Yang, J. C. et al. (Eds.) (2017). Extended Summary Proceedings of the 25th International Conference on Computers in Education. New Zealand: Asia-Pacific Society for Computers in Education

Measuring stress in doctoral research: a case for reality mining across psychological, physiological and environmental dimensions

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One night during the third year of my PhD program, I sat on my bed with a packet of tranquilizers and a bottle of vodka. I popped a few pills in my mouth and swigged out of the bottle, feeling them burn down my throat. Moments later, I realized I was making a terrible mistake. I stopped, trembling as I realized what I'd nearly done (Walker, 2015).

1 Introduction

Stress levels in doctoral students have long been of concern (Bélanger et al., 2015; Hill & Smith, 2009; Offstein, Larson, McNeill, & Mjoni Mwale, 2004). Not only do they affect doctoral completion rates and retention (Kearns, Gardiner, & Marshall, 2008), they have been found to have a detrimental impact on students overall wellbeing (Haynes et al., 2012; Ross, Bathurst, & Jarden, 2012). There are signs that a growing number of students are experiencing levels of stress that appear to be higher than any time in history (The Faculty Advisory Council of the Illinois Board of Higher Education, 2007). A recent study by Ickes, Brown, Reeves and Zephyr (2015) of 1,139 college students revealed 80% of graduate and undergraduate students reported they struggle with stress. The U.S Associated Press survey on stress and mental health of college students (Associated Press & mtvU, 2009) found 85% of students surveyed experienced stress on a daily basis. Of these, six in 10 reported having felt so stressed that it interfered with their academic work.

It is interesting to note that many of these studies are focusing not on the psychopathology of the individual but on the influence of the academic environment. For instance, the 2013 National U.S. College Health Assessment, where the average age of those surveyed was 21 years, reported that almost half (46.3%) of all undergraduate students surveyed felt traumatised or overwhelmed in regard to their academic responsibilities. Similarly, a study by Waghachavare, Dhumale, Kadam and Gore (2013) of 1,224 students undertaking professional courses found 24% regularly experienced prolonged negative stress as a result of academic factors. These studies reflect a growing realisation of the stressful demands contemporary educational environments can place on students (Bélanger et al., 2015; Meriläinen & Kuittinen, 2014). Given this, it seems reasonable to accept institutions have an obligation to ensure that educational environments operate in a manner that mitigates rather than promotes factors associated with stress or burn-out.

To date, studies of student stress in higher education have been based on student self-reports of stress through various punctuated collection methods. As a result, measures of stress are typically bound to individuals and guided by post-event recollections as opposed to measures situated at the time of the stressful event: they reflect perceptions of stress and perceptions of stressors. Non perception based measures, such as environmental and physiological, have, until recently been impractical to capture in 'real-life' contexts. However, recent developments in wearable biometric devices and auto-camera technology, offer new opportunities to capture in real-time continuously digital traces across psychological, physiological and environmental dimensions.

2 Method

The aim of this study was to explore psychological, physiological and environmental factors associated with stress through the use of devices that afforded the capture of continuous naturally occurring data.

Four doctoral students from various disciplines took part in the 3-month study which captured three core datasets.

Physiological Data: Each participant wore the biometric wristband (Figure 1) during awake hours; Monday to Friday. The device captured four core measures required for analysing sympathetic arousal through analysing electrodermal activity (1) photoplethysmography (BVP-blood volume pulse & HRV heart rate variability), (2) EDA-electrodermal activity (variation in electrical characteristics of the skin), (3) peripheral skin temperature, and (4) movement (of the wrist, along X, Y and Z axes). Each person wore the band for approximately 15 hours per day over the study period (15 weeks) generating 1,600 - 2,000 hours of biometric data.

Figure 1: Empatica Biometric E4 wristband sensor

Environmental Data: A small wearable auto-camera (Figure 2) set to activate every 30secs was used to capture continuous environment/context data. Over the period of time approximately 100k images were generated for each participant. Middleware was developed that mapped these images by date and time against the *Physiological Data* in order to identify core environmental stressors.

