Using Ranked SCRs in Ambulatory Measurements: A New Approach to Distinguishing Real-World Salient Events

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Background and Methods

Typical ambulatory EDA analyses have low specificity for capturing short term salient events.[1] Our goal was to explore methods for detecting these short-term events in individuals listening to classical music concerts.

Methods: We measured EDA from the wrist using a comfortable ambulatory monitoring device[2] from 16 individuals while they listened to one (or more) of 4 live concerts. Participants were instructed to avoid clapping and were interviewed about their experiences afterwards.

Case Example: In a post interview, M. reported that the main theme of the Romeo and Juliette Overture was emotionally stimulating. How can psychophysiologists identify this emotionally salient event?

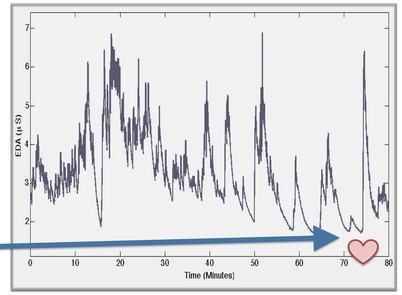
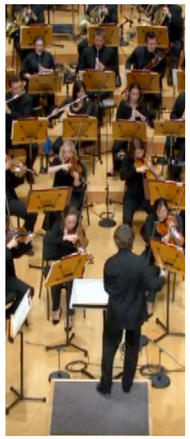


Figure 1: M.'s EDA during a Romeo and Juliette classical concert



Challenge

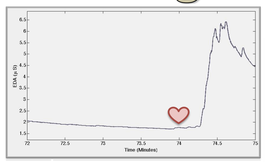


Figure 2: Large SCR during melody onset

As expected[3], M. produced a large skin conductance response (SCR) after the onset of the melody.

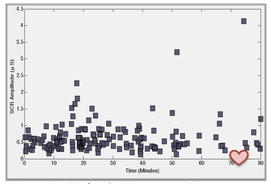


Figure 3: All of M.'s SCRs across the concert

However, M. produced many SCRs across the concert, many of which appeared to be non-specific. Which responses were due to emotional or environmental stimuli?

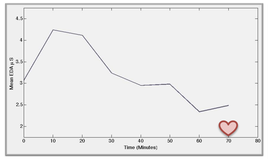


Figure 4: M.'s mean EDA in 10 minute segments

When the mean EDA level is averaged across time, as typically done in ambulatory measures, M.'s response to the melody is no longer apparent.

Solution

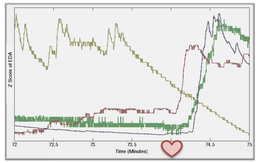


Figure 5: SCR's during melody onset

1. Assess Responses from Multiple Participants

Of the 4 listening, 2 other participants produced SCRs at the same time as M. Since these responses co-occurred, the SCRs are likely event-related SCRs.

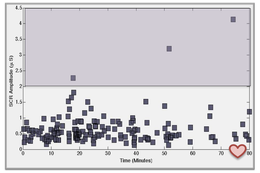


Figure 6: M.'s SCRs above 2 μS

2. Select SCRs based on amplitude

SCRs with the largest amplitude are more likely to be related to a specific stimulus. By setting a minimum threshold, most non-specific SCRs can be ignored. (See Myrtek, 2004)[4]

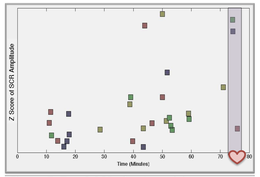


Figure 7: Top 8 SCRs for 4 participants

3. Select SCRs from Multiple Participants

All 4 participants produced one of their largest SCRs during the Romeo and Juliette theme, suggesting that the music was related to M.'s SCR.

Identifying Frustration

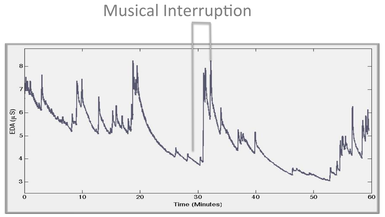


Figure 7: J.'s EDA during a concert with Ravel's Mother Goose

All four participants reported annoyance with the concert being interrupted by the moderator talking. During this interruption, large SCRs occurred for each participant, suggesting the interruption was particularly salient.

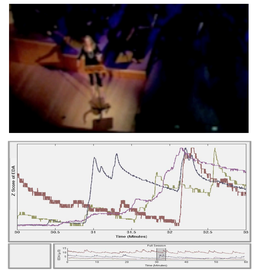


Figure 8: SCRs after a musical interruption

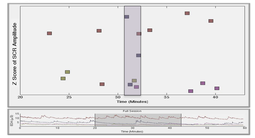


Figure 9: Top 20 SCRs co-occur during interruption

Salience of an Oboe

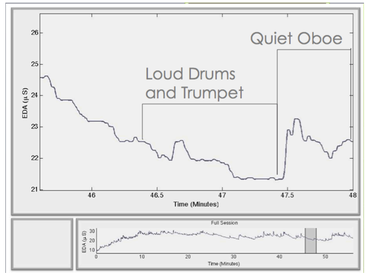


Figure 10: K.'s EDA during a classical concert featuring Debussy

We expected loud drums to be stimulating during a concert. However, during the loud drum section no large SCRs were present for any participant. Conversely, all 3 individuals had a large SCR during the transition to an oboe solo, right afterwards.

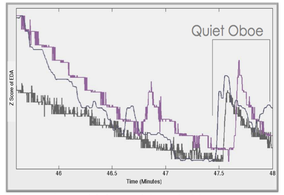


Figure 11: Multiple Participant's SCRs

Discussion

The classical concert setting in particular provided a nearly ideal ambulatory setting. Participants sat still, avoided clapping, and for the most part focused on one primary (albeit multi-modal) stimulus, the concert. While the study was ambulatory, the setting made for a relatively controlled environment, allowing for greater specificity and better inference. A combination of an optimal setting and appropriate methods allowed us to analyze salient events with EDA.

Conclusion

Individual SCRs can provide meaningful information to ambulatory researchers that typical longer-term averaging techniques would not reveal. By denoting simultaneous, large responses from multiple individuals we can isolate putative event-related SCRs in large ambulatory data sets.

Future Work

The presented methods are only one of many possible ways of making meaning out of momentary data in large ambulatory data sets. Future work should attempt to model the effect of ambulatory artifacts (movement, speaking, etc.) and consider combining multiple psychophysiological measurements as well.

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Sources
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