

Skin Temperature

The temperature at the surface of the skin changes accordingly to blood circulation through body tissue. The small blood vessels (arterioles) crossing through the tissue are surrounded by fibers of smooth muscle, which are controlled by the sympathetic nervous system.

In a state of increased exertion, excitement and stress, these muscle fibers contract, causing a stenosis of vasculature. This leads to a reduction of skin temperature, since blood circulation through the tissue is reduced. In contrast, in a state of relaxation, the musculature is also bound to relax, causing the vasculature to expand. Hence, the skin temperature rises.

Mental stress often leads to a lower peripheral perfusion and a decrease of skin temperature at the hands, caused by increased activity of the sympathetic nervous system. From an evolutionary point of view, this stress reaction serves to prepare us to “fight or flight” in a physically threatening environment, because the maximum amount of blood is concentrated in the working muscles.

This physiological stress reaction can be useless or even harmful in many contexts in modern society (e. g. mental exertion, worries, psychosocial stress, anxiety disorders...). A conscious control of physiological stress can help you to react more relaxed and efficient to many situations. Biofeedback is an established way to learn this kind of control.

Biofeedback with skin temperature

Biofeedback with skin temperature is mainly applied in relaxation exercises. It's easy to handle, and easy to learn. Experience with this technique shows a high rate of success and improvement of subjective well-being.

A particularly easy and effective biofeedback method is hand warming training. It works with the eSense temperature sensor attached to a finger, or simply held between thumb and index. You will learn through direct feedback to intentionally raise the temperature of your fingers, thus increasing perfusion in your hands.

The biological temperature sensors in our hands give us only a coarse impression of our skin temperature. The real-time feedback of the eSense Sensor will give you way more exact information on the perfusion and temperature of your hands, enabling you to learn conscious control of these parameters and your relaxed well-being.

How to train

1. A quiet, comfortably tempered room without phones and other sources of distraction, and convenient seating and clothing are the conditions we need for successful training. As skin temperature depends also on ambient temperature, you should try to perform each training session under similar ambient conditions.
2. Use the accompanying tape (or a fabric tape of your choice) to attach the temperature sensor to your index or middle finger. Plastic tape works as well, although it's less comfortable because it's airtight and can make your fingers transpire.
3. You should get accustomed to the ambient temperature for at least 5 minutes, letting the training start in a steady state of your body. This phase of acclimatization can already raise your hand temperature by several degrees.

4. First stage: observe and experiment, determine your initial status

- a. In comparison with other biofeedback techniques, you will need fewer sessions for a reliable success. 6-10 sessions should be sufficient. To keep focused throughout the entire session you should limit session length to about 15 minutes. If you start feeling tired while training, you should shorten your sessions and practice more often instead.
- b. You should record your baseline state for 2-3 minutes at the beginning of each session, letting the sensor temperature adapt to your finger. Sitting upright and comfortable, do not watch the temperature but simply let the device measure. Sensor temperature will become relatively stable, and the training itself can begin.
- c. In your first session, take 10 minutes to relax consciously as best as you can without watching the temperature feedback. This part is about determining whether simple relaxation without feedback can already raise your skin temperature.
- d. Take a look at the measurements. Did conscious relaxation already raise the temperature? No matter if it happened or not, get accustomed to the feedback function of the application now. Watch the temperature feedback and see if you can exert conscious influence on it! This exercise marks the end of the first stage.

5. Second stage: Biofeedback training with the temperature feedback

- a. Before embarking upon the next session, try to be aware of your hand's temperature during everyday activities. Do your hands feel particularly warm or particularly cold in certain situations? These observations can be very helpful for the exercises to come.
- b. The second stage consists of multiple sessions. These sessions should always follow the following scheme. Start every session with a 2-3 minute baseline measurement without watching the values in order to reach a steady state.
- c. Now you can start to train conscious relaxation, using the feedback signal. Watch the temperature values while relaxing and try to find ways to bring them up. It can be helpful to imagine yourself lying in the sun, relaxing in a sauna, or putting your hands into warm water. You can also work with autosuggestion techniques, telling yourself sentences like "My left hand feels warm...it feels even warmer now...". Feel free to experiment.
- d. As with every activity, regular practice is the key to success. You should be able to raise your skin temperature by several degrees, unless your baseline is already at 33-34 °C / 91-93 °F . The colder your hands are in first place, the more potential you have to raise their temperature. In principle, you can achieve more than 36 °C / 97 °F in your hands, a temperature normally reserved to your body core.

6. Third stage: Transfer, relaxation without feedback

- a. Now you can check if a state of deepened relaxation, and the corresponding rise in skin temperature, can already be achieved without feedback. After measuring the baseline as usual, you should alternate between watching and not watching the feedback, two minutes each way. The longer and more often you can keep the temperature up without the feedback, the better your self-control has already become.
- b. Perform multiple sessions in third stage. When you can keep your skin temperature up for a prolonged time and mainly without feedback, you have successfully completed this stage.

7. Fourth stage: deliberate provocation, relaxation and stress coping

- a. Finally, you should check if you have acquired improved stress resilience. Start a session with the baseline as usual, then keep your skin temperature on elevated levels (well above 30°C / 86°F) for a couple of minutes.
- b. Try to bring yourself in a strenuous situation. You can recall memorized everyday situations in which you tend to have cold hands, or situations that have caused tension and anger. You can also move to a stressful environment, or ask another person to exert a stressful stimulus upon you. Keep the stress situation short and do not overload your ability to cope with it.
- c. If you can sustain elevated levels of skin temperature during strenuous situations, ideally at levels above your personal maximum in the first stage, you have learned to keep relaxed and calm even in difficult and stressful situations. You have fully reached the goal of hand warming training!

