

Physiological Measurement In Empirical Research

Theory, Technology, and Best Practices

Psychophysiology

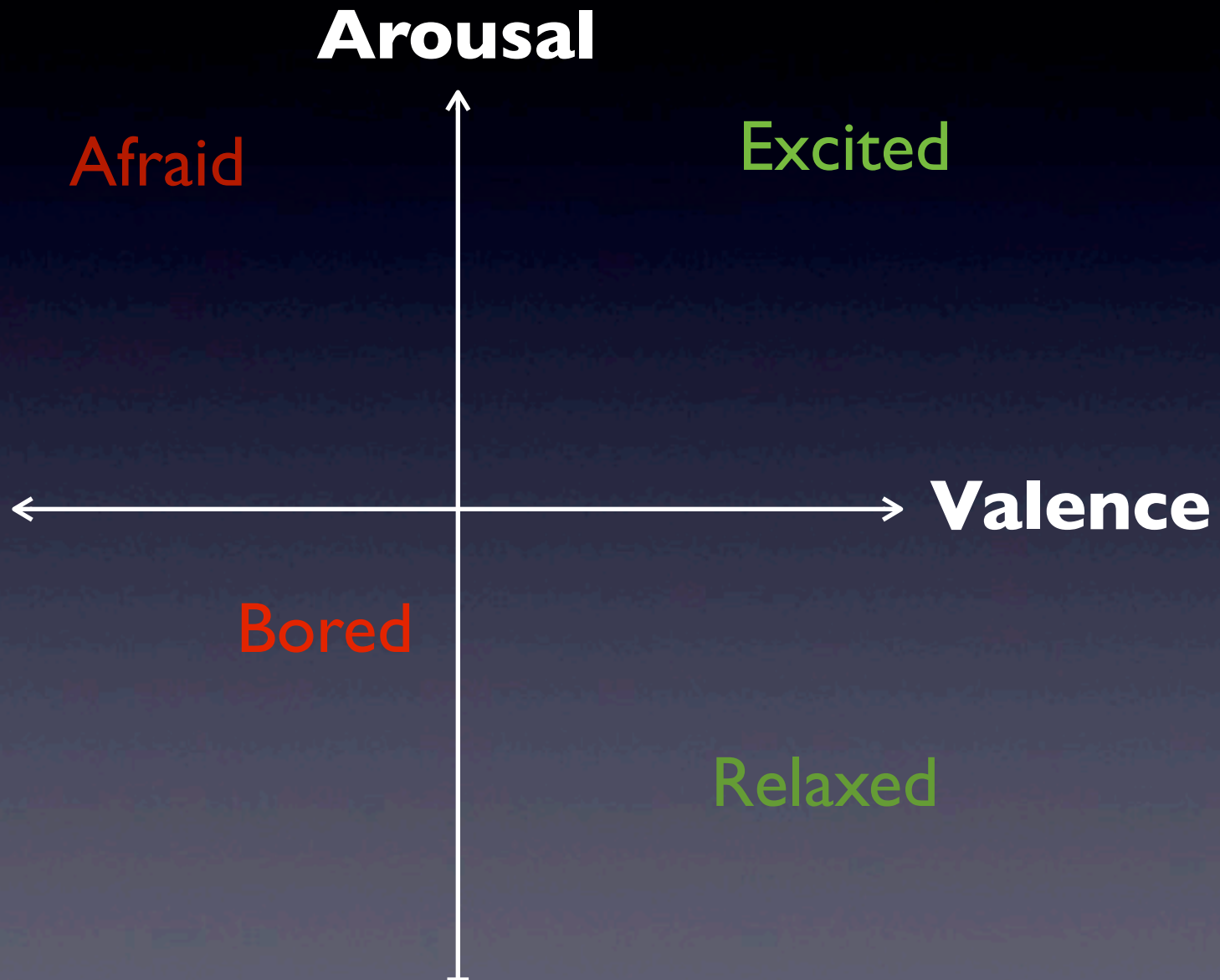
- The use (and study) of physiological measures to help us understand cognitive and affective phenomena

Some simple examples...

