Towards Understanding the Life of Neurodiverse College Students Through Visualization

Sean McCulloch, Bradley Hoefel, Joe Gildner, Shameem Ahmed, Moushumi Sharmin

Introduction

We propose visualizations created on data collected from a *mixed-method study* of college students (N=20). The proposed visualizations are a first step in investigating how to effectively represent such data to enable

- Highlighting patterns of **stress**, **navigation**, and **sleep quality**
- Sensemaking of the everyday lived experiences of neurodiverse students
- Identifying problem areas that can inform technology design and policy making

Data Collection & Processing

We conducted a mixed-method study with 20 college students (10 neurodiverse) from two post-secondary institutions. For each participant, the study consisted of a ***pre-interview***, followed by *a* ***weeklong field study***, and a ***post-interview***.

- From the field studies, we collected
  - **Physiological data** (***1,738,645*** units of ***heart rate***, ***315,345*** units of ***step count***, and ***1,146.63*** hours of ***sleep***)
  - **Contextual data** (***318,848*** units of ***geographical location***)
  - Ecological Momentary Assessment (EMA) responses (**3635** units)

Physiological Distress

Stress is an expected aspect of life for students which can negatively impact quality of life if not addressed properly. **This is especially critical for neurodiverse students who experience higher levels of stress** and have a ***higher rate of drop out*** [1,3].

To help students de-stress, the first step is understanding factors that induce stress. One of the factors that we examined is **physical location and its influence on stress**. Our choice is informed by research on stress management and which identified physical location as one of the major factors that contribute to stress [4].

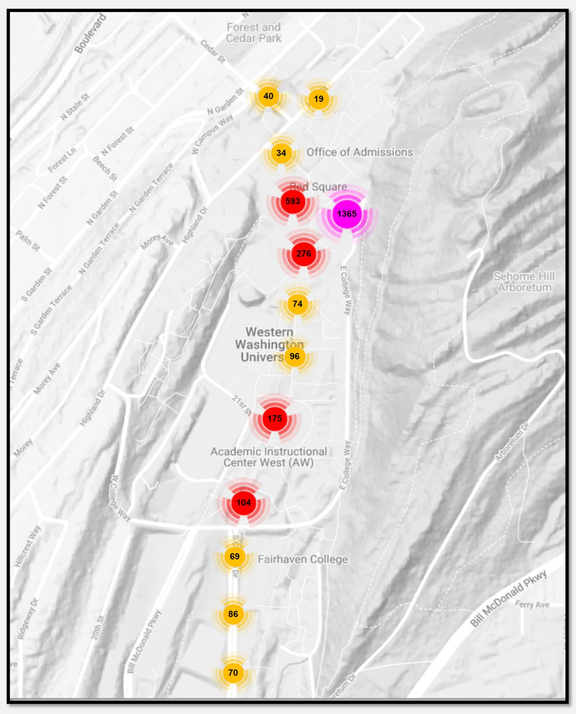

Figure 1. Cluster visualization of location based stress.

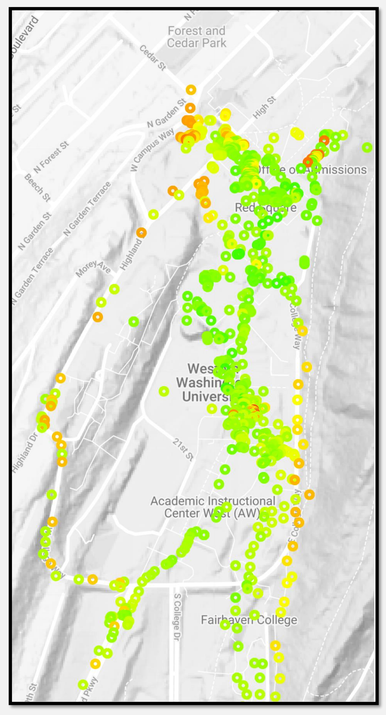

Figure 2. Location based stress measurements of a single participant.

