

itovi[®]



GSR

Galvanic Skin Response

Resource Guide



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INTRODUCTION

Galvanic Skin Response (GSR) measures changes in electrodermal activity (EDA) in response to specific stimuli.

So...what does that mean? To understand GSR, we first need to understand a few things about the human body.

GSR and The Autonomic Nervous System

So much of what the body does is autonomic. Your body digests food, regulates your temperature, and repairs both internal and external damage without your conscious effort.



Autonomic: *involuntary or unconscious; relating to the autonomic nervous system.*

It's nice that our bodies will do work for us without us having to micromanage everything, but the autonomic functions of the body can also be confusing.

Ever wondered what your body was trying to tell you with a headache, a mood swing, an increased heart rate, or any other symptom? The trouble is, trying to read

Whatever stimulus you are testing with, your body's electrical response can be affected by bodily conditions.

Your scan can be affected by your:

- Heart Rate
- Emotional Intensity
- Body Temperature
- Current State of Health
- Hormones
- Stress Level
- Medications
- And other factors



your body can feel like you're talking to an infant: "I know you're crying, but why? What is bothering you?"

Unfortunately, the autonomic nervous system doesn't speak English or any other human language. The tech-

nology to read your autonomic system doesn't yet exist. But GSR manages to give us a little glimpse into the unconscious mechanisms of the human body.

The Beginnings of GSR

In 1888, French neurologist Charles Féré discovered that “by passing a small electrical current across two electrodes placed on the surface of the skin, one could measure momentary decreases in skin resistance in response to a variety of stimuli” (Dawson).

Basically, Féré found that he could introduce a stimulus to an individual and measure their body's autonomic electrical response to that stimulus. And it could be done almost instantaneously because electricity in the body travels fast.

Measuring changes in electrodermal activity eventually led to the invention of many GSR (Galvanic Skin Response) technologies. For decades, GSR has



There are **7,000,000,000,000,000,000,000,000,000,000,000,000,000,000** (7 octillion) atoms in the average human body. Each one contains positive and negative electrical charges.



been used to tap into the human subconscious and autonomic systems.

GSR Since The 19th Century

From the polygraph in the 1920s to modern bio-feedback devices like the Microsoft Band and Jawbone Up, GSR technology has been used for almost a century. It has found applications in psychology, psychotherapy, clinical studies, neuroscience, and even dentistry.

Want to know more about the sciences (electrical and biological) behind GSR technology? This resource page will break it down for you (in words, not electrical signatures).

We'll cover:

- Skin conductivity
- GSR measurement methods
- How iTOVi uses GSR

So, take a good whiff of rosemary or peppermint to help you focus, because we've got a lot of ground to cover.



HUMAN SKIN AND STIMULI

The Job of Human Skin

First, we need to understand our skin a little bit better.

Your skin does much more than keep your outsides in. The skin on your hands especially does more than let you tell the difference between velvet and sandpaper.

Human skin, in addition to performing its sensory role, connects to the body's immune system and thermo-regulation system. Your skin is your largest organ and helps take care of your other organs by maintaining a safe, functional environment for them.

What we're saying is that your skin has a lot of work to do. And to get all that work done, your skin works with *both* your somatic nervous system (all the things you consciously control) and your autonomic nervous system (everything that your body does on its own).

 Somatic Nervous System	A part of your peripheral nervous system, including your sensory nerves and motor nerves. If you can consciously control it, it is part of your somatic nervous system.
 Autonomic Nervous System	A part of the peripheral nervous system that regulates bodily functions (such as heart rate, digestion, pupillary response, etc.) without your conscious effort.

When your body is introduced to any kind of stimulus, your skin responds—triggering and manifesting both conscious and unconscious reactions.

Whether the stimulus is tactile, auditory, visual, or olfactory, there will almost always be some autonomic reaction in the skin.