- Many psychophysiological correlates of affect are common knowledge:
 - Sweaty palms when you're nervous
 - Changes in heart rate / breathing associated with stress or physical exertion

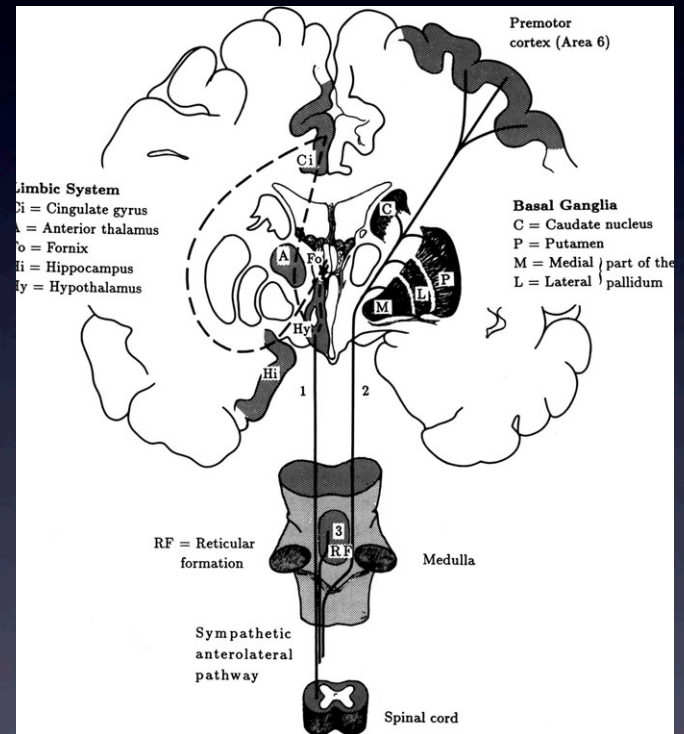
A Model for Quantifying Affect

(The Circumplex Model (Russell, 1980))



Under the hood

- Multiple systems involved in modulating most physiological measures, and the neurobiology of emotions is still not very well understood.
- Most common physiological measures focus on *arousal*, which is primarily modulated via the *sympathetic* and *parasympathetic* nervous systems.



Measures | EDA

- **What it measures:**

- *Psychophysiological arousal, or sympathetic nervous system (SNS) activation.*
- *The SNS is best known for the “Fight or Flight Response”, but also responds to subtle changes in cognitive and emotional activity*

- **How it works:**

- *We measure SNS activity by monitoring Electrodermal Activity (EDA), a measure of tiny changes in the water content of the skin, mediated by dilation of eccrine sweat glands.*

Measures | EDA

- Watch form-factor allows non-invasive, forgettable recording
- Records EDA, along with 3-axis of acceleration, and skin temperature

