

---

# RtD for Self-Inquiry: Sleep Ecologies



Montage of images from all five projects. Clockwise from top left: Making Time, Lego to Sleep, FocusWatch, Sleep Armor, Forest of Sleep.

**Tammar Zea-Wolfson**  
**Dan Lockton**  
**Jackie Chou**  
**Yuhan (Antonio) Song**  
**Erin Ryan**  
**CJ Walsh**

Imaginations Lab /  
Design for Environments  
Carnegie Mellon University  
Pittsburgh, PA, USA

[tammar@imaginari.es](mailto:tammar@imaginari.es)  
[dan@imaginari.es](mailto:dan@imaginari.es)  
Corresponding authors

## Abstract

Perhaps one of the most highly ‘situated’ forms for Research through Design is where the context is personal—autoethnographic inquiry. In this short pictorial we discuss five tools which enable forms of self-inquiry around sleep and wellbeing, created by undergraduate designers to investigate bedtime routines, personal scheduling of time, focus, sleep data, and sleeping in non-traditional places.

## Introduction

These projects are covered in detail in a *DIS 2020* full paper [12], from which this pictorial is adapted. Here we illustrate the projects and concentrate particularly on the ways in which they relate to issues around Research through Design (RtD) in situ, and the context of student sleep.

First-person research in interaction design and HCI [4, 13] is increasingly of interest to researchers. A range of projects address autoethnography techniques, and include artefacts themselves which may take a RtD approach. There are parallels with self-tracking and the idea of personal/reflective informatics, but also, practically, projects such as *Dear Data* [15], and practices such as bullet journaling [1], have brought attention to the use of designed artefacts or ‘systems’ (we might even call some of them probes) as a way for people to notice and make sense of patterns in their own lives, particularly around wellbeing. The potential of ‘self-probes’ (better name needed!), as tools designed primarily for self-inquiry by someone (who might also be the designer, or might not), is interesting; the artefacts created could build on the wide variety of innovative probes that exist [18], from the playful and intentionally open-ended [e.g. 7], to the speculative [e.g. 5], to more quantitatively data-driven [e.g. 9], but be tailored directly to the context and needs of the person doing the inquiry.

---

Submitted to DIS 2020 workshop:

Tom Jenkins, Will Odom, Kristina Andersen, Andy Boucher, David Chatting, Bill Gaver (2020). RtD in Situ: Discussing the Domains and Impact of Design Research. *DIS 2020*, online, July 2020.

## A personal context: students' sleep

Via a prompt developed in collaboration with Philips, the healthcare technology company, five junior (3rd year) design students explored the context of student sleep, and wider issues of wellbeing and mental health in relation to sleep [16], over eight weeks. The context was not simply the act of 'being asleep', but more ecological: a recognition that the wider environments (physical and digital) and other contextual aspects of people's lives, beyond sleep itself, are connected, systemic, and important elements to investigate rather than solely considering sleep in isolation. While chosen partially for convenience and to enable self-inquiry by the students, studying sleep ecologies in the context of student life is not without wider applicability; over 60% of US students have been categorized as poor-quality sleepers [14], and there have been a variety of HCI projects addressing student sleep tracking [e.g. 17]. While we did not seek to produce exhaustive 'systems' mappings of factors influencing sleep, the students were initially asked to pay close attention to their own sleep routines for five days, and then list and map factors which they felt were relevant to their sleep experiences in order to identify opportunities or avenues they wanted to explore further. Many factors interrelate with work and stress and the scheduling of classes, but some have more universal applicability. Phones—often the first thing looked at on waking, and the last thing looked at before sleeping (as also noted by Rodgers et al [17]), with “so many responsibilities tied” to it, socially and in relation to work, were present a lot in the mappings.

