# BioSelf

TECHNOLOGY·LABS

## - STUDY REPORT -

" Using Sensate daily for two weeks decreases stress and anxiety and improves sleep and well-being. "

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| **Study** | Sensate INC, Bioself Technology, UK |
| **Results** | Statistically significant improvements in perceived stress, anxiety, sleep and general well-being after 2 weeks of daily Sensate use |
| **Population** | Adults, age 25-65 |
| **Sample Size** | 25 |
| **Outcomes** | Self-report questionnaires on stress, anxiety, sleep and well-being |

## Background

**Stress, anxiety, sleep, and well-being are closely intertwined.**

Sensate pairs auditory soundscapes with infrasonic vibrations to disrupt the cycle of stress and positively affect all of these aspects of people's lives. Years of clinical work and user testimony support Sensate's benefits. This study was conducted to contribute additional scientific validation for these benefits.

## The study

25 participants used Sensate daily for 14 days, completed a battery of scientifically-validated questionnaires assessing their perceived stress, state and trait anxiety, sleep quality, and well-being at the start and end of the study, and provided feedback about their experience with Sensate.

## Results

**Almost all measures showed statistically significant improvements.**

• Perceived stress was reduced from high moderate to low moderate levels.

• Sleep quality improved, including an increase of more than an hour of sleep to a full seven hours and a decrease in the time required to fall asleep; from more than an hour to less than 30 minutes.

• State anxiety was reduced from high to low levels and trait anxiety reduced from high to moderate levels.

• 80% of participants said their experience of Sensate was excellent or very good.

## Conclusion

This pilot study provides preliminary scientific support for Sensate's benefits for stress, anxiety, sleep, and well-being.

## Additional highlights

• Perceived stress levels in the general population have increased since the COVID-19 pandemic. Participants had higher levels of perceived stress than current norms at the beginning of the study, but reported pre-pandemic levels of stress at the end.

• 18 out of 25 (72%) participants rated their sleep as "fairly bad" or "very bad" at the start of the study. At the end of the study, not a single participant rated their sleep as "very bad," and only two rated it "fairly bad."

• 16 out of 25 (64%) participants felt relaxed at the end of the study, compared to only 1 out of 25 (4%) at the start.

• 19 out of 25 (76%) of participants reported feeling only not at all tense at the end of the study, compared to 9 out of 25 (36%) of participants at the beginning of the study.

• 17 out of 25 (68%) participants reported "I am Happy" often or almost always at the end of the study.

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## Background

Stress, anxiety, sleep, and well-being are all tightly interwoven aspects of our lives. Stress increases our anxiety, disrupts our sleep, and decreases our well-being.

But it's also not a one-way street. Not only does stress have these effects on anxiety, sleep, and well-being; high anxiety, poor sleep, and low well-being themselves become sources of stress. It's both a tangled web and a vicious cycle. Sensate is meant to untangle this web and disrupt this cycle. Pairing soothing music with broad-spectrum vibrations emitted by a device placed on the chest, Sensate was developed over a period of three years in a top London clinic with patients dealing with stress, trauma, and dysregulation of the autonomic nervous system.

Sensate has now been available directly to consumers for four years. Clinical work and user feedback from a combined 30 million minutes attest to Sensate's benefits for stress, anxiety, sleep, and well-being. The present study was conducted to provide further support for the benefits of regularly using Sensate with scientifically-validated psychometric measures.

## Methods

25 people aged 25-65 that had never used Sensate and experienced moderate to high levels of stress according to the Perceived Stress Scale completed the study.

The Perceived Stress Scale is a scientifically validated and widely used psychometric questionnaire of stress that asks questions like, "How often have you felt that you were unable to control the important things in your life?" and "How often have you felt that things were going your way?" We recruited participants from a database of people that had never used Sensate but had expressed interest in trying it.

