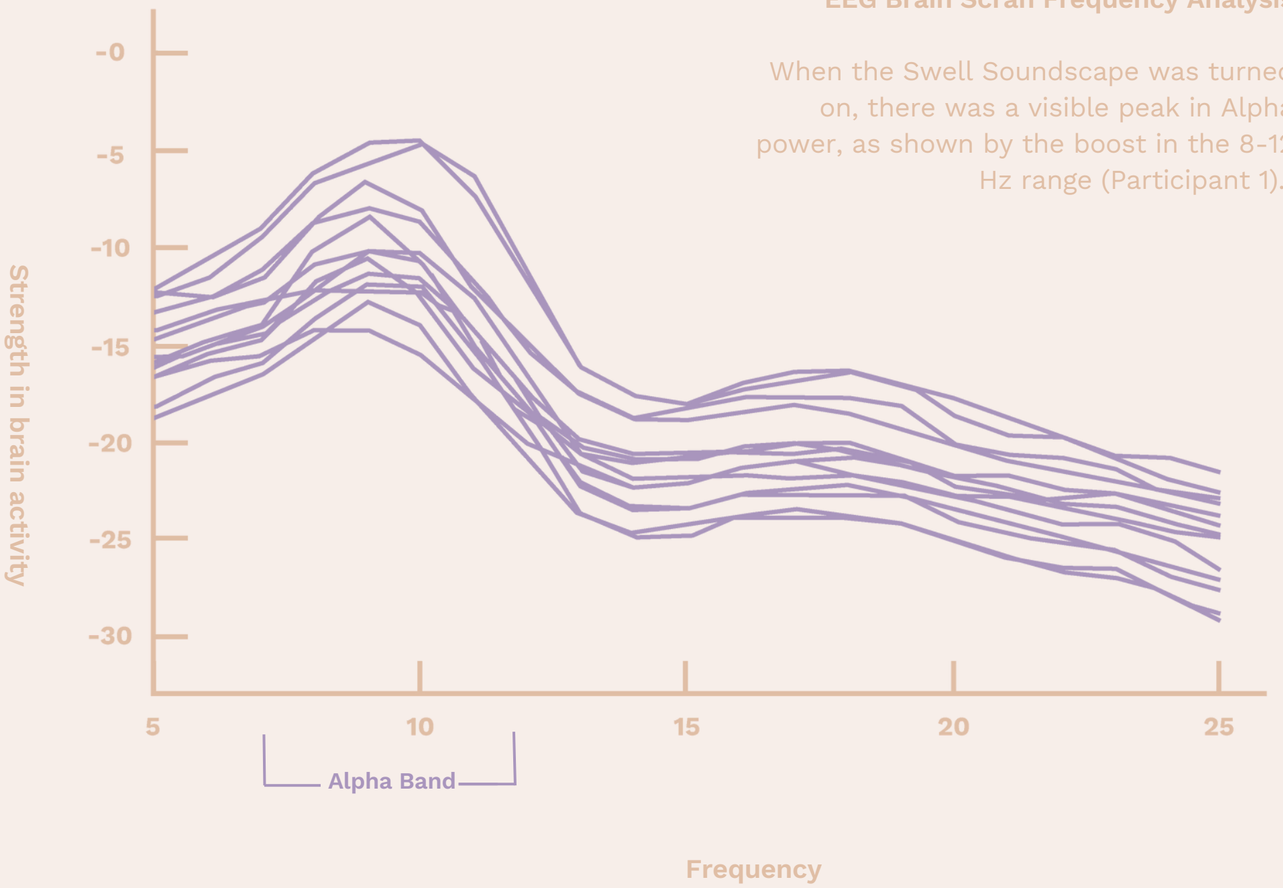
Emotiv EEG 14-Channel Brain Map

Map of placement of the EEG electrodes on the brain where data was collected for all participants.