In this in-situ context for RtD, we intentionally did not start our brief with a literature or precedent review: we wanted students to explore their ideas through grounded self-inquiry. Each student chose to focus on particular elements of sleep ecologies important to them in their own lives, or which they saw as interesting to study among their peers. The five projects progressed through stages of development, with feedback from a Philips design team, to arrive at outcomes which each addressed different contexts in the student sleep and wellbeing ecology:

- Visualizing and re-framing the time/scheduling aspects of wider lifestyle habits and routines: **Making Time**, Tammar Zea-Wolfson
- Tracking and visualizing focus and distraction, particularly tackling 'all-nighters': **FocusWatch**, Antonio Song
- Pairing a Philips sleep monitoring app with encouraging / tracking 'bedtime routines' physically: Lego to Sleep, **Jackie Chou**
- Visualizing sleep data from a fitness tracker in a more qualitative and experiential way, using VR: Forest of Sleep, **Erin Ryan**
- Investigating & enabling sleeping in non-traditional physical environments: **Sleep Armor**, CJ Walsh

Each project uses different technologies, but all adopt an RtD stance in their approach to using design as a form of inquiry into the context.

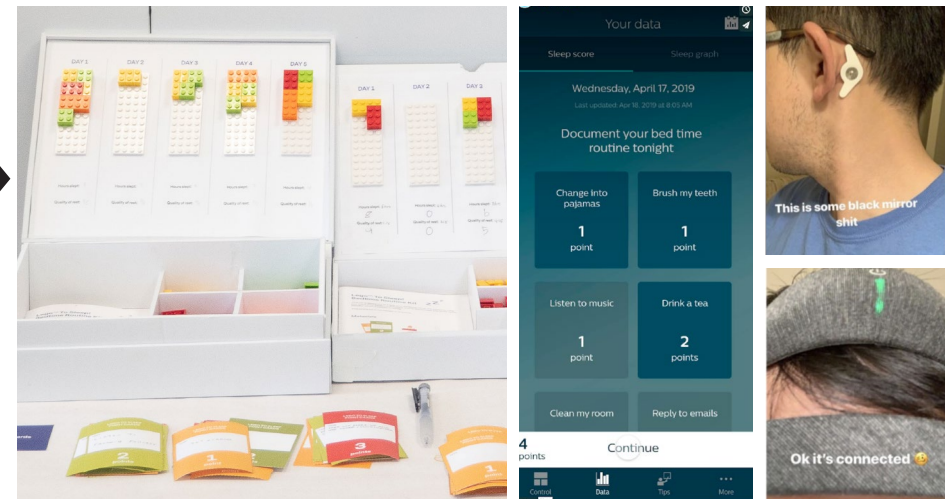


In **Making Time**, Tammar focused on how maintaining her own sustainable sleep practices required scheduling, yet products such as alarms and calendars do little to address longer term needs or patterns. Exploring open-ended circular interfaces which might help people imagine longer cycles of time, Tammar created probes comprising an easel with two disks, one stationary and another motorized (with variable rate of rotation). Two participants lived with and annotated the devices using dry-erase markers and a journal over a 3-day study, with the prompt: “This is a tool to help you think about how you plan your time. You can use it anywhere and anyway that is helpful to you.” Building on insights from these trials, the final artifact maintains enough ambiguity to allow a user to assign their own meaning—the disk rotates once per day, triggering a music box-like analogue audio reminder; unlike an alarm clock or phone alarm, the artifact doesn't communicate where you are in time or presume urgency. The sound is soft and singular, simply acting as a physicalized intention of a daily practice the user wants to attend to, from going to bed or turning off screens at certain times, to calling a loved one.



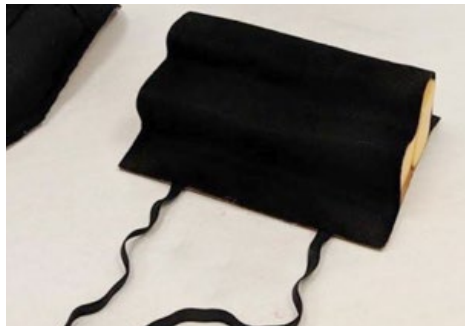
With **Focuswatch**, Antonio was interested in college cultures of sleep, specifically “all-nighters,” which, in his experience have “become an inevitable part of the campus culture.” Antonio tested his and his peers’ commonly held understanding, by tracking his own ‘focus rate’, during a 9-hour period between midnight and 9 AM. By reviewing his browser history he found that he was only around 26% productive when ‘working’ overnight but much more effective after having had a full night’s sleep and starting working at 6AM instead. The Focuswatch app for the Apple Watch, which Antonio developed, works in conjunction with a Google Chrome extension monitoring browser tabs, and displays either a smooth clay ball that becomes dented, or a clear sheet of crystal that becomes progressively more shattered when browsing patterns steer predominantly towards “non-productive” sites, giving real-time feedback on focus rates in a non-obtrusive, metaphorical [11] interface.