As part of the study, participants completed at least one 10 minute Sensate Session every day for two weeks. Sensate includes a variety of soundscapes with a range of inspirations and sonic styles to fit different moods and tastes, and participants could choose whichever track they preferred for each session. At the beginning and end of the study, participants completed a rigorous battery of assessments comprising four scientifically-validated and widely used self-report questionnaires about their subjective experiences. At the end of the study, participants also provided feedback about their experience with Sensate and the study itself.
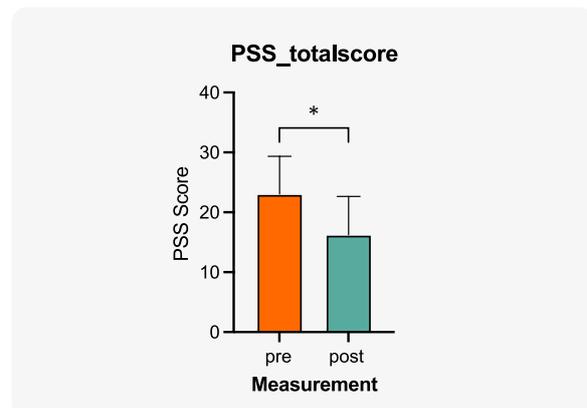
## Results

The data for each metric was inspected and found to be non-symmetric and non-normally distributed. Therefore, Sign Tests were conducted to calculate statistical significance. Additionally, significance values were rounded conservatively.

**STRESS**
Stress levels were assessed with the Perceived Stress Scale-10 (PSS). The PSS has 20 questions, and scores can range from 0-40, with higher scores indicating more stress. PSS scores are generally divided into three categories: low (0-13), moderate (14-26), and high (27-40). Before the study, all participants had moderate or high levels of stress.

We also asked participants at the end of the study to judge how relaxed and stressed they felt compared to the start of the study.

At the end of the study, 22 out of 25 people reported feeling more relaxed, and 21 out of 25 reported feeling less stressed.



These answers are supported by the results of the PSS questionnaire. Participants experienced a statistically significant decrease in stress ($p < .01$). At the start of the study, the average stress score for all participants was 23.0, and at the end, it was 16.2. Therefore, on average, the group moved from "high moderate stress" to "low moderate stress" levels. To put this into context, note that before the COVID-19 pandemic, perceived stress levels in the general

population according to the PSS-10 were approximately 14-17 pts [1]. Since the pandemic, average PSS-10 scores have increased to approximately 20 pts [2,3,4,5]. Our participants started out even more stressed than the average COVID-19 weary person, but after the study, their stress reduced to pre-pandemic levels.

**ANXIETY**

We measured anxiety with The State-Trait Anxiety Inventory (STAI). It has two components, state anxiety, which is anxiety in the moment, and trait anxiety, which is anxiety in general. The STAI has 20 statements for assessing each type of anxiety, and participants rate to what extent they agree with that statement. Examples include, "I am tense," I am worried," and "I worry too much over something that really doesn't matter."

Scores for each component range from 20-80, and scores are generally divided into three categories, low anxiety (20-37), moderate anxiety (38-44), and high anxiety (45-80). At the end of the study, participants had a highly significant decrease in both state and trait anxiety ($p < .001$).

At the beginning of the study, participants' state anxiety score was 50.4, placing them in the high state anxiety group. At the end, it had significantly
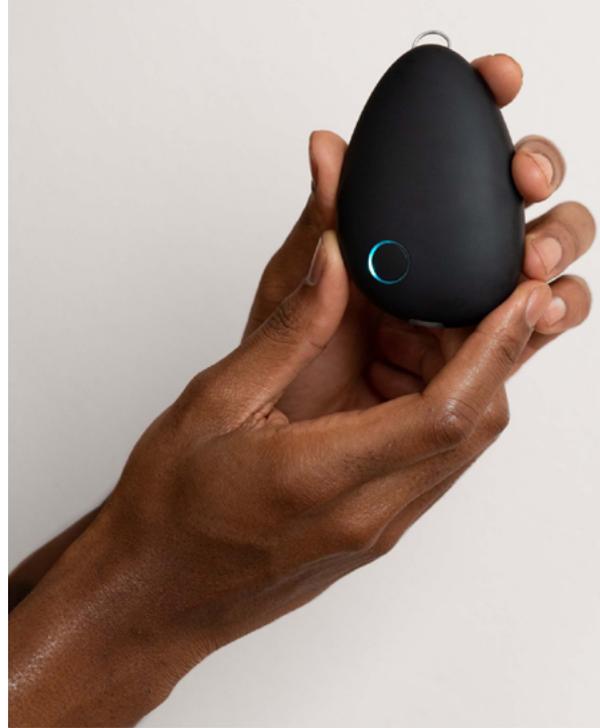
decreased ($p < .001$) by a whopping 16 points to 34.4 moving them from the high anxiety category to the low anxiety category. At the beginning of the study, participants were also in the high anxiety category for trait anxiety with an average score of 54.0. After two weeks of daily Sensate sessions, this significantly decreased ($p < .001$) by 12.7 points to 41.2, moving them down to the moderate trait anxiety category.

