

# Electrodermal Response (EDR)

Authored by  
**mohammad looti**

September 26, 2025

## RECOMMENDED CITATION

mohammad looti (2025). *Electrodermal Response (EDR)*. PSYCHOLOGICAL SCALES.  
Retrieved from <https://scales.arabpsychology.com/?p=29019>

## Electrodermal Response (EDR)

**Primary Disciplinary Field(s):** Psychology, Psychophysiology, Neuroscience, Biomedical Engineering

### 1. Core Definition

The **Electrodermal Response** (EDR), often interchangeably referred to as **electrodermal activity** (EDA) or **galvanic skin response** (GSR), denotes the changes in the electrical properties of the skin. This physiological phenomenon is a direct consequence of the activation of eccrine sweat glands, which are primarily innervated by the sympathetic branch of the autonomic nervous system. These subtle, non-conscious alterations in skin conductance or resistance are widely recognized as a robust indicator of an individual's psychological or emotional arousal, encompassing both positive and negative affective states.

The nomenclature surrounding EDR is diverse, reflecting its long history and varied applications across scientific disciplines. Beyond EDR, EDA, and GSR, the phenomenon is also known as **skin conductance**, **psychogalvanic reflex**, **skin conductance level** (SCL), and **sympathetic skin response** (SSR). While these terms often describe the same underlying physiological mechanism, some may emphasize specific measurement parameters (e.g., SCL for tonic baseline activity versus SCR for phasic, event-related responses) or historical contexts. Regardless of the specific terminology employed, the fundamental principle remains consistent: the measurement of skin's electrical properties as a proxy for sympathetic nervous system activity and, by extension, emotional and cognitive states.

The assessment of EDR involves a non-invasive procedure where electrodes are strategically placed on the skin, typically on areas rich in eccrine sweat glands such as the palms of the hands, soles of the feet, or sometimes the fingers or shoulders. A very low, imperceptible voltage is applied across these electrodes, and the connected device precisely measures the resulting electrical conductance of the skin. As sweat glands activate in response to sympathetic arousal, they excrete a saline solution (sweat) onto the skin surface. This moisture acts as an electrolyte, significantly increasing the skin's electrical conductivity and decreasing its resistance. Therefore, a rise in measured conductance directly corresponds to heightened sweat gland activity and, consequently, increased psychological arousal.

### 2. Etymology and Historical Development

The earliest observations of what would later be termed **Electrodermal Response** date back to the late 19th century, marking a pivotal moment in the nascent field of psychophysiology. One of the pioneering figures was Charles Féré, a French physician, who, in 1888, described changes in

skin resistance in response to various sensory stimuli. Around the same time, in 1890, the Russian physiologist Ivan Tarchanoff independently reported similar findings, observing that changes in skin potential occurred in conjunction with mental activity, irrespective of external stimulation. These initial investigations laid the groundwork, demonstrating a clear physiological link between the skin's electrical properties and the internal psychological state of an individual.

The concept gained further prominence in the early 20th century, particularly through the work of the renowned Swiss psychiatrist Carl Jung. Jung incorporated the measurement of galvanic skin responses into his word association tests, a technique designed to uncover unconscious complexes by observing emotional reactions. He noted that certain emotionally charged words would elicit significant EDRs, providing a measurable physiological correlate to psychological disturbance or conflict. This application underscored the potential of EDR as an objective measure in psychological assessment, moving beyond purely subjective self-reports and paving the way for more objective psychological inquiry.

Throughout the 20th century, research into EDR continued to evolve. The development of more sophisticated electronic measurement devices allowed for greater precision and reliability in data collection and analysis. The understanding of the underlying physiological mechanisms deepened, solidifying the role of the sympathetic nervous system and eccrine sweat glands as the primary drivers of the response. This period also saw the integration of EDR into various practical applications, most notably in the development of polygraph technology (lie detectors), where EDR became a core component for assessing physiological arousal during questioning. Modern psychophysiological research continues to refine EDR measurement and interpretation, exploring its nuances in relation to complex cognitive and emotional processes, and integrating it with other physiological and neuroimaging techniques for a more holistic understanding of human behavior.

### 3. Key Characteristics

A fundamental characteristic of **Electrodermal Response (EDR)** is its direct and exclusive physiological basis in the activity of the **eccrine sweat glands**. Unlike apocrine sweat glands, which are primarily involved in thermoregulation, eccrine glands are widely distributed across the skin surface, with particularly high concentrations on the palms of the hands and soles of the feet. These glands are uniquely innervated by cholinergic sympathetic nerve fibers, meaning their activity is controlled almost entirely by the sympathetic nervous system. This direct neural pathway ensures that any changes in sweat gland secretion, and thus skin conductance, are a sensitive and immediate reflection of sympathetic arousal, making EDR a highly specific marker for this aspect of the autonomic nervous system.

Another crucial characteristic is EDR's inherent **sensitivity to emotional and cognitive arousal**. The sympathetic nervous system is a key component of the body's "fight or flight" response,

activating in situations perceived as threatening, exciting, novel, or requiring significant mental effort. Consequently, EDR exhibits measurable changes in response to a wide spectrum of psychological states, including stress, anxiety, fear, surprise, attention, decision-making, and even positive emotional experiences like joy or anticipation. This broad responsiveness makes EDR an invaluable tool for researchers and clinicians seeking objective indicators of internal psychological processes that are often difficult to verbalize or consciously control. For instance, a sudden unexpected noise, the anticipation of a challenging task, or recounting a vivid emotional memory can all elicit a discernible electrodermal response, signaling a shift in an individual's arousal state.