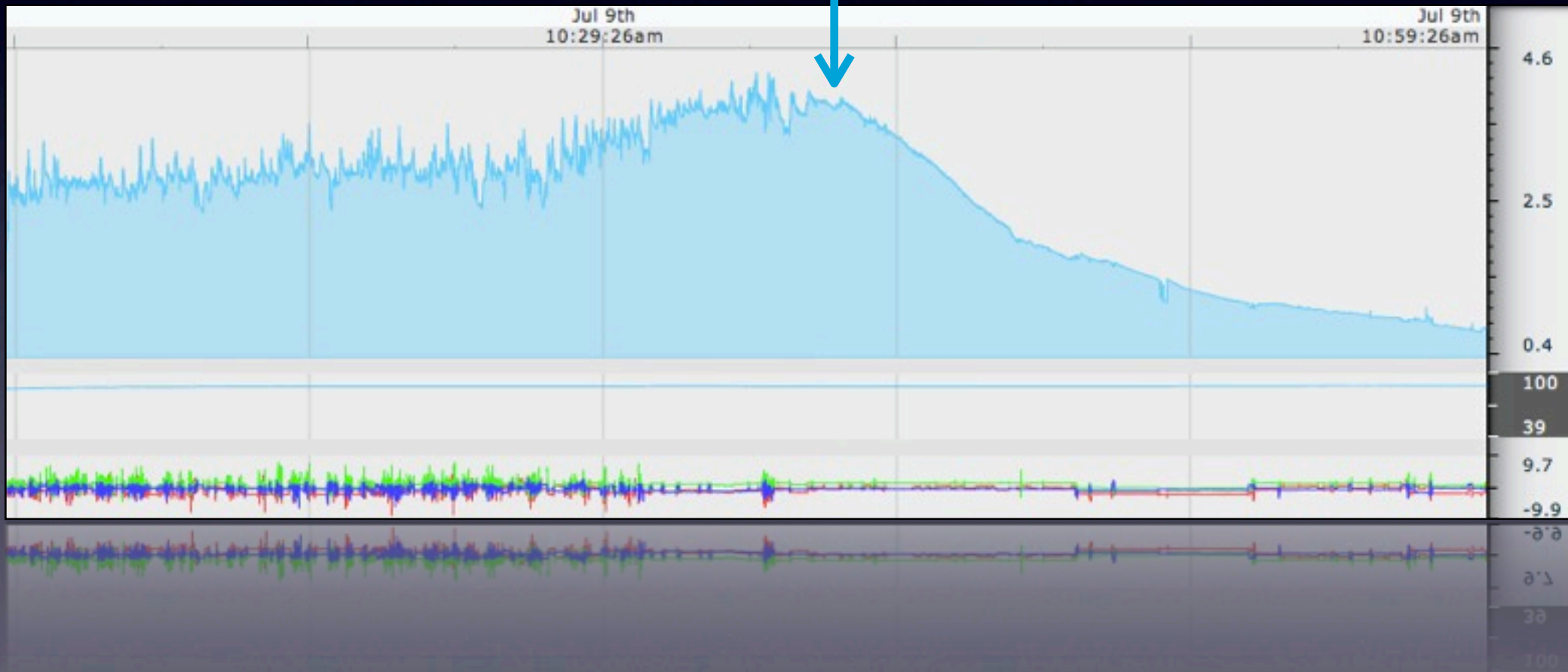


The Q Sensor

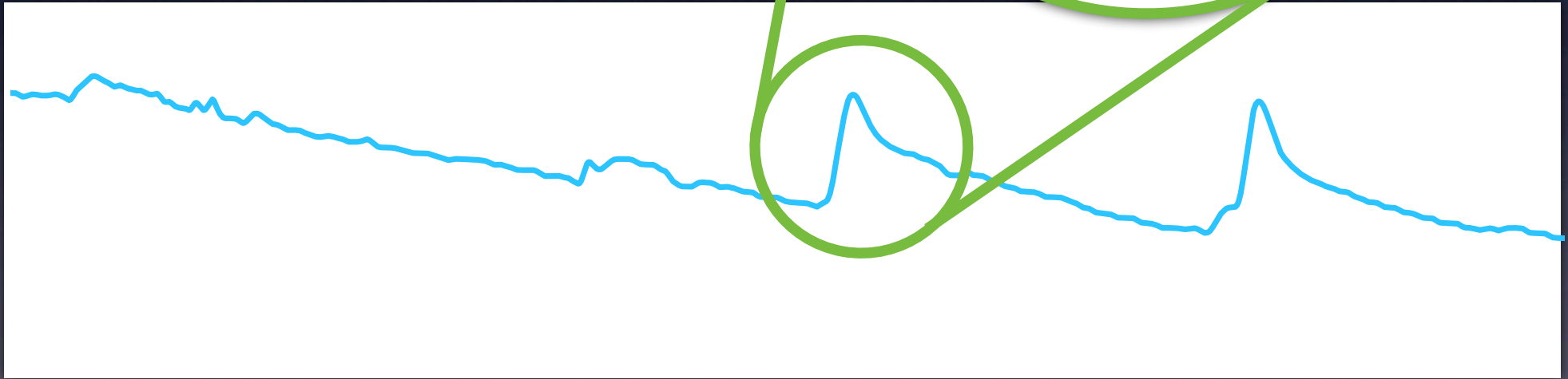
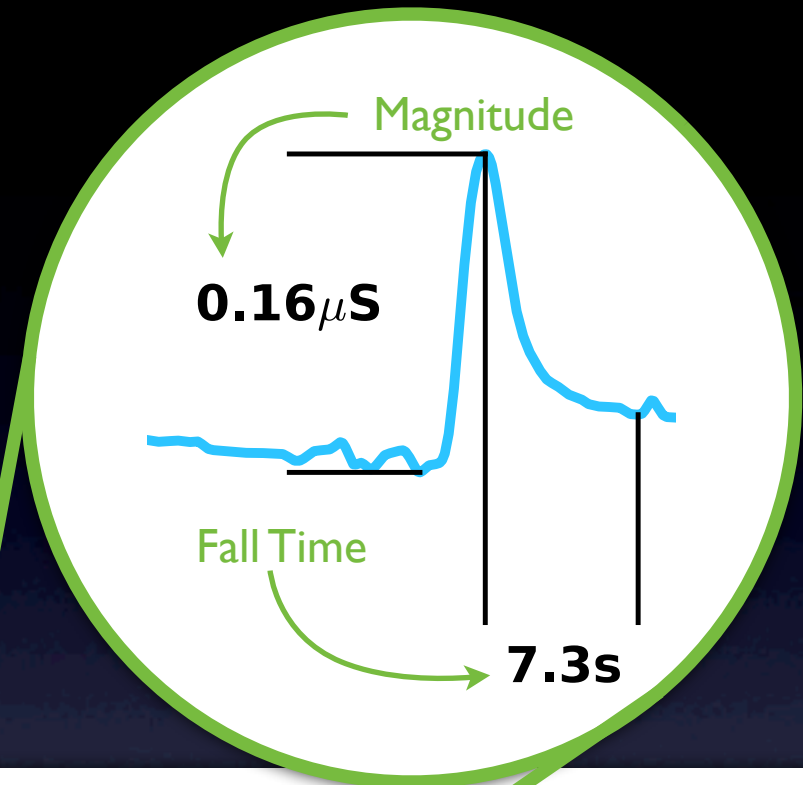
What the data looks like...