Figure 2: Narrative clip wearable auto camera

Psychological Data: Weekly interactions were scheduled with participants as a feedback technique to explore the data compared with the student’s conceptions. The graphical time sequences middleware was used in order to assist in context recall through the use of the photographic data. The biometric wristband also allowed the wearer to self-record (physiological measure) stress through activating a button on the top of the wristband which adds a marker to the data. These data points were also included in the weekly discussions.

3 Preliminary Findings

Although the study is in the early stages of analysis, early data from two core measures will be discussed in the presentation. Firstly, stress as it relates to activity of the sympathetic nervous system (SNS), in particular the extent to which each participant experiences variations in SNS load.

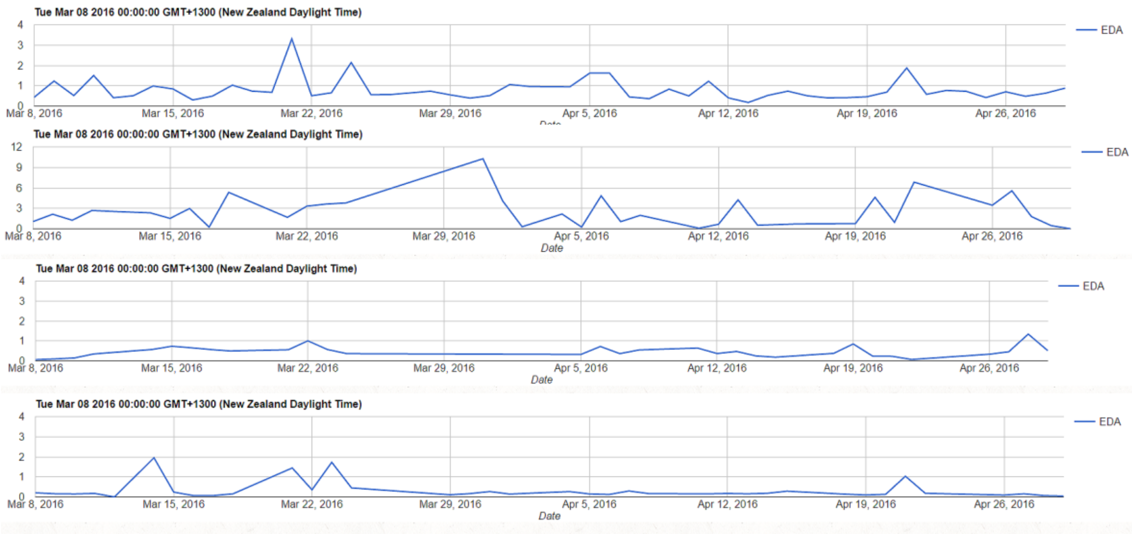

Figure 3: time sequence of EDA measure across the study period for each participant.

Secondly, I discuss various environmental contexts that surfaced as stressors. Examples of three of these are presented in Figure 4 below. These events will be reviewed by incorporating physiological, environmental and participant accounts (psychological). These will also include the curious phenomenon of misalignment that regularly occurred between EDA measures of an ‘event’ and the participants account (psychological) of an event. In many cases participants were amazed to see that particular events rendered no physiological signature.

