

## **Three Key Factors that Influence EDA in Observational Studies of Occupational Therapy**

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### **Motivation:**

Changing physiological arousal is an important goal of occupational therapy but therapists do not have a way to objectively measure how therapy affects arousal. We hypothesized that when children with Sensory Processing Disorder (SPD) participate in guided activities within an occupational therapy setting, informative changes in electrodermal activity (EDA) could be detected using iCalm<sup>1</sup>.

### **Comparing Mean EDA Responses Across Children was Inconclusive:**

In our observation of 77 therapy sessions, average changes in EDA changes, across children and different pieces of equipment was not statistically different from zero<sup>2</sup>.

Individual therapeutic activities affected EDA. However, EDA changes often varied across sessions.

For example, Child 13's EDA extensively increases while playing in the ball pit

As an opposing example, Child 11's EDA substantially decreases while playing in the ball pit.

Other unaccounted for factors play a large role in how a child's EDA changes with therapeutic activity. In the next section we suggest 3 factors that can account for these differences.

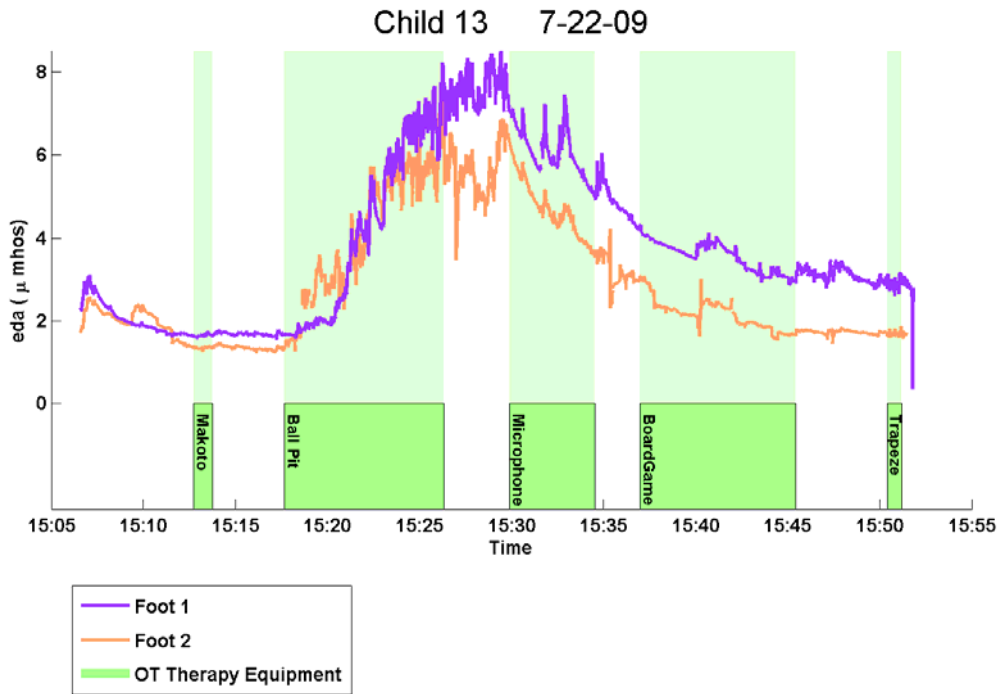


Figure 2: Child 13's EDA increases when using the ball pit. As an opposing example, Child 11's EDA substantially decreases while playing in the ball pit. Notice in Figure 3 how Child 11's EDA moves from 2.5 u Mhos to 1.7 u Mhos while in the ball pit.