Navigation

By examining participants' navigation patterns, we aimed to answer a specific question: ***Do navigation patterns differ between neurotypical and neurodiverse college students and if yes, how?***

Students navigation patterns reflect their freedom through the choices of where they travel and the locations where they spend time. Closer examination of navigation may reveal how students have adapted to their newfound independence.

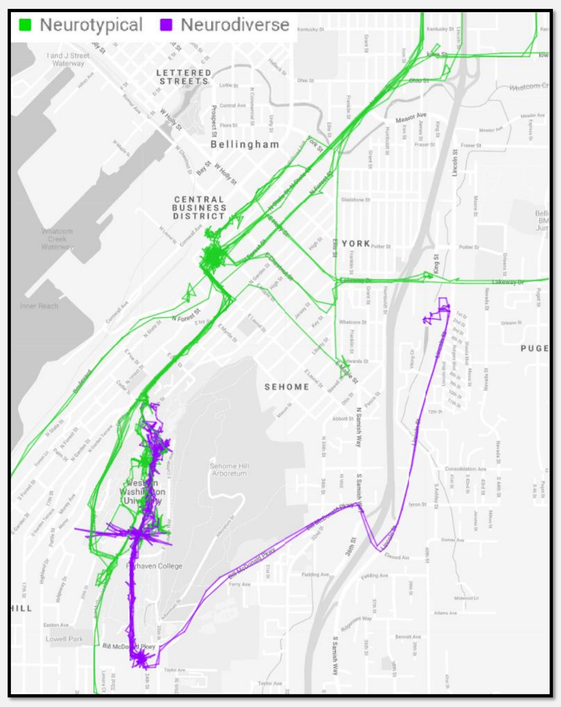

Figure 3. Navigation pattern of a neurotypical and neurodivergent college student.

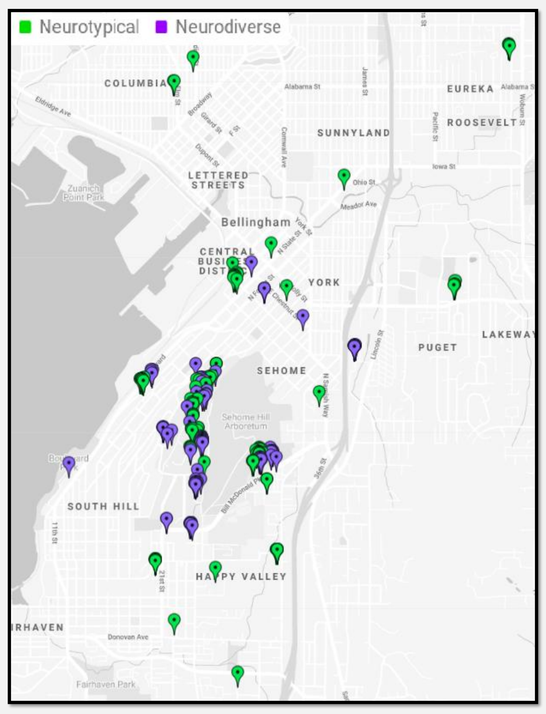

Figure 4. Differences in navigation patterns as shown by all locations visited by participants

Sleep Quality

Sleep, and the quality thereof, is important to sustain various brain and bodily functions. To understand differences in sleep quality, we investigated three markers: ***rapid eye movement (REM)***, ***sleep-phase duration***, and ***time spent awake (TSA)*** during the full sleep period.

An overview of all gathered sleep data is visualized in Figure 5**,** which indicates general differences in the four different sleep phase's durations.

In Figure 6, we visualized differences using days-of-week to indicate sleep pattern trends.