EEG Brain Scran Frequency Analysis

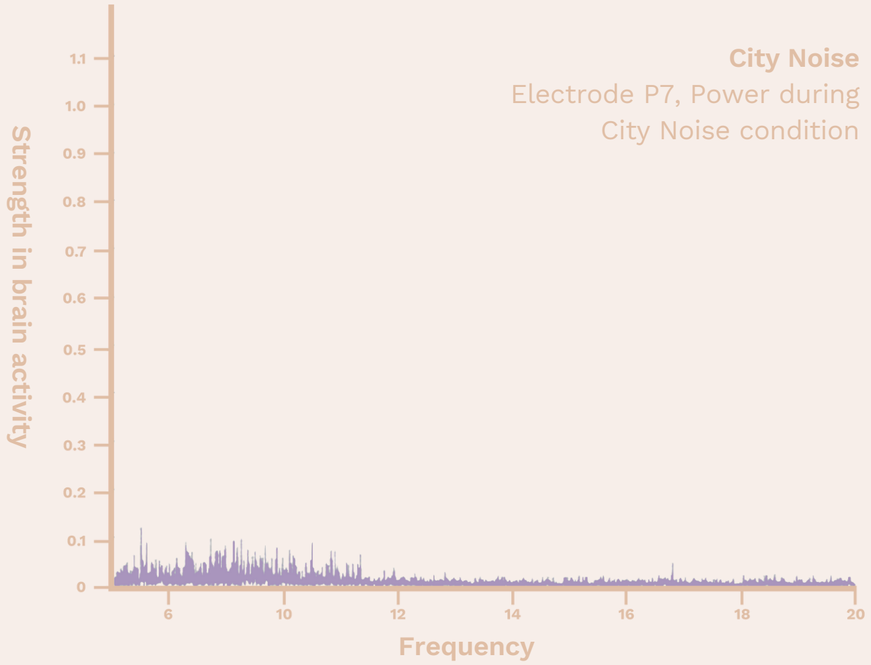
When the Swell Soundscape was turned on, there was a visible peak in Alpha power, as shown by the boost in the 8-12 Hz range (Participant 1).



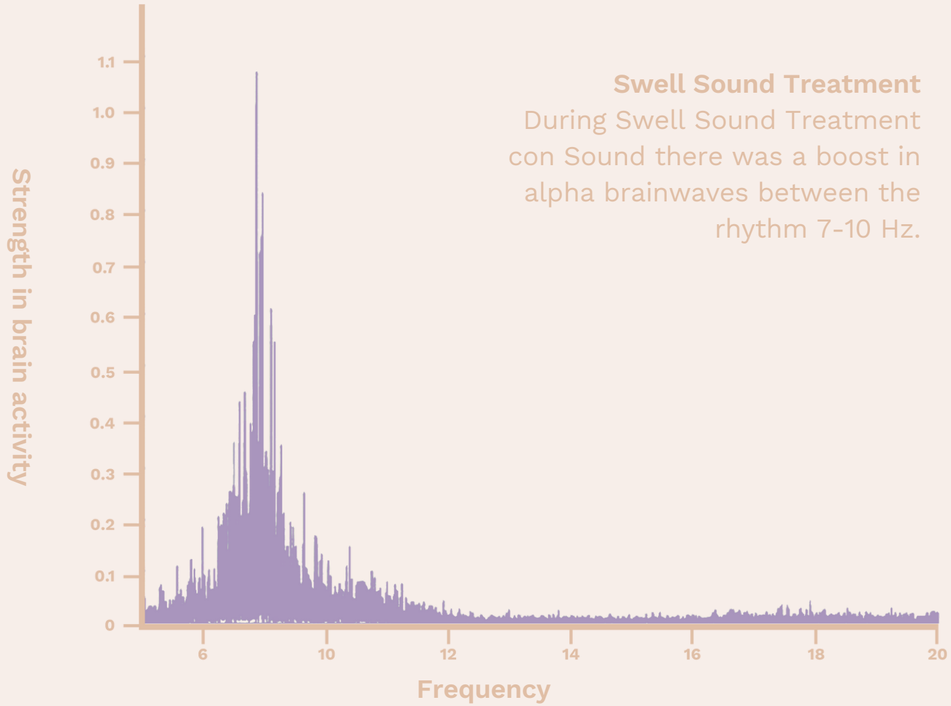
Finding 01

An individual electrode comparison between Urban Noise and Swell (in participant 9). A large boost in power can be seen between 7-9hz in the alpha band while listening to Swell. This is specifically taken from the P7 electrode, located above left and right parietal lobe. This brain region is related with sensory information integration. It is a key region to understanding of the world around you. Other brain regions process other sensory information and forward their processed information to the parietal lobe to integrate it for a cohesive understanding as it relates to ones own self perception.

Individual Electrode Power Comparison between listening Swell and Urban Noise



City Noise
Electrode P7, Power during City Noise condition



Swell Sound Treatment
During Swell Sound Treatment con Sound there was a boost in alpha brainwaves between the rhythm 7-10 Hz.