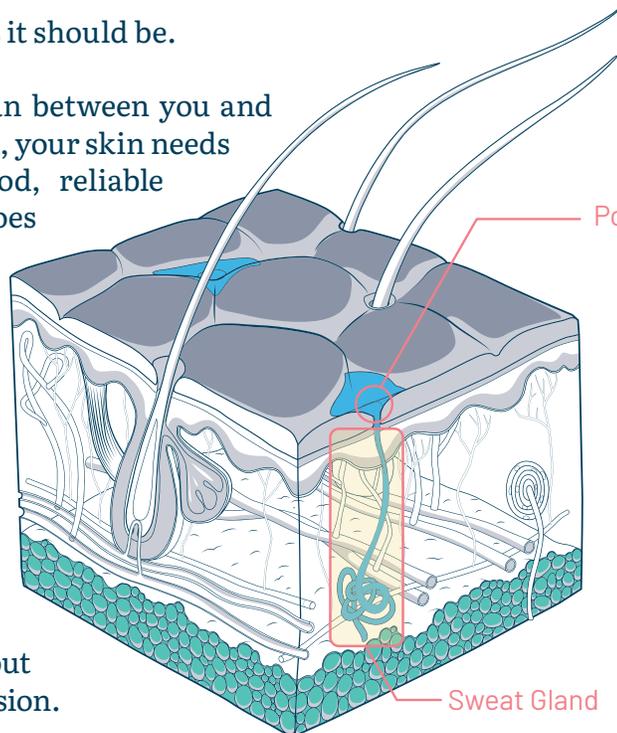
And that's just as it should be.

As the middleman between you and the outside world, your skin needs to be like a good, reliable employee who does

Epidermis

Dermis

Hypodermis



Pore

Sweat Gland

their job without constant supervision.

For example, your skin allows you to feel and recognize if the air around you is too cold. You can consciously choose to put on a sweater, but your body will begin to regulate its own temperature by shivering and raising goosebumps—whether you decide to put on a sweater or not.

If you come across a particularly intense emotional stimulus, your skin will respond by activating some of the millions of sweat glands on your hands, feet, and face. Your skin may well know that you are intensely emotional before you do.

These autonomic reactions go deeper than the first layer known as the epidermis. The sweat glands that get autonomically activated are down two levels deeper in the hypodermis of your skin. So the skin will get all its layers involved to respond to stimuli.

Enter The Stimulus

With GSR technology, there is always a stimulus. With polygraphs, the stimulus is the mental and bodily stress of lying. Some psychotherapists use images relating to their patient's trauma or phobia as a stimulus.

Of course, some stimuli have little effect, while other stimuli have a marked effect.

One man gets goosebumps at the sight of a spider while another man is unaffected. The scent of peanut butter will register very differently on the skin of someone who has a peanut allergy than it will on the skin of someone who doesn't.

The emotional and physical intensity of any single stimulus will be different from person to person, depending on their body, their mind, and other variables.

This individualization isn't an obstacle; it is precisely what GSR technology is all about.

GSR's job is to read the autonomic responses in your skin as it reacts according to the intensity of the stimulus's effect on **you**. GSR's method for measuring that intensity is the electrodermal activity in your skin.

Are iTOVi Scanners More Reliable Than Polygraphs?