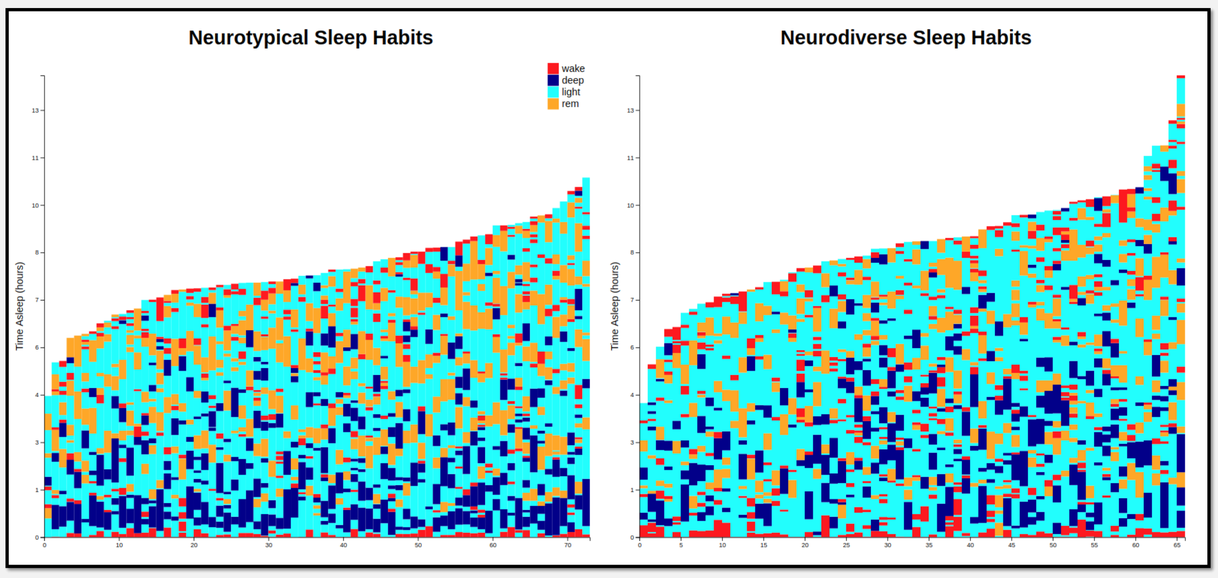

Figure 5. Sleep habits of each group arranged by sleep duration. Each vertical bar represents one participant's night.

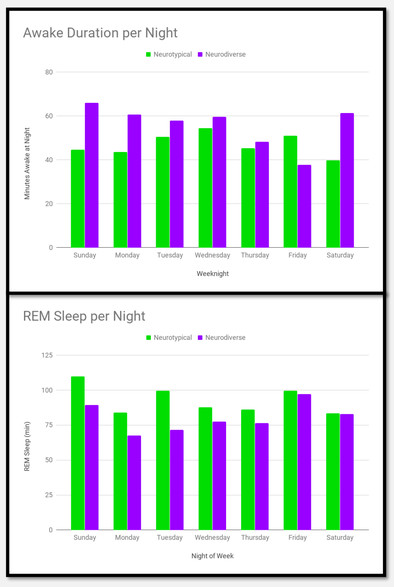

Figure 6. Weekly sleep trends.

Challenges

Visualizing large dataset collected using sensors and mobile phones presented many challenges.

- We collected heart rate data from Fitbit and location data from mobile phones, which were not synchronized. While Fitbit collects heart rate every second, location data was collected every ~20 seconds.
- Plotting a hundred thousand heart rate data points at once in the google map was difficult. To address this scalability issues, we aggregated data to create clusters instead of plotting individual data points, though they may not reflect the accurate stress data at a given time.

Conclusion

- We investigated how to visualize physiological and contextual data to better understand the everyday experiences of neurodiverse college students.
- Findings from our research yields valuable insights into design considerations for the visualization of everyday living experience.
- Effective visualizations will help neurodiverse users better understand factors contributing to stress and lead to better stress-management techniques.
- Visualizations can aid design of interventions and guide policy-making.

References

[1] Buescher, AV., Cidav, Z., Knapp, M., and Mandell, DS. 2014. Costs of autism spectrum disorders in the United Kingdom and the United States. JAMA Pediatrics 168, 8: 721–728.

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[3] Newman, L., Wagner, M. et al. 2011. The post-high school outcomes of young adults with disabilities up to 8 years after high school. A report from the National Longitudinal Transition Study- 2 (MLTS2).

[4] Sharmin, M., Raij, A., Epstien, D., et al. Visualization of time-series sensor data to inform the design of just-in-time adaptive stress interventions. In Proc. UbiComp 2015, pp. 505-516.