Furthermore, EDR is characterized by its largely **non-voluntary nature**. While individuals can consciously influence certain physiological responses, the activation of eccrine sweat glands is predominantly an unconscious, reflexive process beyond direct volitional control. This involuntary aspect is particularly significant because it means EDR can provide an objective, less easily manipulated measure of arousal, circumventing potential biases associated with subjective self-report measures. This characteristic is precisely why EDR became a cornerstone in applications like polygraph testing, where the goal is to detect physiological signs of deception that are presumed to be beyond conscious suppression. The measurement process itself is also non-invasive, involving surface electrodes that do not cause discomfort, thus minimizing interference with the natural physiological responses being observed.

EDR measurement typically distinguishes between two main parameters: **skin conductance level** (SCL) and **skin conductance responses** (SCRs). SCL refers to the tonic, slowly changing baseline level of skin conductance, reflecting an individual's general state of arousal over a period. It can fluctuate due to factors like ambient temperature, hydration, and overall psychological state. In contrast, SCRs are phasic, transient increases in skin conductance that occur rapidly in response to specific discrete stimuli or events. These rapid spikes, appearing typically within 1 to 3 seconds after a stimulus onset, are indicative of an immediate orienting response or emotional reaction. Analyzing both SCL and SCRs allows for a comprehensive understanding of both sustained (tonic) and event-driven (phasic) arousal patterns, providing a nuanced perspective on an individual's physiological engagement with their environment.

#### 4. Significance and Impact

The significance of **Electrodermal Response** (EDR) in the scientific community, particularly in psychophysiology and experimental psychology, is profound. EDR serves as one of the most widely used and reliable physiological markers for assessing sympathetic arousal, providing a quantifiable window into an individual's emotional and cognitive states. Its non-invasive nature and direct link to the autonomic nervous system make it an indispensable tool for researchers investigating a vast array of human experiences, from basic emotional processing and learning to complex decision-making and social interactions. The ability to objectively measure arousal, often

below the threshold of conscious awareness, has revolutionized the study of emotion and attention, offering insights that subjective self-reports alone cannot provide.

In clinical settings, EDR plays a vital role in biofeedback therapy, a technique that teaches individuals to gain voluntary control over physiological processes that are normally involuntary. Patients suffering from conditions like anxiety disorders, phobias, or chronic stress can learn to modulate their sympathetic nervous system activity by observing real-time EDR feedback. For example, a patient experiencing high anxiety might see their skin conductance spike; through relaxation techniques, they learn to consciously lower this response, effectively managing their physiological reactivity. This therapeutic application empowers individuals with self-regulation strategies, improving their ability to manage stress and emotional reactivity, and fostering a greater sense of control over their internal states.

Beyond traditional research and clinical applications, EDR has found its way into diverse and innovative fields. In forensic science, EDR is a central component of polygraph examinations, despite ongoing debates about their scientific validity. In this context, significant EDR changes are interpreted as potential indicators of deception, reflecting the physiological stress or arousal associated with lying. Furthermore, with the advent of miniaturized sensors and wearable technology, EDR monitoring is increasingly integrated into consumer devices for real-time stress tracking, emotion recognition, and personal well-being applications. This broad integration underscores EDR's versatility and its continued relevance in both scientific discovery and practical applications, extending into areas like human-computer interaction (HCI) and neuromarketing, where it helps assess user engagement and emotional responses to digital content or products, thereby informing design and marketing strategies.

## 5. Debates and Criticisms

Despite its widespread use and established physiological basis, **Electrodermal Response (EDR)** is not without its debates and criticisms, particularly concerning its interpretation and application in certain contexts. One of the most prominent and enduring controversies revolves around its use in polygraph ("lie detector") testing. Critics argue that while EDR reliably measures physiological arousal, it cannot definitively distinguish between different emotional states. A heightened EDR might indicate fear, anxiety, surprise, or general stress, rather than deception specifically. Therefore, an individual might show a strong EDR due to the stress of being accused or the fear of the examination itself, leading to false positives. Major scientific bodies, such as the National Research Council, have expressed skepticism about the scientific validity of polygraph tests for detecting deception, emphasizing that physiological responses like EDR are not unique to lying and can be influenced by various factors.

Another significant limitation of EDR is its **lack of specificity regarding emotional valence**. EDR

primarily reflects the intensity of arousal, not its quality (i.e., whether the emotion is positive or negative). Both a thrilling experience and a terrifying one can elicit similar increases in skin conductance. This means that EDR data often needs to be combined with other physiological measures (e.g., heart rate, facial electromyography) or subjective reports to fully understand the emotional context. Relying solely on EDR can lead to ambiguous interpretations of an individual's affective state, making it a valuable but not standalone measure for comprehensive emotional assessment. Researchers often integrate EDR with other data streams to build a more holistic picture of an individual's emotional landscape.

Furthermore, several methodological and individual variability factors present challenges in EDR research and application. **Individual differences** in baseline skin conductance levels, the magnitude of responses, and habituation rates can vary significantly across participants, necessitating careful calibration and within-subject designs to account for these inherent variances. Environmental factors, such as ambient temperature and humidity, can also influence sweat gland activity and thus EDR readings, requiring controlled experimental environments for accurate data collection. Additionally, factors like skin hydration, electrode placement, and skin preparation can introduce measurement artifacts. Researchers must employ rigorous protocols to ensure data quality and valid interpretation, acknowledging that a "spike of sweat gland activity" is a general arousal indicator and its specific meaning requires careful contextual analysis, especially when attempting to infer complex psychological states.

## Further Reading

[Electrodermal Activity - Wikipedia](#)

[Electrodermal Activity - ScienceDirect Topics](#)

[Physiological Correlates of Emotion: A Psychophysiological Perspective - PMC](#)