Key Terms: Arousal | Attention | Waveforms | Tonic | Phasic | Drifts | Peaks | Skin Conductance

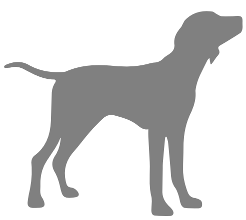
Galvanic Skin Response (GSR) can also be referred to as Electrodermal Activity (EDA), Psychogalvanic Reflex (PGR), Skin Conductance Response (SCR), or Electrodermal Response (DR). Whatever you want to refer to it as (the remainder of this post will use GSR for the sake of clarity), it is a biometric signal that is used to study the autonomic activation of sweat glands.

IT'S ELECTRIC: A CRASH COURSE ON *Galvanic Skin Response*

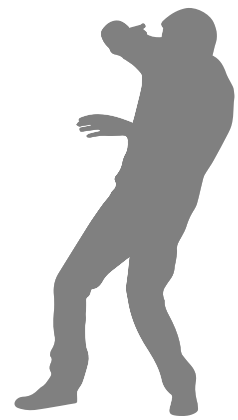
μS

μmho

Information can be collected in several places on the body including fingers, palms and even specific areas on your feet. By applying electrical potential between two areas of skin contact and then finding out the difference between the output and the input, skin conductance can be quantified in units called microSiemens (μS) or micromho (μmho). Both units are equivalent.



> Sweat comes from our body's response to when we are emotionally aroused. *Arousal* is a general term that implies an overall activation. GSR is used in research to determine the intensity of the emotional arousal. The reasoning for the stimulation could vary from seeing a jump-scare during an action movie to passing the cutest puppies on the street. Being anxious, afraid, excited, worried, surprised, etc. can all create the experience of being emotionally aroused.



While arousal doesn't *determine* emotions, it is a good indicator for memory, attention and engagement levels that are caused by them. There is no way to control GSR response, thus making it an autonomic response. The response can take seconds to arise and decline slowly.

HOW DOES GSR WORK?

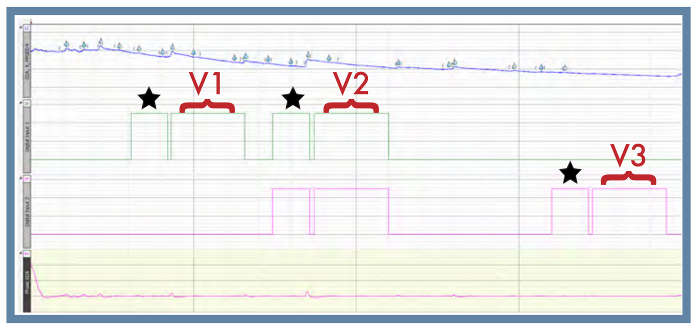
The human body is a great conductor for electricity, which is why as kids we are taught to keep our fingers out of the electrical outlets. The skin becomes a better conductor of electricity when something is emotionally arousing. When the sweat glands become more active, the balance of positive and negative ions changes. The ionic activity from sweat glands changing is noted by the electrodes, making electrical current flow more readily. The difference in skin conductance is GSR. Two waveforms make up the overall complex of GSR: tonic and phasic.

HOW DOES GSR WORK? *(continued)*

Skin Conductance Level (SCL) is known as Tonic Skin Conductance (TSC) or tonic waveform. SCL of electrical conductivity can be achieved by applying a constant low voltage on the skin. The current is low, which could be attributed to why the voltage is not felt by the respondent. The tonic waveform can be characterized by having slow changes over long periods of time. The conductance level generally ranges from 2-16µS when measuring tonic waveform; however, it has been reported as high as 1-40µS. Each individual person's SCL can vary based on psychological state and autonomic regulation. Tonic conductance is also representative of biological noise of autonomic arousal like hydration, respiration or digestion. When running an experiment with GSR, tonic is used to generate a baseline reading.