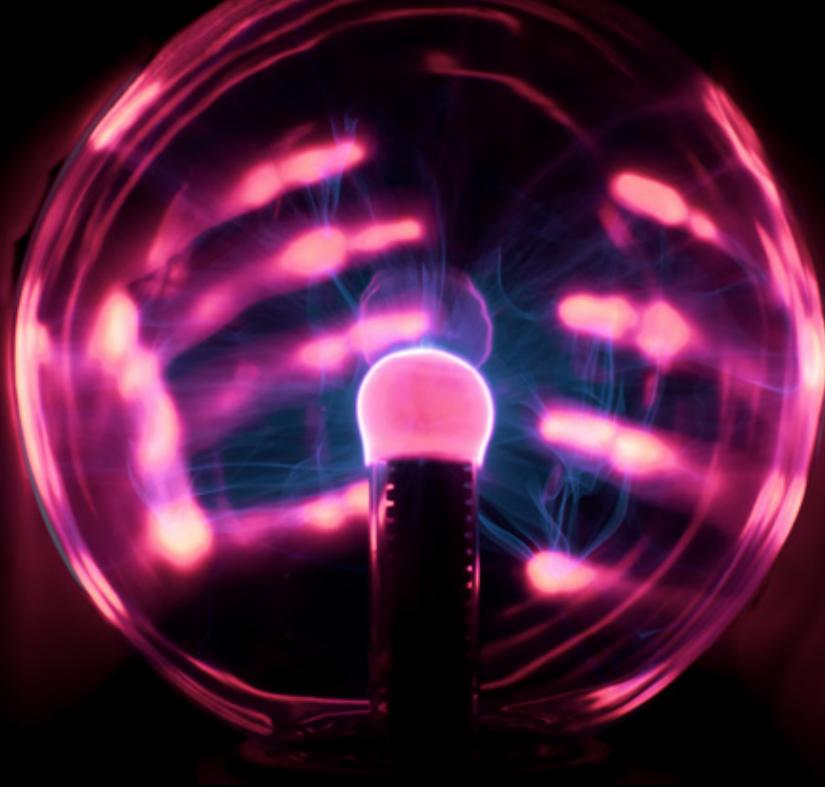


The polygraph you are thinking of probably monitored heart rate, respiratory rate, and electrodermal activity.

Polygraphs were once considered to be reliable "lie detectors", but these monitoring devices were only capable of measuring the *quantity* of the physiological response, not the *quality*.

A suspect's heart rate could increase because they were lying or simply because they feared a false conviction. We simply don't know enough yet about the systematic psychology of deception to be able to build a truly reliable "lie detector."

iTOVi's scanners and reports give you the quantity reports, but we leave the *why* to you. You know better than we do if your body responded to Cedarwood for an emotional or a physical reason.



ELECTRICITY: HOW THE BODY SPEAKS

Your Body Works With Electrical Precision

Have you ever observed your fingers typing away on a keyboard, and wondered, “How does my brain communicate with my fingers so fast? How is it that I can move so quickly and precisely?”

The answer is electricity.

Your body conducts electricity (think of the last time you gave someone a small electric shock through skin contact) and it communicates through electricity.

Electrical signals run from your brain to anywhere in your body and back again as fast as, well, lightning.

Without these electrical currents, you wouldn't move, think, or feel. All functions, sympathetic and

autonomic, like the beating of your heart, are controlled by electricity running through your body.

Sweat and The Electrical Levels In Your Body

Of course, the body can also be pretty electric-resistant and will only communicate within a certain range of voltages.

The voltage of the electrical signals in your body is largely limited by the body's Tonic Skin Conductance Level (SCL). In the tonic level, the energy never increases or decreases very quickly. So there isn't much for GSR scanners to read into there.

Something happens, though, when your body is introduced to an intense stimulus—your sweat glands



Electrical speed:

Did you know that an electrical signature in your body can move faster than 100 meters per second? No wonder you can play whack-a-mole so well!



activate autonomically. The more pronounced the stimulus's effect on you, the more your sweat glands will activate, increasing the conductivity of your skin.

When the conductivity of your skin increases, we get something called Phasic Skin Conductance Response (SCR). SCR is when electrical currents ride on top of tonic level changes and show swift voltage alterations.

Ergo, the stronger the simulant's effect on you, the more conductive your skin becomes and the greater the voltage change.

The increase of sweat gland activity changes the ionic balance through which your body's electrical signatures flow. This change in ionic balance decreases the resistance in your skin, if only mo-

mentarily. This is what causes the spikes in the voltage readings. GSR technology measures these voltage spikes to infer just how much a stimulus has affected you.

As soon as your body adjusts to the stimulus, those sweat glands will deactivate, and the voltage of those phasic responses will go back down. But, as soon as there is another intense stimulus, the phasic reaction will spike again.

In summary, GSR uses your body's instant and subconscious increases in skin conductivity to measure your body's response to stimuli.

But how can GSR scanners measure these voltage changes? And then, how can these readings be interpreted effectively?