Looking more closely at individual items on the scale, 16 out of 25 (64%) participants reported feeling moderately or very much relaxed after 14 days of Sensate Sessions (item = I am feeling relaxed), compared to only 1 out 25 (4%) at the beginning of the study. Additionally, 19 out of 25 (76%) participants reported feeling only somewhat or not at all tense after 14 days (item = I feel tense), compared to 9 out of 25 (36%) participants at the beginning of the study. The other 16 participants reported feeling moderately or very much tense before the study.

17 out of 25 (68%) participants reported "I am Happy" often or almost always after 14 days of using Sensate.



**STAI Scores**
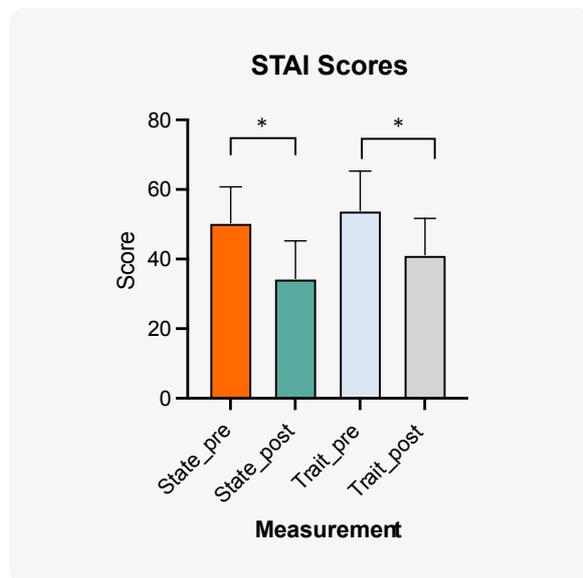
## SLEEP

Sleep quality was assessed with the Pittsburgh Sleep Quality Index (PSQI), an in-depth assessment of sleep quality consisting of seven components added up to yield a Global PSQI Score. The items include a question to rate subjective sleep quality overall and questions about what time the person went to bed and woke up, how long it took to fall asleep, and how often their sleep was disrupted by various factors. Scores on the PSQI range from 0-21 with higher scores indicating worse sleep and scores of 0-4 being considered "good" sleep. We also asked participants to judge whether Sensate improved their sleep at the end of the study.

18 out of 25 participants answered "yes" to this question, and these responses are also supported by the PSQI questionnaire.



**Hours of sleep** / **Time to fall asleep**



**PSQI_totalscore**
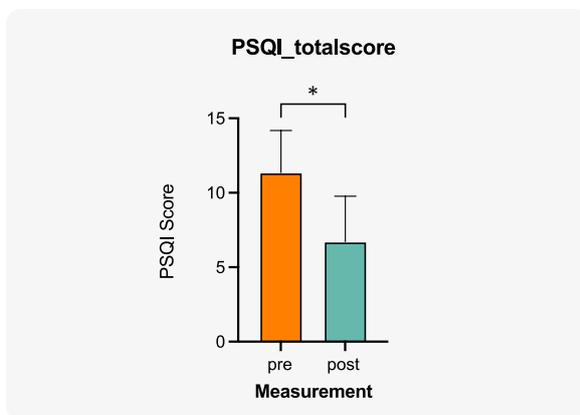
Participants experienced a highly statistically significant decrease in Global PSQI Score (p < .001) and therefore a significant improvement in sleep quality. At the start of the study, the average Global PSQI Score was 11.4, and at the end of the study it was 6.7, a reduction of 4.7 points.