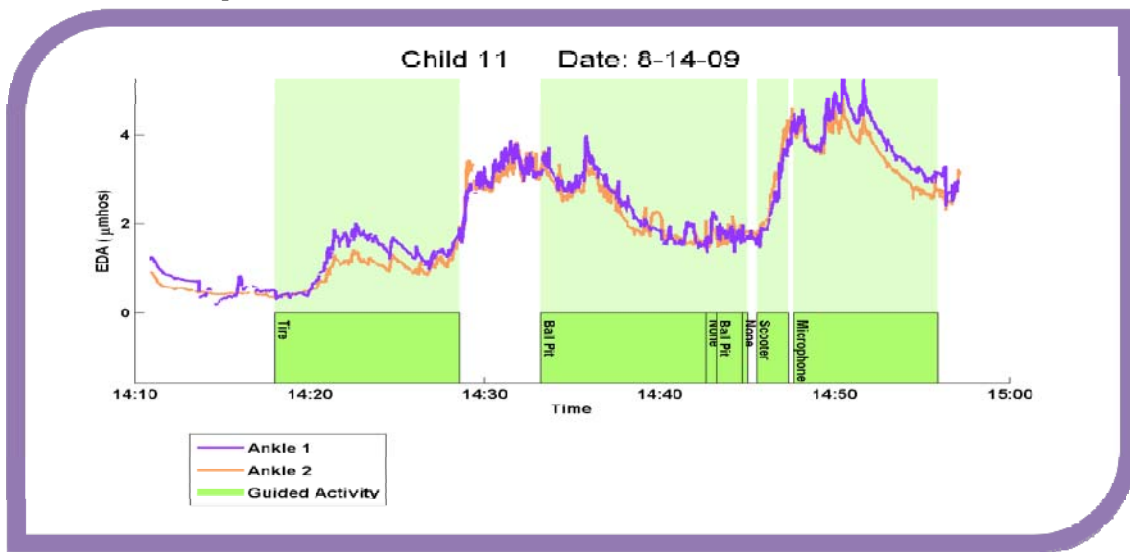


Figure 3: Child 11's EDA decreases when using the ball pit.

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## Three Observed Factors that Influence EDA Response

### 1. Therapeutic Intent

The intent of a therapist can determine the effect of therapeutic equipment. For example, Child 19 participates in two guided activities on the Lycra Wall and has opposite EDA responses (Figure 4).

The therapist intentionally raised Child 19's arousal in the blue section – having him climb five levels on the net. When he reached the highest level he played volleyball on his knees. This task required arousing elements: physical exertion, balancing, cognitive thinking, and competition.

Conversely, in the red section the therapist intentionally lowers Child 19's EDA, calming him down. She has him lie on the bottom level of the Lycra Wall while the therapist annunciates slowly and has him reflect on his internal state.

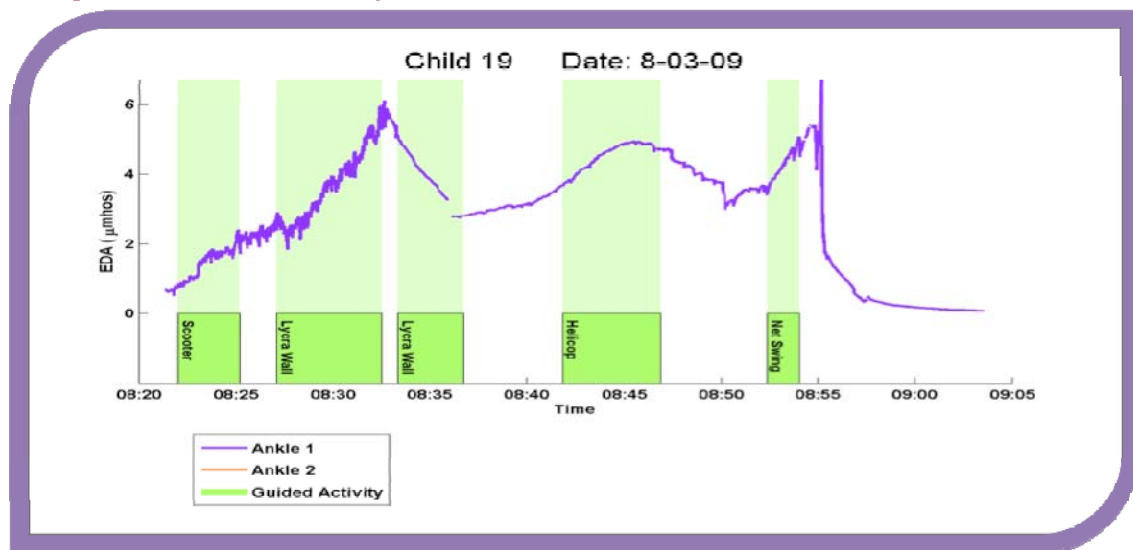


Figure 4: Child 19's EDA increases and then decreases without changing equipment

While both activities included the same therapeutic equipment, how the therapist intended to use the equipment influenced the direction Child 19's EDA changed.