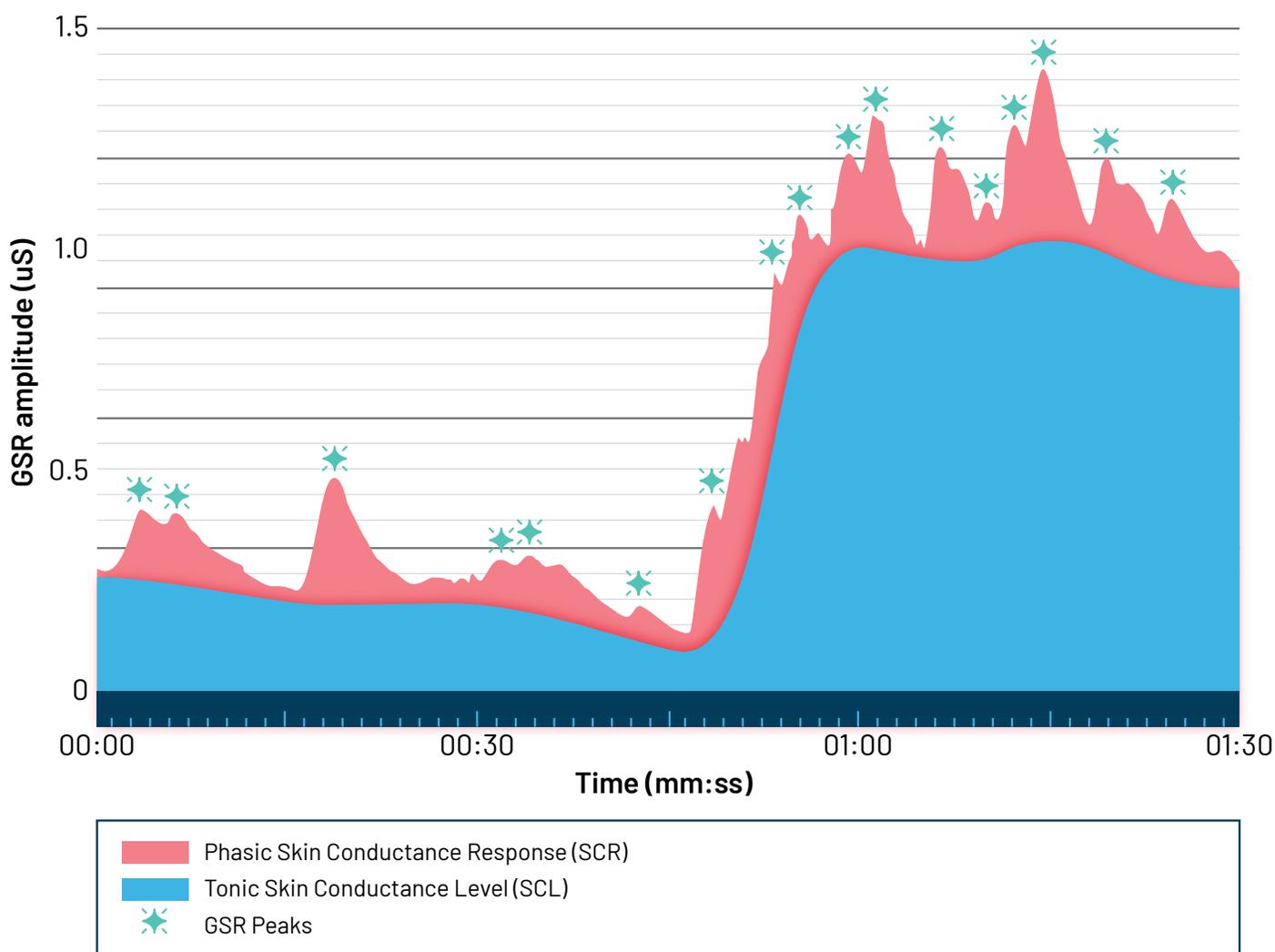