Because the PSQI is so in-depth and contains multiple components, we could break down participants' sleep quality even further. At the start of the study, 18 out of 25 participants rated their sleep as "fairly bad" or "very bad." At the end of the study, not a single participant rated their sleep as "very bad," and only two rated it "fairly bad."

The average overall amount of sleep participants reported increased from 5.89 to 7 hours, an impressive increase of more than an hour extra sleep per night.
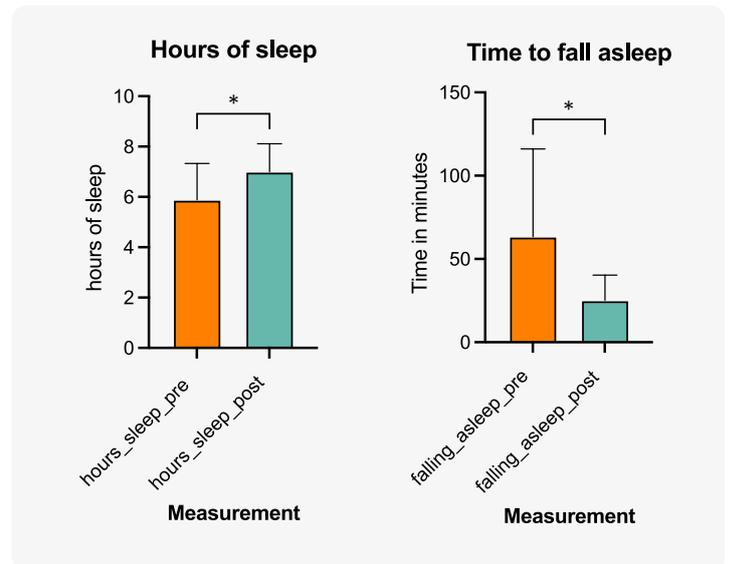
You've likely heard the recommendation of 7-9 hours of sleep per night. Before the study, our participants were falling far short of that recommendation, but after two weeks of regular Sensate sessions, their average sleep time was boosted to a healthy range. Not only did they sleep longer, it also took them less time to fall asleep. The average time to fall asleep, known as sleep latency, was over an hour (63 minutes) at the start of the study, but by the end it was less than half that (25 minutes).

## WELL-BEING

Defining well-being and scientifically measuring it is a tricky proposition. After intensive research, we decided to represent well-being with the Positive and Negative Affect Schedule Short Form (PANAS-SF), which is one widely accepted way of getting at this nuanced concept. It is a questionnaire that asks people to rate to what extent they recently felt certain ways, such as excited, nervous, proud, or hostile. It is divided into two subscales representing two components, positive affect and negative affect. Positive Affect is associated with positive emotions and Negative Affect is associated with negative emotions. One of the reasons we chose this measure is because Positive Affect as assessed by the PANAS has been shown to correlate with longevity [6]. The PANAS-SF is 20 items long, and scores range between 10-50 for each subscale. Higher scores indicate a greater degree of that affect.

Our study showed highly statistically significant changes in positive affect (p < .001) and a trend towards significant change for negative affect after two weeks of regular Sensate sessions.

The researches that developed the PANAS-SF found in a sample of almost 600 people that on the scale of 10–50, the average Positive Affect score was 32.0 when participants were basing their responses on the past several weeks [7]. At the start of our study, the participants' average score for positive affect was 21.5, much lower than the average of 32.0. However, at the end of the study, participants' positive affect had significantly increased (p < .001) by a whopping 10.7 points to 32.2. Low Positive Affect scores reflect 'sadness and lethargy' whereas high Positive Affect scores reflect 'high energy, full concentration, and pleasurable engagement' [7]. Therefore, at the start of the study, our participants had much lower positive affect than average, likely feeling more sadness and lethargy, but two weeks of regular Sensate use boosted their positive affect hugely to be consistent with population averages, suggesting they had higher energy and experienced more pleasure in their experiences.



