Notes for presentation slides

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Author: Yinghe Liu

Slide 1 & 2: Topic Intro/What is EDA

Electrodermal activity (EDA) refers to small changes in the electrical activity of the skin, usually occurring 1–3 seconds following the onset of a stimulus [1]. Since the late 19th century, it has been recognized as a useful measurement to estimate human emotional responses, especially under stressful situations. Historically, it has had many past names, such as sympathetic skin response (SSR) or skin conductance level (SCL). [2] They may not all follow the same measurement paradigm, but all conceptualize targeting sweat secretion.

Slide 3: Mechanisms of EDA

Overall, we can explain EDA using an information processing system model that contains Input, Information Process, and Output. When an outside stressor generates some stimulation (Input), the signals then pass down to the CNS for further processing. The outcome is executed by the peripheral system, or more specifically, the autonomic system, which controls sweat glands to produce more secretion, resulting in changes in skin surface conductivity. We have learned from past courses that such a mechanism may represent evolutionary adaptations to mobilize body resources to respond to challenging events.

The picture on the right illustrates how we measure EDA by attaching electrodes to the palms. Palms, rather than areas under the arms, are more sensitive to stressors, but may not be the best measurement loci. Fingertips, instead, are now found to be the more recommended loci. [3] We have decided to remain consistent with our manual that still uses palm loci. In addition to palms, electrodes may also be attached to the chest cavity to measure respiration rate and heart rate. As discussed later, these measurements are usually coupled together to ensure the convergence of autonomic system responses. [4]

Slide 4: Who uses EDA?

EDA is widely used in the following psychology-related areas:

• Emotion Research: Investigating how individuals react to emotional stimuli, such as images, videos, or emotional experiences. [5]

• Stress and Anxiety Studies: How individuals react in stressful situations. [6]

• Affective Computing and Interactions (My case)

• Pain Perception

• Biofeedback in PNS

• Marketing and Consumer Behavior: How people react to marketing stimuli, even used in tourism. [7]

• Clinical Application: Anxiety-related Disorders/Traumatic experiences: Used in clinical psychology and psychiatry to assess physiological responses in individuals with conditions such as anxiety disorders, post-traumatic stress disorder (PTSD), and phobias. [8]

Slide 5 & 6: Paradigm Examples

In my case, we use the Trier Social Stress Test (TSST) to create tension by asking them to pretend to be an interview candidate. [9] The Iowa Gambling Task (IGT) investigates how people make decisions and conduct risky behaviors. [10] Lie Detector Tests (Polygraph Examinations) are the first time I have heard of this technique. In this test, people react to questions that evoke considerable emotional responses.

From one of our past coursework, we learned about some platforms that share protocols. The figure shown in the slide is a screenshot of TSST from Protocol.io. [11] We can see some interesting descriptions: "Heart rate, EDA, and respiration rate are assessed continuously,..., [and] participants are asked to abstain from ..., smoking, using substances, ..., engaging in physical exercise..." Some factors are very intuitive, such as physical exercise, and were realized by early researchers, but others were gradually learned in the following decades. [12]

Here, the reproducibility crisis emerges. For instance, an early dataset may not exclude smoking as artifacts, whereas later datasets benefit from recent studies and remove smoking-related skin conductance responses. This usually shows up as different criteria in manuals. Another good example would be loci choice, as discussed previously.

Slide 7 & 8: Basic Properties

As shown in the picture, it takes about 1 to 3 seconds for skin conductance to occur. The latency is the state where our body receives the stimuli, processes the information, and generates reactions. The amplitude is how dramatically the sweat glands secrete accordingly.

The picture in slide 8 shows two major components of EDA data: tonic and phasic. The tonic component refers to the non-specific, steadily changing rhythms of the autonomic nervous system, and the phasic component refers to event-related responses that most studies target. They are vital in controlling variables.

Slide 9 & 10: Influencing Factors

EDA is complex because it involves many influencing factors. The major ones are technique, environment, and individual differences. Technique factors range from electrode materials to measured loci; environmental factors include temperature and humidity; individual differences encompass drugs, exercise, respiration, age, and skin water content. [12] Among all factors, we can control technique, environment, skin water content, drugs, and exercise status, but some individual factors are not subject to laboratory settings. The most commonly seen uncontrolled factors are respiration, connection stability, miscellaneous actions such as sudden movement, and pressing electrodes. On top of this, we need to delete falsely marked skin conductivity responses resulting from software settings.

Slide 11 & 12: Artifacts Demonstration

Illustrations of irregular respiration and pressing on the sensor as artifacts.

Irregular respiration may lead to sudden changes in EDA value, with few standardized methods that can rule out these artifacts. [13]

Slide 13 & 14: Cognitive Bias

In practice, I realized that EDA editing is under the threat of cognitive bias. This is primarily because of the ambiguity in describing artifacts, such as respiration. We consider "2 to 3 times larger than the average" as irregular, but finding the average may be highly subject to human error. The pictures I show in the slides are two examples where we have trouble identifying the average respiration rate of a task. A messy file part in the earlier half may change how editors value the rest half.

Slide 15: Efforts towards Open Science

We have implemented some quality assurance processes to protect our results from cognitive bias. Firstly, we decided to double-edit files that might be controversial. By introducing a second editor, we can provide more diversified interpretative perspectives and correct the misuse of editorial manuals by a single editor. Then we labeled all major artifacts with a code, as shown on the right slide. Any modification made to the raw data would be recorded with the "Type-Time" abbreviation so that we can track all objective decisions. Additionally, I also use programming languages to make the generation of double-edit files and the transfer of data more replicable. If the EDA data in the study I engage in were eventually openly shared, I would have at least the confidence to speak of "an attempt towards open science."

Slide 16: Many-Analyst Approach

In fact, the ambulatory EDA setting has raised some concerns in the last decade. [13] [14], but no study has quantitatively assessed how dramatically human-led measurement errors can be affected by standardized manuals in an ambiguous setting. Thus, I designed a study that uses a many-analyst approach to estimate how editors from different backgrounds act on the same raw EDA data.

Editors will be provided with raw datasets from a standardized test such as TSST for analysis. Other coupled variables used during assessment are also included, including heart rate variance, impedance, and respiration rate. Any manipulation of the dataset would be recorded by a unified coding system, such as "Type-Time" abbreviations. Editors would be required to share their applied manuals, which would be provided by a third-party or originated by the editors. Ultimately, the overlap of the results could be estimated by comparing different data processing results. In our in-group trial where editors used the same manual and were trained by the instructor concurrently, we achieved an 88 percent consistency rate.

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