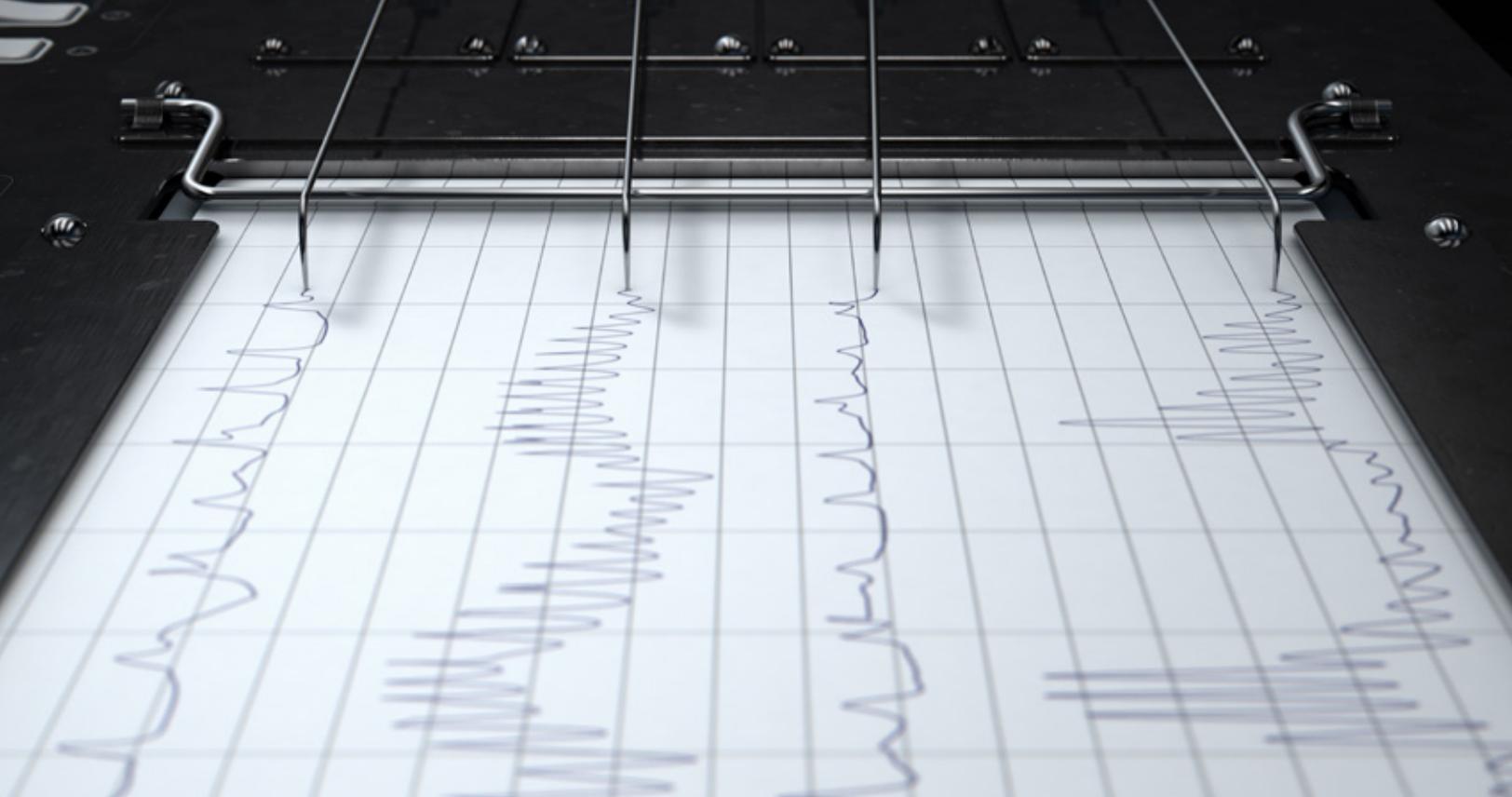