**PANAS Scores**
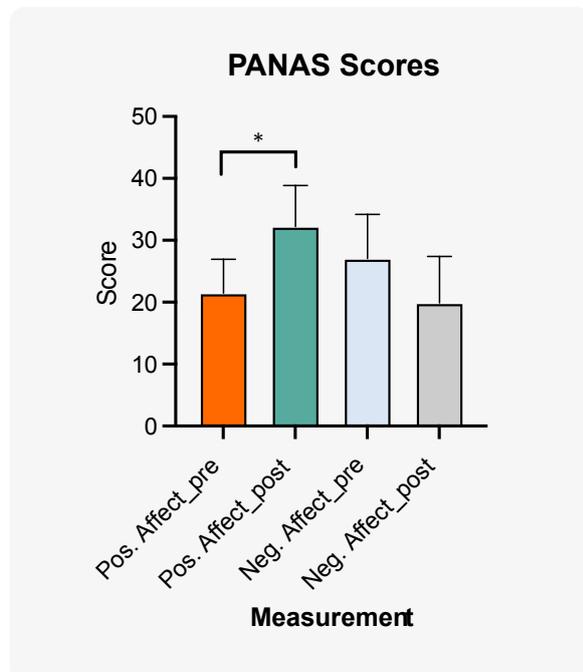
The researchers that developed the PANAS also found that the average Negative Affect score was 19.5 for their sample of people. At the start of our study, participants' Negative Affect score was much higher, averaging to 27.1. At the end of the study, participants' Negative Affect score decreased to 19.9. This decrease was not statistically significant, but there was a trend towards it (p = .06). Low Negative Affect scores describe 'a state of calmness and serenity' whereas high Negative Affect scores suggest 'subjective distress and unpleasurable engagement' [7]. Therefore, our participants started in a state of much higher distress than average, but after two weeks of regular Sensate sessions, this decreased dramatically, allowing them to reach a normal state of calm and serenity.

## Feedback

In addition to the questions about whether Sensate reduced their stress, increased their relaxation, and improved their sleep, we asked participants to provide feedback on their experience with Sensate.

88% of participants reported their experience to be good, very good, or excellent, and none said their experience was poor.

We also asked participants to describe their experience in their own words. Here are some of the things they said:

*"Sensate has seriously changed my life!"*

*"The sounds and vibrations would take me away... Often [I] would fall asleep within 5 to 6 minutes of having it on."*

*"Very calming, soothing and relaxing. Helped me to feel more rested."*

Some people reported using Sensate specifically to help cope with difficult situations, like a rough work call or conversation with a friend, or that it helped them create a ritual to decompress.

As with any practice of this kind, people's experiences vary, and a couple of people did find the vibration unpleasant or that their mind still had too much time to wander back to their anxieties.

## Conclusion

The study was a first internal pilot study of regular Sensate use in new users to support years of positive clinical results and user feedback with scientifically-validated questionnaires.

The results were overwhelmingly positive, with participants experiencing significant changes in almost every measure, namely decreased stress and anxiety, improved sleep, and increased well-being.

The use of scientifically-validated measures allows us to see that our participants, who had expressed interest in Sensate because of their stress-related concerns, were indeed struggling more than average, with higher stress, less sleep, high anxiety, and poorer well-being compared to the norms established by these measures. Two weeks of daily Sensate use led to dramatic impacts on these factors, allowing people to achieve healthy sleep patterns, pre-pandemic levels of stress, low anxiety, and a healthy level of well-being. This study is a pilot study, so the sample size is small, and there is no control group. However, the results are highly encouraging, and Sensate is preparing for additional research studies to further strengthen this evidence.

References

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