Phasic response, which is used to dictate Skin Conductance Response (SCR), is a faster changing waveform, which can be noted when the sweat ducts fill as a response to something the person is experiencing both physically or mentally. Graphically, an event related phasic response shows bursts and peaks. It can either occur due to a stimulus that either does or does not elicits a response. There are also NS-SCRs (Non-Stimulus locked Skin Conductance Responses) that occur spontaneously without being caused by provoking events.

tonic skin conductance

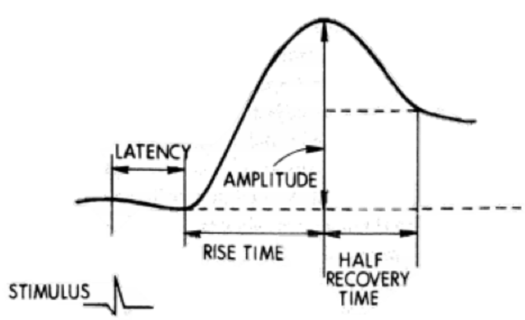


An example of Tonic Skin Conductance (blue) and Phasic Skin Conductance (pink). The square blocks are the baselines (★) and exposures of three videos (V1, V2, V3).

phasic skin conductance

HOW TO INTERPRET GSR DATA?

Analyzing data from an experiment with GSR is how we can draw conclusions about what exactly is emotionally arousing for a participant. There are a few key components of GSR data that can be interpreted to gain a more comprehensive understanding of what is happening. A common aspect of GSR analysis is latency. Latency occurs during the beginning of the manipulated event until SCR initiation. The duration of latency is typically 1-3 seconds after stimulus onset. The deflections that do not meet the pre-set temporal threshold criteria are NS-SCRs. Since it did not hit the minimum threshold, these deflections are typically disregarded. Other telling components of GSR event data include peak amplitude, rise time and recovery time. The value between onset to peak is referred to as the peak amplitude and the duration between onset to peak is known as the rise time. Recovery time is the time between peak and the return to baseline.



An example of the components of event related GSR (taken from Dawson et al., 2007).

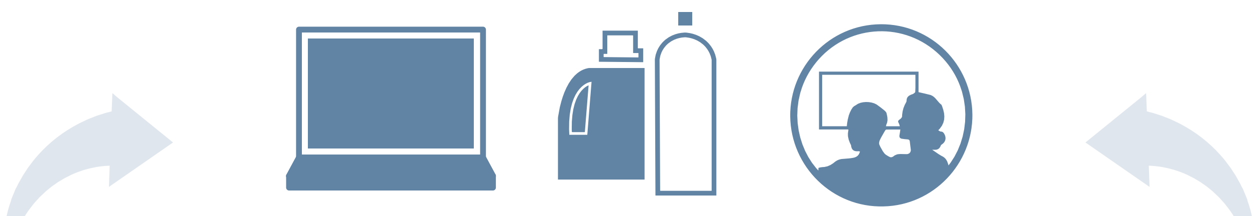
INTERPRETING GSR DATA

Visual analysis also can help detect factors that assist in sharing the overall findings. Drifts are common in GSR data and should be corrected prior to heavy analysis. There can also be shifts that correlate with specific stimuli that are intentionally utilized in an experiment. Being able to differentiate between unimportant drifts and important periodic shifts in tonic waveforms is critical. Distinguishing conditional GSR patterns, specific to each experiment, is only possible via a trained eye of visual analysis.

Standardization is an area within GSR being explored, but still in need of progress. Correcting data to be more direct when comparing individuals is the goal of standardization. For example, some participants naturally have high or low values. Extreme outliers in either direction will overpower the other individuals in a study, making it challenging to draw any strong conclusions.

GSR can also be influenced by a variety of external components such temperature, clothing and humidity. Each of these factors should be considered when designing a study. By recording ambient temperature and physical activity, it is easier to find time periods that stray from the average, and thus should be excluded. Internal variables such as age, sex and ethnicity should be considered when analyzing findings as well. Having a strong description of the baseline conditions helps to better interpret the data being presented and provide an overall understanding of the sample size being that is being reported.

Once the fieldwork is completed, there are several GSR metrics that can be used to determine differences between respondents, groups or manipulated events. The more telling information can be found in GSR peaks and skin conductance values. This can also help determine an average amount of GSR peaks among participants. The average GSR peak amplitude can be compared, excluding the participant's lacking any GSR peak (zero responses). Since this is an average, it may not be the most encompassing metric since there can be a variety of responses. Other means include the average magnitude, which computes all stimulus presentations other than the zero responses. Reporting magnitude should be supported by a frequency measure.



GSR can be an extremely useful measurement to analyze emotional arousal caused by autonomic responses. This can be beneficial when evaluating consumer preferences on products, services, software or different types of media such as commercials or trailers.

IF YOU HAVE ANY QUESTIONS OR WISH TO LEARN MORE ABOUT HOW HCD CAN HELP YOU APPLY GSR TO YOUR RESEARCH, PLEASE FEEL FREE TO REACH OUT VIA EMAIL INFO@HCDI.NET OR CALL 908.788.9393.

CITATIONS

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