Fig. 1. Tonic and Phasic responses from: iMotions "Galvanic Skin Response (GSR): The Complete Pocket Guide." 2017, p. 22.



GSR SCANNER READINGS

How GSR Scanners Read

First, to measure the voltage, GSR uses two electrodes. They are placed some distance apart on your skin, usually on the hand.

iTOVi chose white trivalent chromium for our GSR electrodes because it is both safe for human contact and conductive enough to measure the phasic responses.

Because there are more sweat glands in the skin of your palms than most other areas of your body, it's an optimal place to monitor electrodermal activity. Often, the non-dominant hand is preferred since excessive movement can throw off the Scanner's readings.

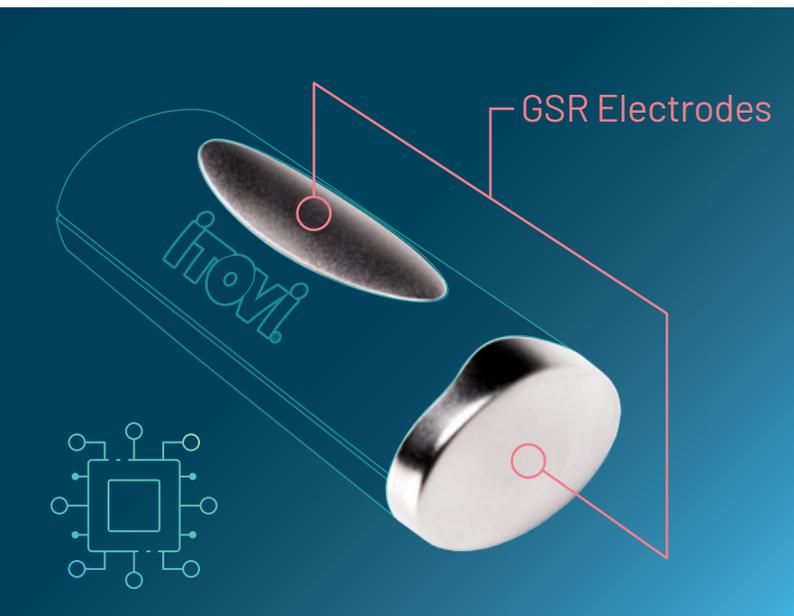
When voltage spikes in the phasic response occur, the current of that voltage passes through your skin (faster than any human could possibly track) and the two electrodes measure the current that is passed between them.

What GSR Scanners Read

The GSR scanner can measure the latency, peak amplitudes, rise times, and recovery time of every voltage spike. And all of these values can be used to read how much, and for how long, different stimuli affect you.

The current can change in less than a second, but modern GSR scanners can take more than a hundred readings per second.

All of the electrical data that the GSR scanner picks up is then imported via wires or Bluetooth, so the



information is transferred almost instantaneously to whichever server, program, or algorithm that will be used to interpret the data.

This way, stimuli can be given and electrodermal responses recorded in fast succession. The GSR electrodes will pick up every little change in the phasic reactions and the algorithm will be ready to interpret the data.

GSR Data Interpretation

Wait! What was that about algorithms?

All the data the GSR scanner picks up could be stored on a graph, like the polygraphs of the 1930s,

and be studied manually. However, it is much faster to feed the GSR data into an algorithm that will pick out and quantify the information that is relevant to the present experiment.

Developers will orient their analyzing algorithm to extract the data they are most interested in, whether that be the frequency of voltage spikes, the amplitude of significant peaks, the latency period between particular intervals, or any other targeted information.

So now we've covered GSR scanners in general—how does iTOVi use the GSR scanner? What are our stimuli? And what information does our algorithm prioritize?



THE ITOVI SCANNER AND GSR

iTOVi's Unique Approach To GSR Stimulus

iTOVi developers decided there was more to be explored with the human body and electricity than most GSR scanners were using.

Electricity can be used to measure a person's autonomic response to a particular stimulus very quickly. But what if the stimuli could be delivered through electricity as well?

Rather than take one essential oil product at a time and use it as a stimulus (that would take quite a while),

iTOVi developers decided to present each product, not in oil form, but through their frequencies.

Each essential oil product has a unique electrical frequency that can be imitated through radio frequencies. And iTOVi uses those radio frequencies as stimuli for a GSR scan.

Sending a frequency that is identical to the frequency for, say, Turmeric to the body is like giving the body the quickest, tiniest dose of Turmeric imaginable. Or at least that is what the skin believes is happening.

The scanner sends that frequency into the body and can immediately pick up the body's autonomic response to it. The amplitude of the phasic response to the Turmeric frequency can act as a measure of how responsive this individual would be to Turmeric in oil form.