Jackie’s **Lego to Sleep** Bedtime Routine Kit explored the role of pre-bed routines in healthy student sleep. Observing his own routines immediately before bed, and talking to others, he noticed how taking care to follow a skincare regime, connect with loved ones, send emails, or read a book had different effects on the perceived quality of his own sleep. He developed a game-like physicalization of the routines, with different numbers of points for different activities represented through colored Lego bricks building up to produce a physical pattern each day, to support more intention and awareness of routines. The kit could then be linked to the existing Philips sleep app, which uses quantitative data from a brainwave-measuring headband, to give people a hybrid and more holistic experience of their sleep routines.



Erin’s **Forest of Sleep** offers a different approach to how self-tracking and personal informatics data captured by devices such as Fitbit might support better sleep habits if quantitative data were represented in a more qualitative format [10]. In observing her own sleep patterns, she noticed it was often difficult to remember how long or well she had slept even a few nights before. In interviews with peers she found many students likewise couldn’t recall previous nights of sleep. Erin found the current data visualizations from tracking devices provided primarily short-term quantitative feedback and wondered if there might be space to display this same data in more qualitative ways that maintained engagement over time. Exploring how different metaphors might be used to map the data of many nights of sleep into a digital environment, she arrived at the idea of wandering through a VR ‘data landscape’, with one tree representing each night of sleep, in which a person might ‘visit’ previous weeks and months of sleep noticing differences and patterns perhaps prioritizing healthful sleep more. She built a ‘design language’ of how each night’s data could be expressed through changes in the tree’ appearance (leaves, shape of the tree) through a participatory drawing exercise with fellow students [3]. The result is a unique personal experience, generated from someone’s own sleep data.





## Reflections on the projects as RtD in situ

These projects each use insights from the autoethnographic phase of work, translating them into a ‘product’ or artifact at differing levels of resolution, but the artifacts embody and preserve directly the focus on supporting self-inquiry. These projects’ scope, the methods used, and the kinds of ‘studies’ run with participants were constrained by their primary role as part of a taught, assessed class rather than being conventional research projects—however, they can be seen to form proofs of concept for further investigation. There are insights useful for work around sleep and the factors relating to it, but also more broadly around the potential for combined ‘suite’ kits of autoethnographic tools for self-inquiry in situ around topics as being an appropriate way of generating insights for designers as well as for participants themselves.

For example, a person (or a household) experiencing sleep issues, or just interested in exploring patterns in their sleep and wellbeing, could use existing self-tracking devices for sleep in conjunction with new ways to visualize the data (e.g. *Forest of Sleep*), and a *FocusWatch*-type visualization to explore online behavior, and then patterns could be identified—do you sleep differently after working late into the night? *Making Time* could be used to observe and notice rhythms in one’s life, and plan and schedule rest or sleep as something important, to look forward to and pay attention to, perhaps in conjunction with particular routines established and supported by *Lego to Sleep* and its connection to sleep-tracking devices and apps. Other kinds of probes such as ways of recording particular moments or subjective experiences, could be incorporated to build a bigger, connected system for self-inquiry. This richer picture of people’s lives would be of greater value to designers as well as to the self-inquirers themselves. We draw parallels here with project by Philips themselves, van Kollenburg et al’s ‘family toolkit’ project [9] around baby data, in particular the use of physical data-loggers whose meaning is user-configurable, in a similar way to the disks in the *Making Time* probe.