How does the eSense temperature app work?

Moveable training thresholds for the color gradient (hot to cold)

Temperature scale (°C or °F)

Momentary temperature value

Start and stop of the recording process

Indicator for rising or falling values

Time elapsed

Momentary value.

Overall session minimum

Overall session maximum

Last 60 second's average value

Instructions and help

You can switch between **Fahrenheit and Celsius** scales through the settings menu for this app, which you find in the General Settings of your iOS device.

Zeit
44.00 Sec

Akt. Wert
33.90 °C

Minimum
33.90 °C

Maximum
34.20 °C

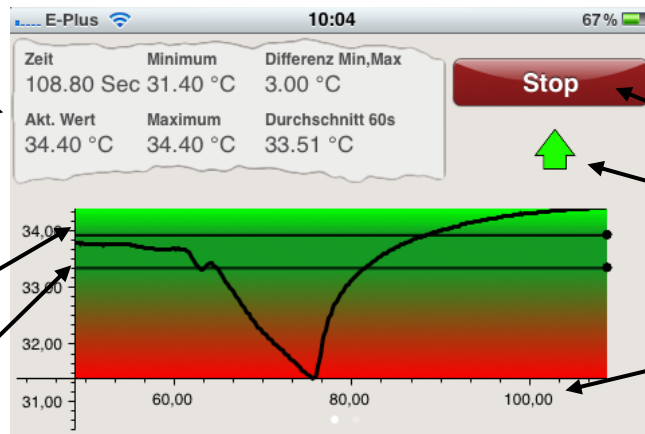
Differenz Min,Max
0.29 °C

Durchschnitt 60s
34.07 °C

Display on iPhone®/ iPod touch® in vertical format

Same values like in vertical format

Moveable training thresholds for the color gradient (hot to cold)



Start and stop of the recording

Indicator for rising or falling values

Time scale in seconds

Display on iPhone®/ iPod touch® in horizontal format

Sweep your finger over the display to change between the horizontal format and the animation.

Double tap on the animation to maximize it!



Rising temperatures keep the animation going, while falling temperatures stop it. You want to raise your skin temperature, so keep the animation going!

Display on iPhone®/ iPod touch® in horizontal format

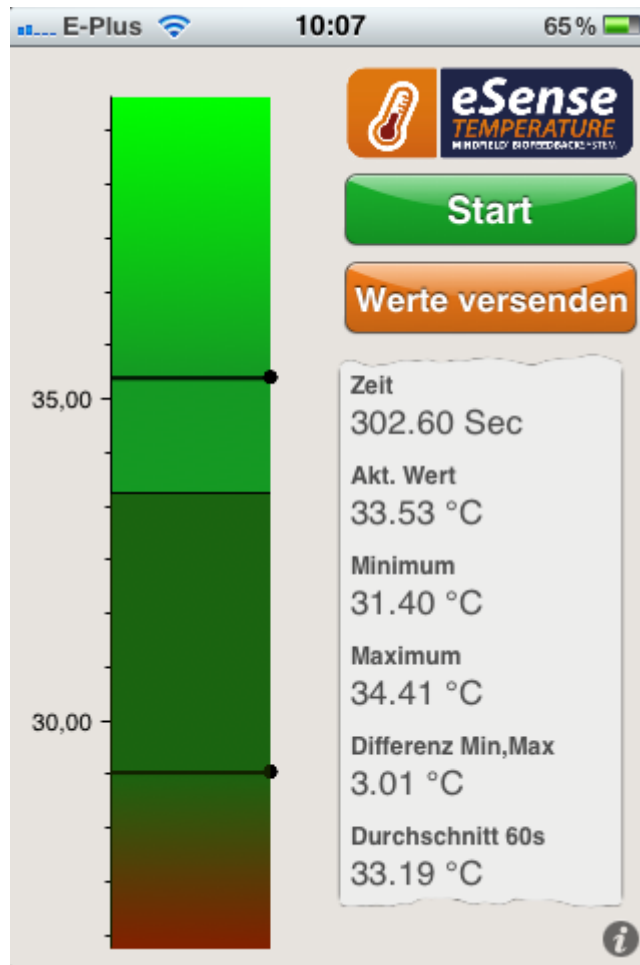
Move two fingers together ("pinch") to shrink the animation to original size!



Tap on Custom Video to choose your own video, an on Default Video to return to the standard video!

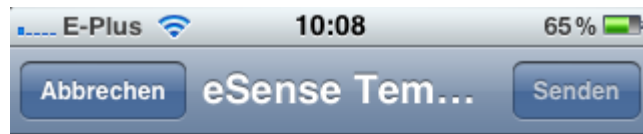
After stopping a recording, you can transfer the measured values via e-mail. You need an email account in your iOS for this function.

5 values per second are saved to a CSV file where every line indicates one value, so 5 lines correspond to one second of measurement.



Click on „Werte versenden/send values“ to send a CSV (comma separated value) file to your personal or any other email.

The file can be processed in Microsoft Excel™ or Open Office



An:

Kopie/Blindkopie, Von:

Betreff: eSense Temperature 16-05-2012 ...

Die gemessenen Werte befinden sich
in Form einer CSV-Datei im Anhang.



values.csv

Von meinem iPhone gesendet

Sending the measured values to your email account

If your you are using an iPad®, all functions described above are displayed on a single screen. The functionality itself is identical.