Since electricity moves so fast—GSR scanners can record samples quickly. In less than two minutes, the iTOVi Scanner can send you the frequencies for more than a hundred products, measure, and record your response to all of them. Talk about efficiency!

The iTOVi Scan Report

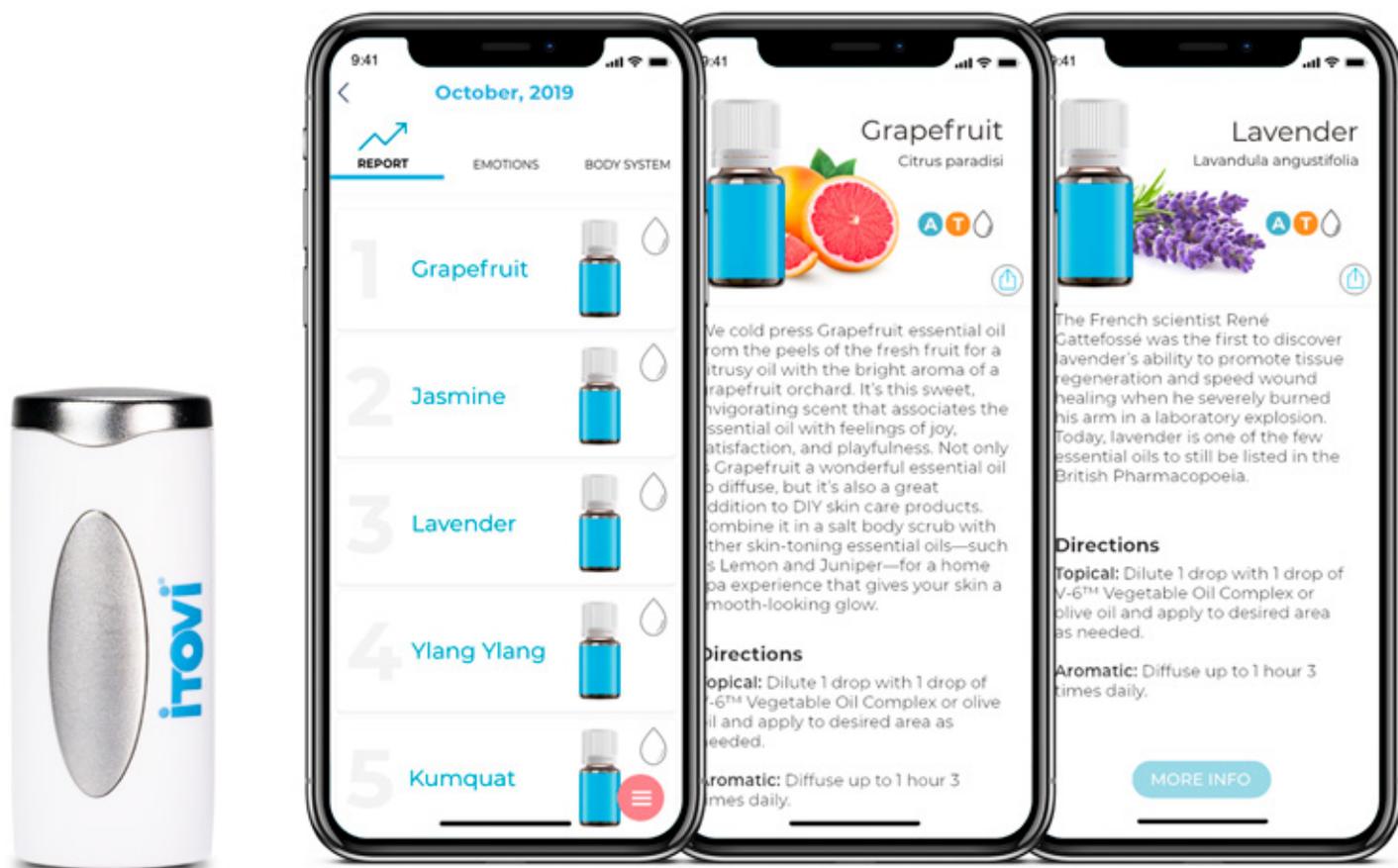
The iTOVi algorithm takes all the data that the iTOVi scanner picks up and analyzes it, detecting which frequencies your body had the strongest reaction to.