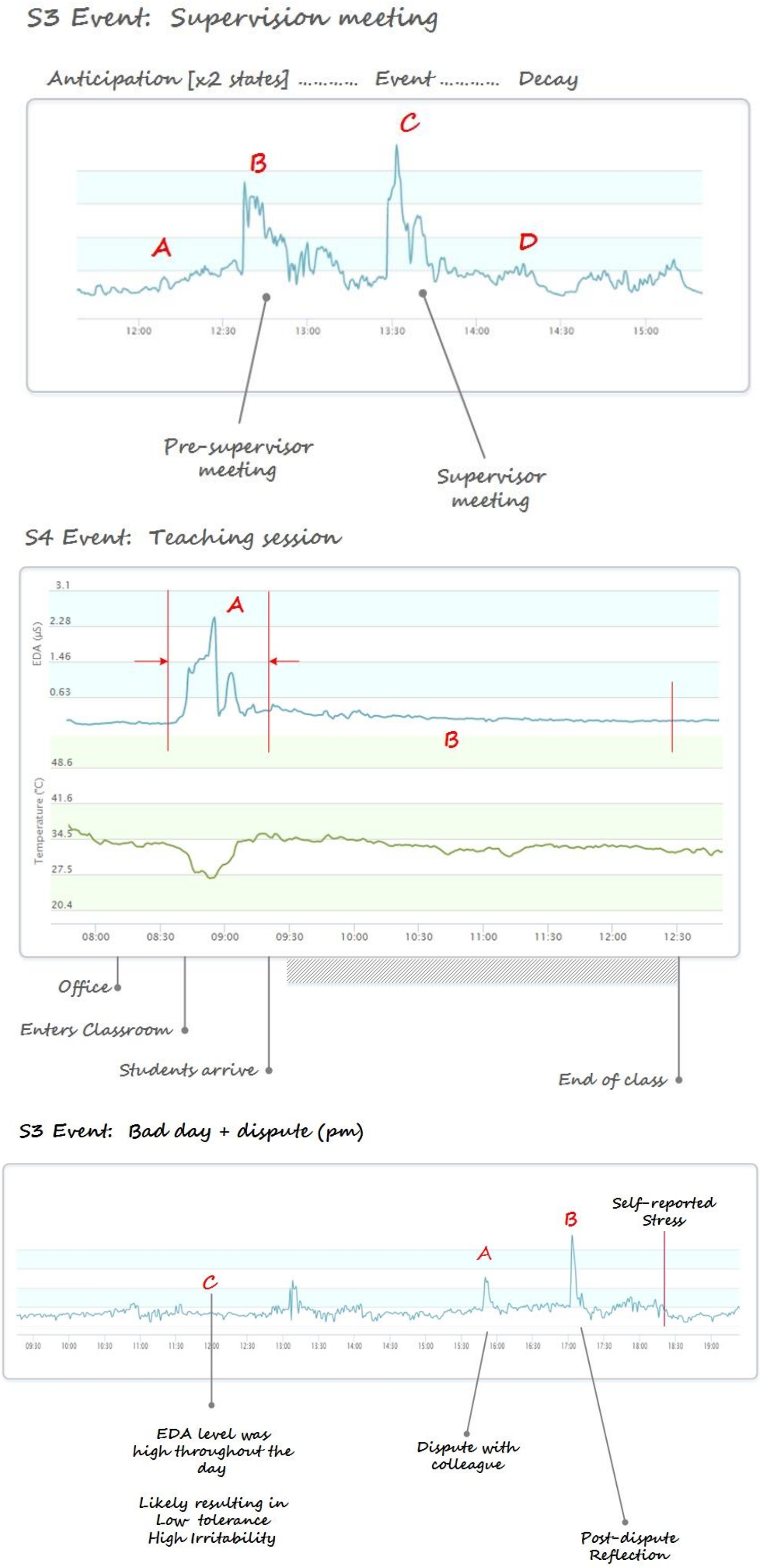

Figure 4. Three examples of EDA mark-up data with context information supplied by photos and participant accounts.

4 Conclusion

While still in the early stages of analysis, it is clear that physiological measures had a profound impact on the participants understanding of stress. In particular, it raised a new tension for them as they grappled with the relevance and validity of the physiological data as a new reality over their conceptual or psychological understanding. An important point that surfaced early in the participant discussions, as a result of lower than expected EDA activity, was the idea that they adopted the 'construct of being stressed' as a condition of being a doctoral student.

From a methodological perspective, it became obvious early on in the data analysis that the act of seeking meaning from the data has been greatly improved by the coupling together of psychological, physiological and environmental dimensions. I would go so far as to suggest that this capability is likely to revolutionise the way we undertake behavioural research.

Acknowledgements

I would like to thank Professor Rachel Spronken-Smith, University of Otago, New Zealand, Assistant Professor Bert Arnrich, and Yekta Said Can from the University of Bogazici, Turkey for their contributions.

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