Additionally, participants reported an increase in their own subjective states of relaxation when listening to the Swell Sound Treatment.

Participants more relaxed when listening to Swell

57.4% — **compared to urban sounds**

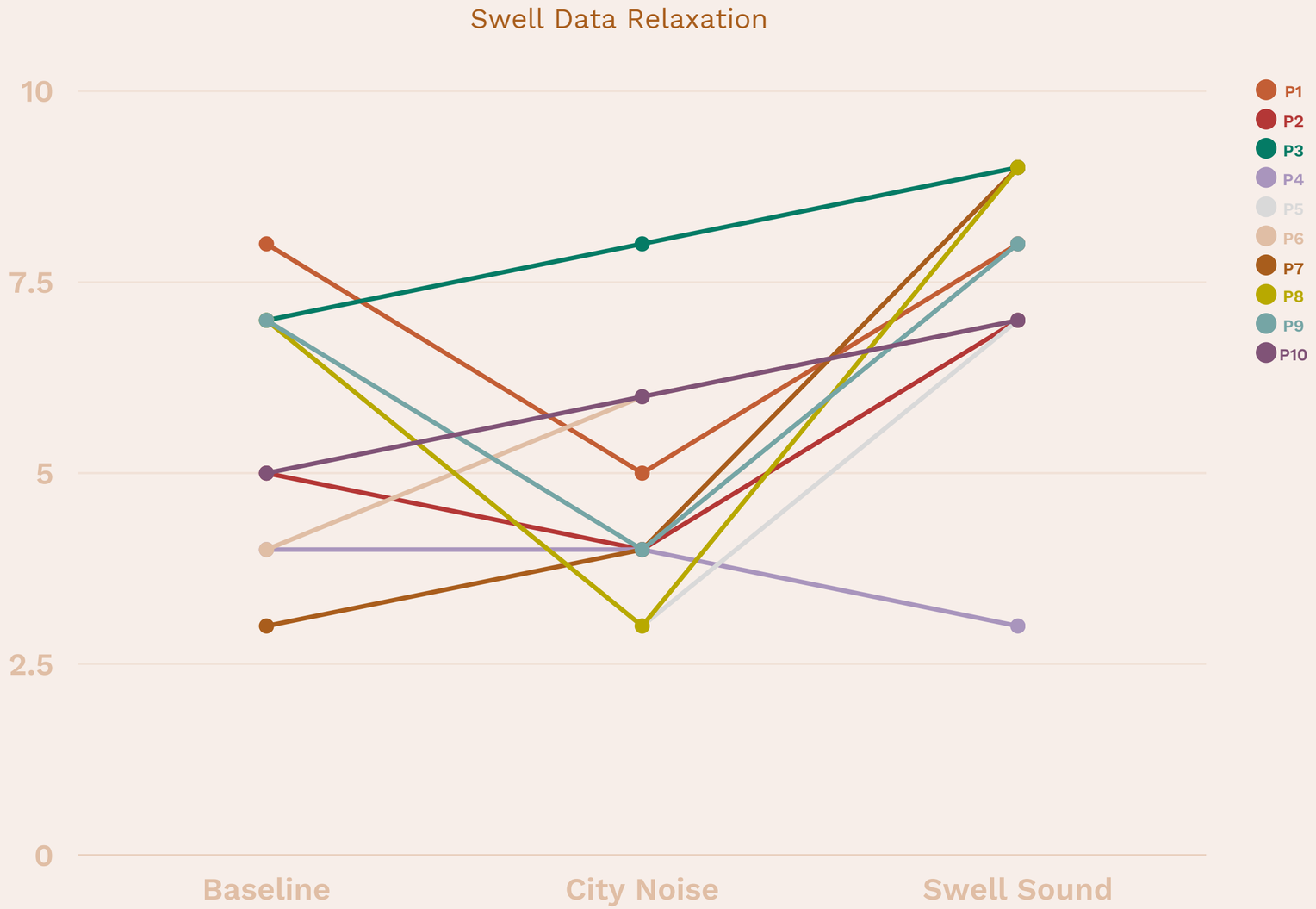
29.8% — **compared to silence**

Finding 01

When looking across all 3 groups, an ANOVA analysis revealed a statistical difference in self-reported relaxation between each of the 3 groups - Silence (baseline), urban noise and Swell [F(2, 18) = 8.101, p = .003 eta2= .327].