### 2. Environmental Influences

Sometimes stimuli from the environment can influence a child's EDA response. In one example, Child 14 rocks in a cuddle swing which decreases her arousal (Figure

5). When the therapist shows Child 14 a noisy robot, Child 14's EDA rapidly increases. Even though the Cuddle Swing itself can help Child 14 lower her arousal, the robot prevented the cuddle swing from being calming – in fact the activity became highly arousing. Many external factors can influence a child's EDA – noises, smells, flickering lights, people in the room, etc. At times, these factors can affect the child more than the therapeutic activity itself.

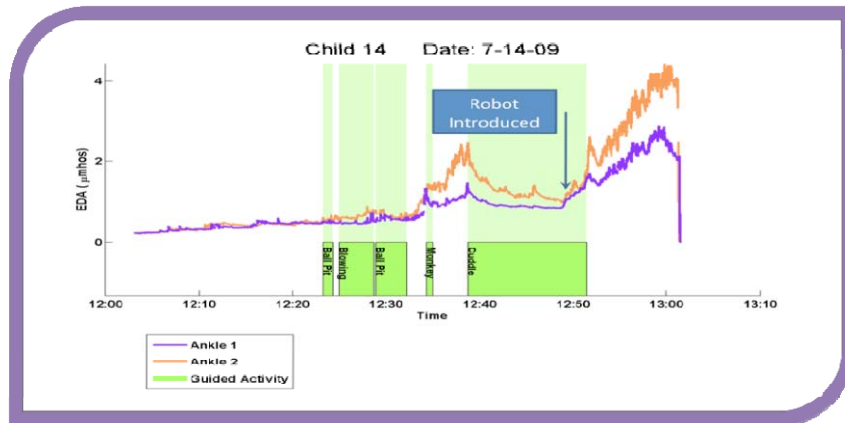


Figure 5: Introduction of a Noisy Robot Changes Child's EDA Response

### 3. Individual Differences

Different children may respond differently to the same stimuli. In Figure 6, Child 20's EDA substantially increases when she begins to play with tactile toys. Child 20 has a higher than usual response to touch – one of the reasons she is in therapy. As expected, not all children's EDA increased like Child 20's when working with tactile toys. Statistical averages fail to take into account that some children have unique, individual responses to some therapeutic equipment.

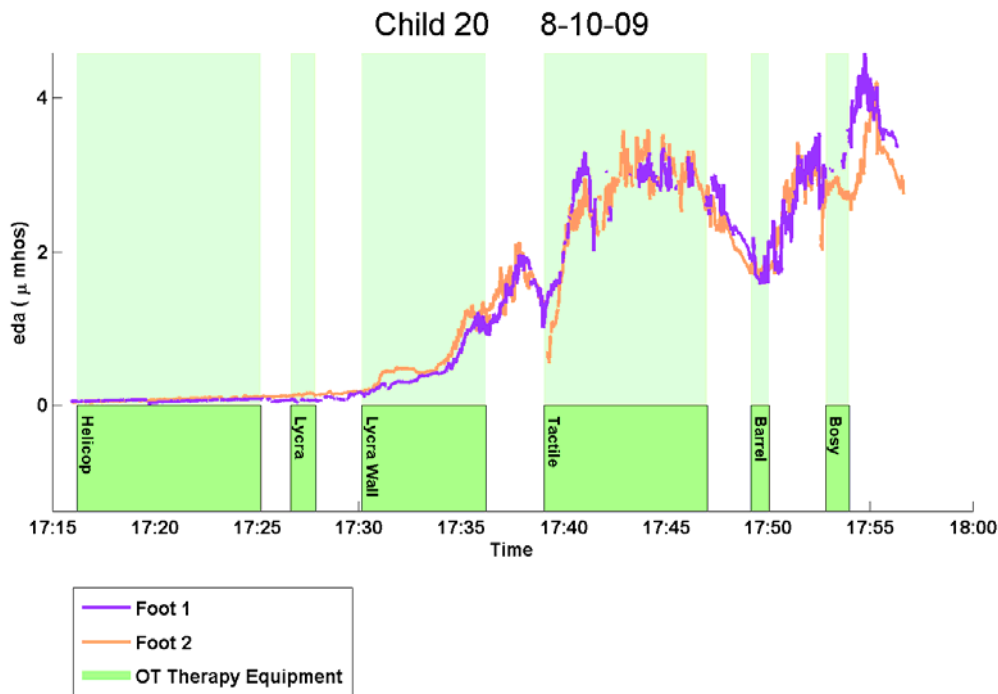


Figure 6- Child 20's EDA substantially increases when interacting with tactile toys

