Chapter 26
Measuring Electrodermal Activity in an Afterschool Maker Program to Detect Youth Engagement

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ABSTRACT

In this chapter, the authors describe a new approach for exploring individual participants' engagement in immersive youth maker activities. Participants were outfitted with wearable first-person point-of-view still-image cameras and wrist-based electrodermal sensors. The researchers analyzed the recorded electrodermal data stream for surges in skin conductivity and compared them with the corresponding photographs based on their timestamp. In following with prior work, these surges were interpreted as moments of engagement. A comparison sample was created to look at moments that lacked this psychophysiological marker. Results suggested that the two participants had both shared and divergent engagements with the afterschool program's activities. While the group project of building a high altitude balloon had been established prior to the youth's participation, the girls were able to choose what aspect of the project they wanted to be responsible for. This range of activities provided opportunities for youth to sample a variety of practices typically associated with making.

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INTRODUCTION

Making is thought to be an immersive and highly engaging set of technological practices for a broad range of youth (Calabrese Barton, Tan, & Greenberg, 2016; Svihla, 2015). As such, there is an opportunity for researchers to better understand the ways that individuals differentially engage with making. This is important to explore because making often provides an opportunity for custom experiences. What one youth does in a makerspace may be different from what another youth does at the same makerspace. Moreover and relatedly, what one youth finds engaging in a makerspace may differ from what another youth finds engaging. This could apply when makers are doing the same activity. The current study aims to examine youths' psychophysiological responses to some common maker activities in the context of a multi-week afterschool maker education program. Typical maker activities include crafting with both traditional and digital tools to fabricate a designed object (Martin, 2015). In this study the participants collaborated on the building of a high attitude balloon and sensor payload. The current study investigated participants' psychophysiological responses while engaged with maker activities in the context of a project with a predetermined final product, the high-attitude balloon. This study examines whether there are indeed differential levels of engagement for youth experiencing the same activities in a makerspace.

In the proceeding sections we first provide a brief overview of prior work on the use of skin conductance as a psychophysiological measurement and follow with an explanation of the role that engagement and interest play in making. Next we present a new method we are exploring and initial findings from it using wearable cameras and sensors to examine engagement in maker activities at a minute-by-minute grain size. Finally, we conclude with a discussion on our interpretations of this new method, their potential for future work, and limitations.

BACKGROUND

Electrodermal Activity

The measurement of electrodermal activity (EDA), sometimes referred to as skin conductance or galvanic skin response, gauges psychophysiological activity of the sympathetic nervous system. That is, we are attending to the response of a physiological body system to psychological states and changes. Orienting reflex theory explains the activation of the sympathetic nervous system as orienting response, where "OR (orienting response) functions to produce a heightened sensitivity to environmental stimulation and results in increased intake and processing of information" (Raskin, 1973, p. 128). This response prepares the body for action by signaling sweat glands on or near the hands and feet to produce sweat to increase friction for a better grip and traction respectively (Matsumoto, Walker, Walker, & Hughes, 1990).

Electrodermal activation may not produce a visible amount of sweat at the surface of the skin. However, the electrical conductivity of the skin increases as the sweat glands begin producing sweat into the sweat ducts as part of the autonomic response (Boucsein et al., 2012). The skin can be thought of as a sponge that becomes increasingly conductive as salty water fills the ducts that connect the sweat gland to the surface of the skin. This change in skin conductivity can be measured by passing a small current through the skin and measuring the resistance. The value is presented as the inverse of the resistance with the unit microSiemens (μS).