Further t-test analysis showed the differences were attributed to Urban Noise & Swell [t=-3.95, p.adj=.01].

*Participants where asked how relaxed or tense they were feeling you now on a scale from 1-9



Finding 02

Listening to Swell Sound Treatments increased people's Nature Connectedness

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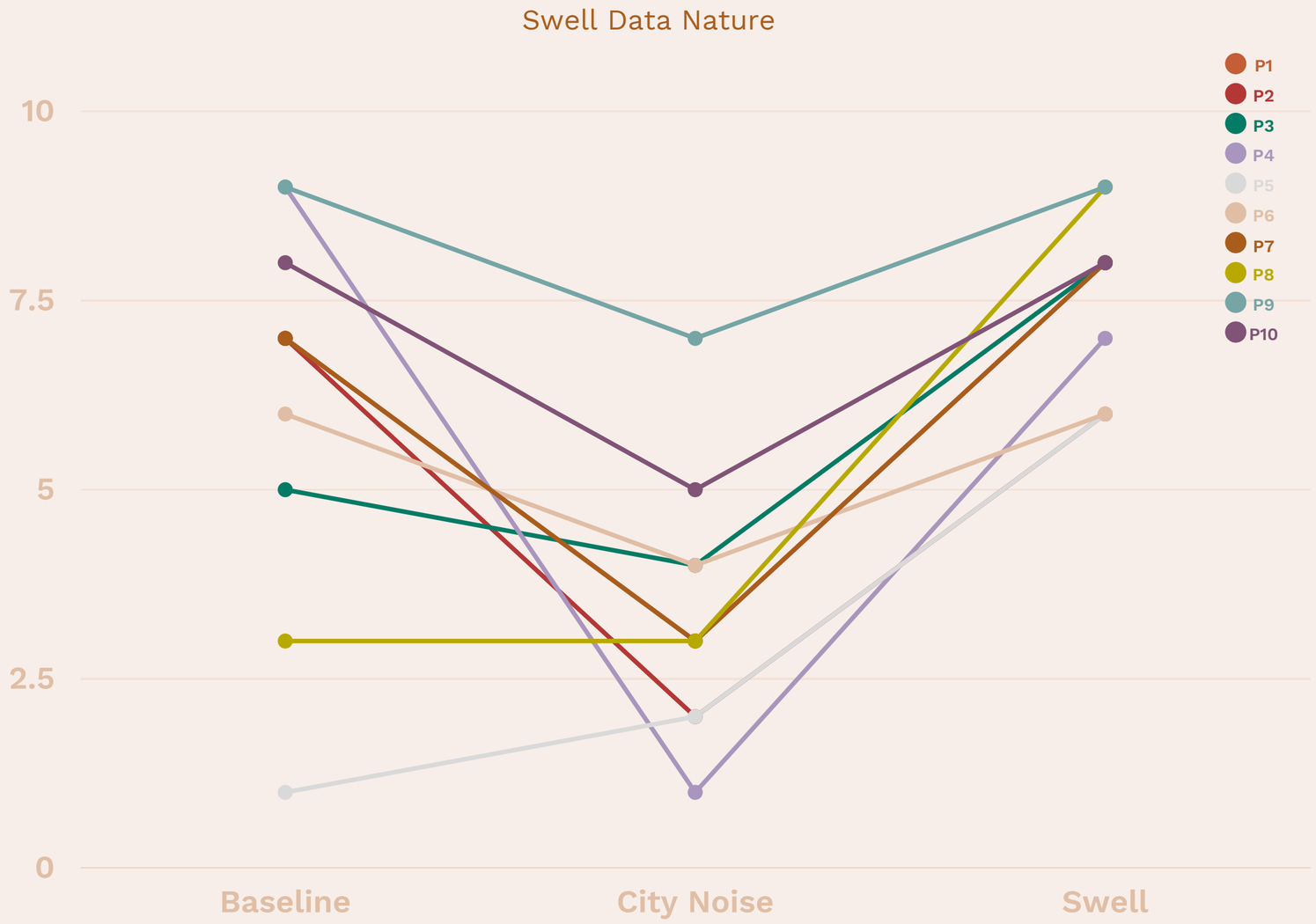
Listening to Swell Sound Treatments increase people’s Nature Connectedness (NC).