### How to Account for these Factors

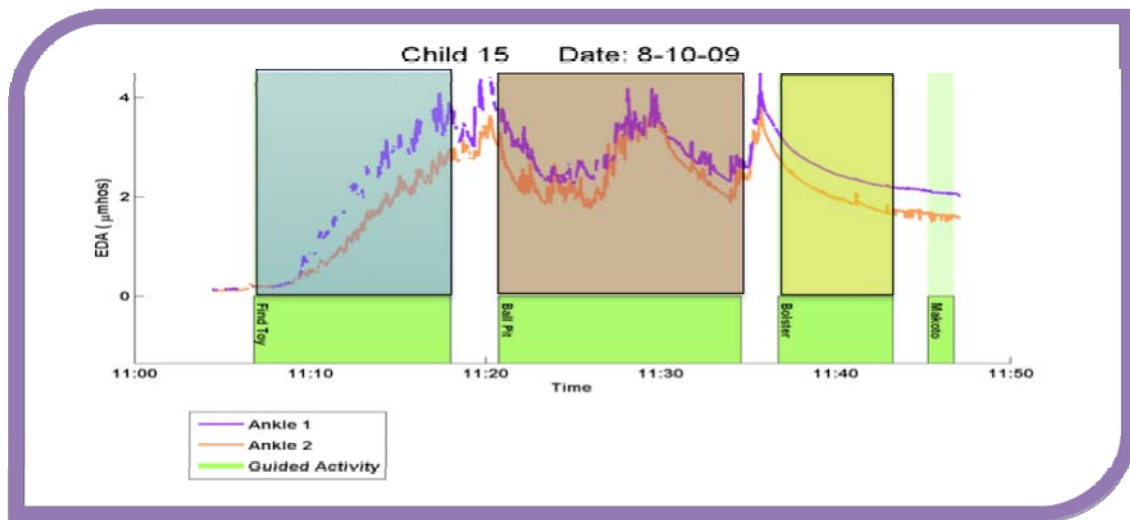
In an observational study, accounting for the three mentioned factors in a statistical model is difficult if not impossible. On the other hand, in depth case studies do provide insights how therapy influences EDA. The below case study provides an example of how a qualitative description of changes in EDA can provide insights into the therapeutic process while accounting for therapeutic intent, environmental influences, and individual differences.

### Case Study Example

In Figure 7, a child with Autism and limited verbal skills attends an hour long therapy session. She spends the first part of therapy moving around and looking in a large room for hidden animals (Blue Section) which corresponds to an increase in EDA. While in the ball pit (Red Section), Child 15's EDA decreases when she lies still but her EDA then increases when she begins looking for animals buried in the balls.

As Child 15 leaves the ball pit her arousal increases while she approaches an elevated bolster swing. She flaps her arms and verbally moans to the therapist (Green Section). When Child 15 is on the Bolster swing and gently rocking she appears calm – she is focused and does not speak. Her EDA decreases during this rocking (Purple Section).

From this case study we can see that therapy appears to correspond closely with changes in EDA. Further more we can identify factors that influence Child 15's EDA – movement, cognitive tasks, having to move onto an elevated platform, and body position. By looking at EDA in a case study manner, informative information about how therapy influences EDA is obtainable.



## Conclusions

Statistical analysis describing how equipment use corresponds with EDA was inconclusive. Therapist's intent, environmental influences, and individual differences are factors that influence intervention but are hard to account for in a statistical model. By analyzing case studies in conjunction with EDA, we may be able to generate new perspectives in how therapeutic activities work while still taking into account these influential factors.

## Sources

1. Fletcher, R., Dobson, K., Goodwin, M.S., Eydgahi, H., Wilder-Smith, O., Fernholz, D., Kuboyama, Y., Hedman, E., Poh, M. Z., & Picard, R. W., "iCalm: Wearable Sensor and Network Architecture for Wirelessly Communicating and Logging Autonomic Activity," IEEE Transactions on Information Technology in Biomedicine, vol.14, no.2, pp.215-223, March 2010
2. Hedman, Elliott. 2010. In-Situ Measurement of Electrodermal Activity During Occupational Therapy. Master's thesis, Massachusetts Institute of Technology.

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