Discussion

Powerpoint Begins

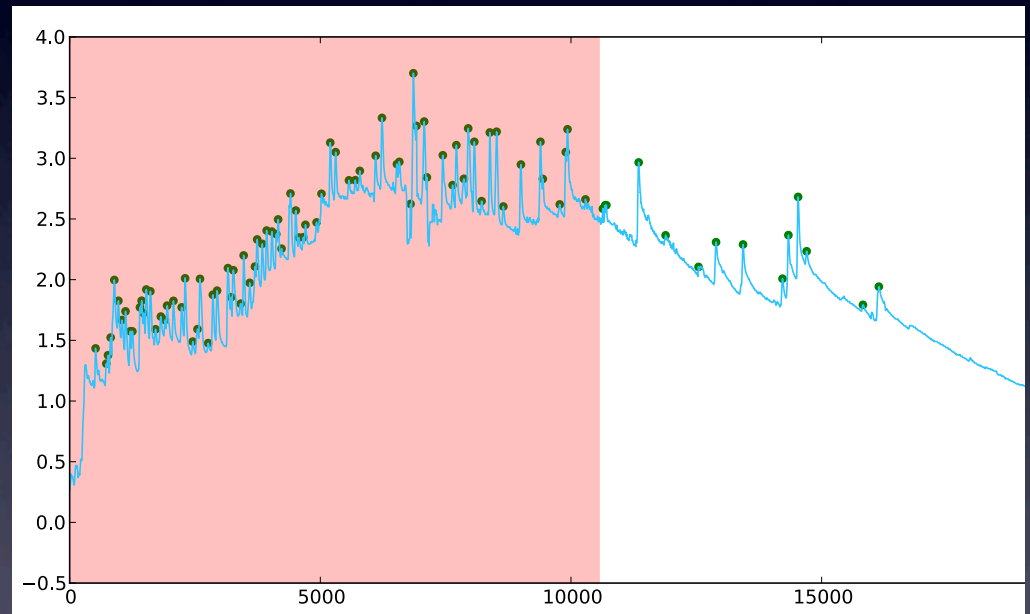


EDA Metrics



Lability vs. Stability

- Most physiology can be analyzed at multiple time-scales, looking either at minute-minute changes or at longer time-scale patterns



Demo

Measures | HR & Respiration

- More complex to interpret than EDA, due to combination of sympathetic and parasympathetic influences, and very sensitive to physical activity and fitness level
- But... still frequently used, and devices for measurement are often more affordable and easier to come by

Measures | HR & Respiration

- Zephyr is one of the companies that makes many affordable HR measurement devices
- Measurement tends to be a bit more invasive than EDA (usually a chest-strap)



Research Design Using Physiology

Within-Subjects Designs

- Almost all physiological measures are subject to large variance across people
- Best way to control for this is to get baseline measurements as part of your study, and to compare against those baselines for each subject

Controlling Extraneous Variables

- Since physiology is influenced by emotion and cognition, there are many potential confounds (e.g. someone rear-ended the subject's car in the parking lot)
- One approach to dealing with this is to actively do something prior to the experiment to try and put everyone into a similar affective state, such as using a relaxation exercise

Beware Order Effects

- Affect and physiology rarely change on a dime, and it is frequently the case that a response from one stimulus (e.g. a movie clip) will persist and influence a subsequent stimulus
- This can be addressed through randomization, and through thoughtful timing and ordering of stimuli

Always Consider Context

- A particular physiological response is rarely meaningful in isolation, and this needs to be taken into account during analysis
- Elevated EDA, for example, could indicate either stress or engagement/interest
- Other behavioral or self-report measures can often be very helpful in disambiguating responses

Social Interaction

- I consistently see social interaction as one of the most reliable ways to impact (usually elevate) psychophysiological arousal
- This can be particularly challenging in certain UX paradigms, where I've often seen systematic psychophysiological responses to interactions with the experimenter which complicate analysis

Qualitative Research

- Physiology can very helpful in qualitative research, especially if you are able to watch it in realtime while observing a subject
- It can be very useful to use video and physiology to ask a subject afterwards about what they were experiencing during a particular physiological response (I've seen this used very successfully in focus groups, usability studies, and pilot intervention studies)

Questions?