Defined as an one's relationship to the natural world (10), NC includes emotions and attitudes towards nature and is proven through science to increase wellbeing, cognition and pro-environmental action.

*Participants where asked to rate how much they feel part of nature on a scale from 1-9



Basline	6.2
City Noise	3.4
Swell	7.5

After listening to Swell, participants self-reported connection to nature increased by:

120% compared to urban sounds

20% compared to silence

Finding 03

Swell made people feel happier as a result of listening to the soundscape. Subjective happiness ratings went up when listening to Swell.

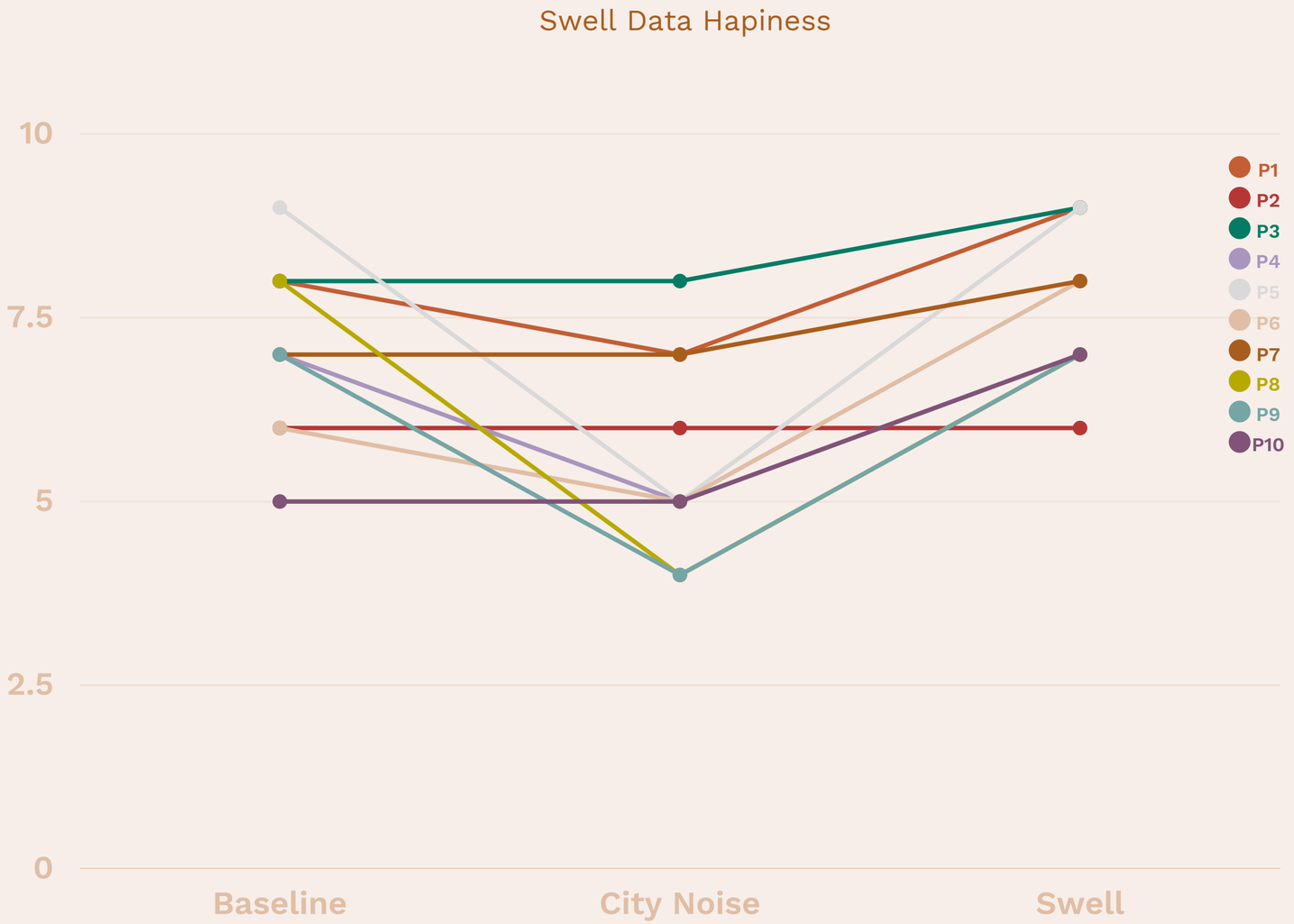
Finding 03

Looking across all 3 groups, ANOVA revealed highly significant mean differences in people's self-reported happiness when listening to silence (baseline), urban noise and Swell [F(2, 18) = 8.101, p = .003 eta2= .327].