Thanks to this algorithm, your scan report will show you an ordered list of the essential oils or supplements that you currently (no, that was not a pun) respond to.

But that is not all the algorithm can do. Due to the plethora of information within the essential oil community, the iTOVi algorithm also sorts the oils according to the physical or emotional system they are associated with.

In short, you get to see which oils your body responds to most and you get to see which oils are a viable option in any of the listed emotional or physical categories.

(Psst, if you want help with your respiratory system, and the scan report displayed four different respiratory system oils—you could choose the cheapest one. Or the nicest-smelling one.)





CONCLUSION

GSR scanners use the resistance properties in your skin to measure your response to different stimuli. Since electrodermal activity is autonomic, GSR readings can provide valuable insights into how your body works and interacts with the world around it.

In conjunction with essential oil companies, the iTOVi scanner offers people a tool they can use to be more proactive about their own wellness. So they can get an idea for which essential oils their body responds to most.

Those who scan regularly (iTOVi does not recommend scanning yourself more than once a day) will get a sense for which products their body responds to most strongly and most consistently, as opposed to which oils their body has a transient response to.

But you don't have to wait. Your very first scan will give you a starting point in creating a wellness plan for yourself or for whomever you scan.

Although the iTOVi scanner is not a diagnostic tool, it is fascinating to see how it has helped thousands of people find essential oils that benefit them.

We look forward to seeing further developments with GSR technology, electrical-pulse stimulus, and essential oils, so we can study our bodies on a deeper level and treat them better.

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Sources

Benedek, Mathias, and Christian Kaernbach. "A continuous measure of phasic electrodermal activity." *Journal of neuroscience methods* vol. 190,1 (2010): 80-91. doi:10.1016/j.jneumeth.2010.04.028.

Boshoff, C. & Toerien, L., 2017, 'Subconscious responses to fear-appeal health warnings: An exploratory study of cigarette packaging', *South African Journal of Economic and Management Sciences* 20(1), a1630. <https://doi.org/10.4102/sajems.V20i1.1630>.

Braithwaite, J. J. et al. "A Guide for Analysing Electrodermal Activity (EDA) & Skin Conductance Responses (SCRs) for Psychological Experiments." In *Psychophysiology*, 49, 1017 -- 1034.

"EDA/GSR Pocket Guide." iMotions. 2017. PDF file.

Hursh JB (1939). "Conduction velocity and diameter of nerve fibers". *American Journal of Physiology*. 127: 131–39. doi:10.1152/ajplegacy.1939.127.1.131.

Jian Feng Zhao, Xi Mei Chen, Bo Dong Liang, and Qiu Xia Chen, "A Review on Human Body Communication: Signal Propagation Model, Communication Performance, and Experimental Issues," *Wireless Communications and Mobile Computing*, vol. 2017, Article ID 5842310, 15 pages, 2017. <https://doi.org/10.1155/2017/5842310>.

Low, Phillip. "Overview of the Autonomic Nervous System." *Merck Manual Consumer Version*. 2018. <https://www.merckmanuals.com/home/brain,-spinal-cord,-and-nerve-disorders/autonomic-nervous-system-disorders/overview-of-the-autonomic-nervous-system>.

"Microsoft Band features and functions." Microsoft. Microsoft Inc. 2019.

PP, Raju. "Here's the Full List of Jawbone UP3 Sensors and Features." *ConnectedArena*. Health and Fitness, News. 2014. <http://connectedarena.com/jawbone-up3-sensors-features/>.

"The Truth About Lie Detectors (aka Polygraph Tests)." Apa. *American Psychological Association*. 2004. <https://www.apa.org/research/action/polygraph>.

Villarejo, María Viqueira et al. "A stress sensor based on Galvanic Skin Response (GSR) controlled by ZigBee." *Sensors (Basel, Switzerland)* vol. 12,5 (2012): 6075-101. doi:10.3390/s120506075.

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