Participants self-reported happiness went up:

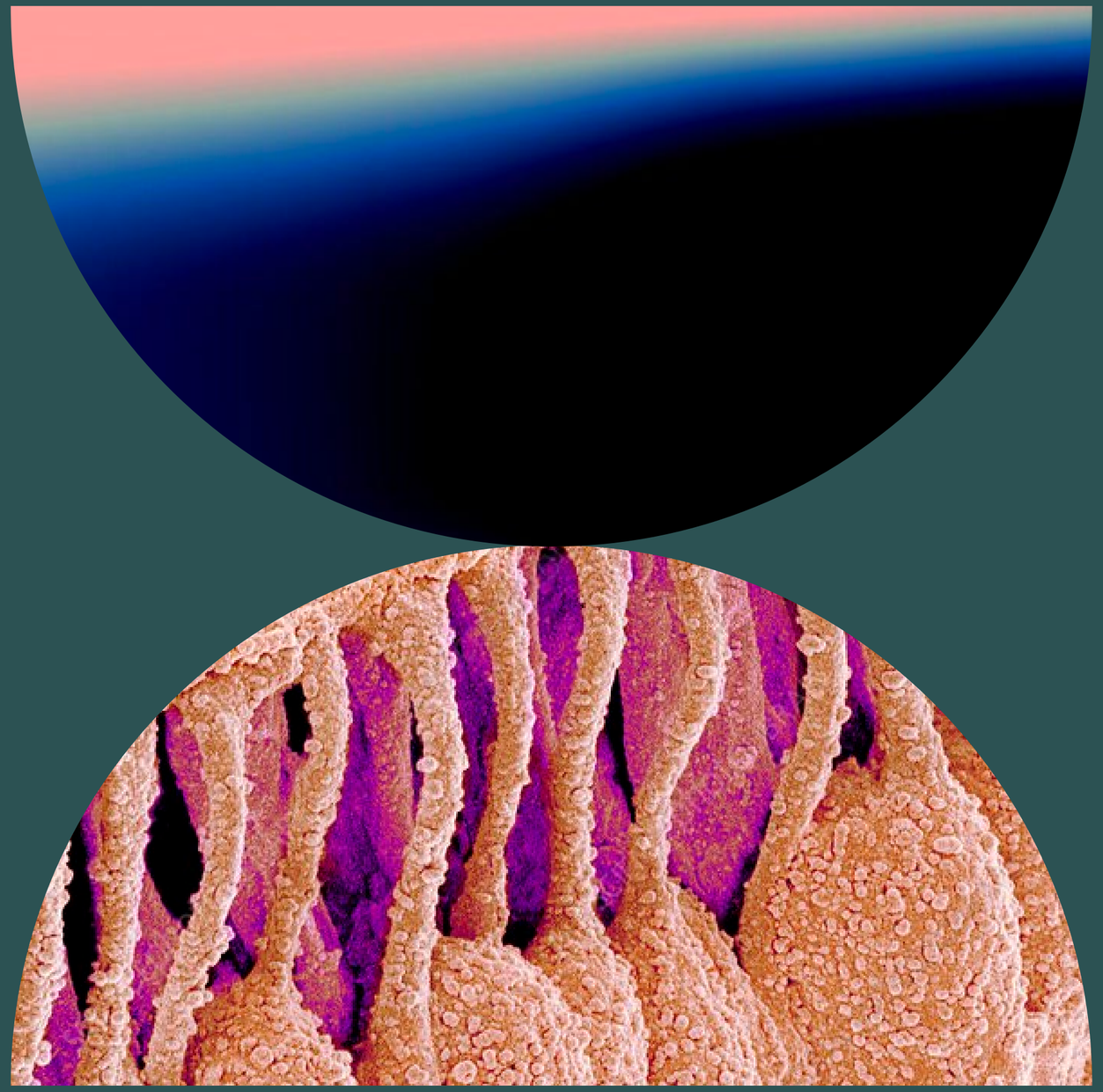
compared to city noise **37.5%**

compared to silence **8.5%**



*Participants where asked to rate how unhappy or happy they are feeling now on a scale from 1-9

Design Applications & Impact



1

Swell is a powerful sound experience that can be used across a range of environments to help people relax in only 15-minutes of use.

In busy ‘always on’ urban lives, it can be difficult to find spaces to calm the nervous system and reduce heart rate. Effective, entertaining and experiential ways to induce states of calm is becoming increasingly important and Swell Sound Treatments prove to be an effective solution to this.

Both sound and experiences in nature are proven (17) to have a restorative and relaxing impact on the brain and body. Elements like pink noise and functional compositions are key components of what make sonic experiences restorative and impactful. Swell’s unique mix of field recordings, music composition, and sound treatments marries these elements to create the ultimate fusion in restoration to combat busy lives.

Reduction in heart rate and boosts in alpha waves are two fundamental brain-body components to relaxation. Shown to reduce anxiety (19), stress (25) and increase states of flow and creativity, Swell’s impact on these two elements can be fundamental to inducing positive relaxation on a neural and physiological level.

2

Access to nature can be a challenge in urban environments. Swell is an effective tool to experience the benefits of nature connection which has profound impacts on a personal and societal level

Swell was proven to significantly improve Nature Connection (NC) among participants.

Rising as a pressing need to be addressed, nature connection includes the emotions and attitudes one feels towards nature. NC is an incredibly important tool not only for personal wellbeing, but collective societal action. Increasing nature connection is not only shown to be pivotal to personal and social wellbeing, but is demonstrated to be a key outcome of psychedelic experiences too (26).

Personal Wellbeing:

Connection to nature leads to more positive affect, vitality, and life satisfaction compared to those less connected (27).

Higher-than-average NC is associated with a 7% increase in feelings of worthwhileness, a 6.4% increase in life satisfaction, and a 2.5% decrease in depression risk. (28)

2

Access to nature can be a challenge in urban environments. Swell is an effective tool to experience the benefits of nature connection which has profound impacts on a personal and societal level

Social Impact

In urban environments we don't often have a chance to get into nature, using Swell can make a big impact in nature connectedness.

The more they are likely to be concerned about and protect the environment. (29)

By increasing a sense of self-transcendence, where a person feels connected to something greater than oneself, NC leads to prosocial behaviours like increasing charitable donations, having more empathy for others, and participating in more daily sustainable actions like recycling, and reducing carbon footprint.

3

Swell provides a new ‘wellbeing as experience’ that can help a wider audience experience wellbeing through the use of technology, art and experiential formats.

While ‘sound healing’ experiences like sound baths are rising in popularity across specific populations, and other sound therapies like vibroacoustic therapy are shown to support a wide range of clinical populations (30), there is a growing need for accessible, effective and relatable sound treatment solutions for a wider demographic.

Increasing rates of stress and anxiety are creating an urgent need for a range of wellbeing activities to cater to wider audiences.

Using aesthetics to tap into sensations in the body and impulses in the brain is rising as a needed format to support wellbeing through culture and the arts. By using proven science within the sonics, Swell Sound Treatments are shown to trigger positive brain and body states through sonic immersion.

Swell offers a new mode of wellbeing, a passive yet experiential, immersive and an engaging experience that can be used for both at-home or spa environments for a broad range of individuals.

Considerations & Future Applications

This study specifically looked at an individual Swell soundscape using within-group participants as compared to both a silent and city noise condition. Information was gathered from 10 participants. Future studies can use larger sample sizes and test different Swell soundscapes against classic spa music and background Muzak.

Future studies can be carried out with larger sample sizes, as well as increased listening durations, testing headphones against speakers as well as frequency of use for impact.

As many as one in seven people are neurodivergent, which often affects sound sensitivity and sensory processing. Likewise, hearing-impaired responses to soundscapes will differ significantly from norm.

Given this study's results, there is a wide remit to explore future applications of Swell soundscapes on wider groups like specific clinical populations, as well as in other contextually-valid environments like spas, museums and at-home immersive.

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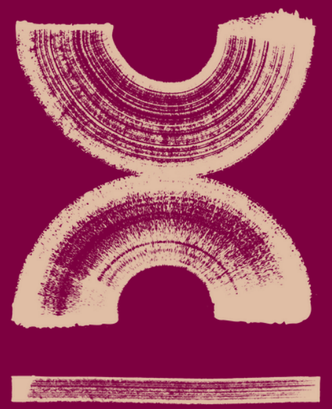
Thank You



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