From an RtD point of view, we are interested in exploring the idea of people (whether ‘designers’ or not) designing and building artifacts to do (self-inquiry) research themselves—taking the ideas of *Dear Data* and bullet journaling into something more explicitly ‘thinglike’—perhaps converging with the idea of ‘Careful Devices’ [8] for health based around personal experience, and perhaps learning from projects such as *MyNaturewatch* [6] which empower people to build devices for exploring and learning more about the world around them, but directed more towards the contexts and ecologies of people’s own lives.

We intend to explore these directions in future work building on the projects here, particularly around student wellbeing—including a ‘Research through Design’ studio class based on creating self-inquiry tools, and then swapping or sharing them.

CJ’s project **Sleep Armor** investigated the culture among his peers—and himself—of sleeping in non-traditional places while on campus. He was curious how he as a designer might support students getting more sleep as well as addressing the stigma associated with public sleeping. After asking peers to use a TaskCam [2] to record places they sleep, and re-stage configurations of furniture in their environments and how they would position themselves for sleep (e.g. using desks as sleep surfaces or chairs to prop up feet), CJ used foam block and other materials to create a series of objects to modify surfaces to be better suited to sleep, such as an adjustable cushion that could be strapped to the arm or used as a pillow. During a studio exhibition, participants used an assortment of materials to craft possible sleep solutions and annotate a sewing bust with points of discomfort and tension.

## References

- [1] Amid Ayobi, Tobias Sonne, Paul Marshall, and Anna L. Cox. 2018. Flexible and Mindful Self-Tracking: Design Implications from Paper Bullet Journals. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18). ACM, New York, NY, USA, Paper 28, 14 pages. DOI: <https://doi.org/10.1145/3173574.3173602>
- [2] Andy Boucher, Dean Brown, Liliana Ovalle, Andy Sheen, Mike Vanis, William Odom, Doenja Oogjes, and William Gaver. 2018. TaskCam: Designing and Testing an Open Tool for Cultural Probes Studies. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18). Association for Computing Machinery, New York, NY, USA, Paper 71, 1–12. DOI: <https://doi.org/10.1145/3173574.3173645>
- [3] Flora Bowden, Dan Lockton, Rama Gheerawo and Clare Brass, 2015. Drawing Energy: Exploring perceptions of the invisible. Royal College of Art, London. [http://www.drawingenergy.com/wp-content/uploads/2015/06/Bowden-et-al-2015-WEB\\_Drawing-Energy-low-res.pdf](http://www.drawingenergy.com/wp-content/uploads/2015/06/Bowden-et-al-2015-WEB_Drawing-Energy-low-res.pdf)
- [4] Audrey Desjardins and Aubree Ball. 2018. Revealing Tensions in Autobiographical Design in HCI. In Proceedings of the 2018 Designing Interactive Systems Conference (DIS '18). Association for Computing Machinery, New York, NY, USA, 753–764. DOI: <https://doi.org/10.1145/3196709.3196781>
- [5] Audrey Desjardins, Cayla Key, Heidi R. Biggs, and Kelsey Aschenbeck. 2019. Bespoke Booklets: A Method for Situated Co-Speculation. In Proceedings of the 2019 on Designing Interactive Systems Conference (DIS '19). Association for Computing Machinery, New York, NY, USA, 697–709. DOI: <https://doi.org/10.1145/3322276.3322311>
- [6] William Gaver, Andy Boucher, Michail Vanis, Andy Sheen, Dean Brown, Liliana Ovalle, Naho Matsuda, Amina Abbas-Nazari, and Robert Phillips. 2019. My Naturewatch Camera: Disseminating Practice Research with a Cheap and Easy DIY Design. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19). Association for Computing Machinery, New York, NY, USA, Paper 302, 1–13. DOI: <https://doi.org/10.1145/3290605.3300532>
- [7] William Gaver, Mike Michael, Tobie Kerridge, Alex Wilkie, Andy Boucher, Liliana Ovalle, and Matthew Plummer-Fernandez. 2015. Energy Babble: Mixing Environmentally-Oriented Internet Content to Engage Community Groups. In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15). Association for Computing Machinery, New York, NY, USA, 1115–1124. DOI: <https://doi.org/10.1145/2702123.2702546>
- [8] Tom Jenkins, Anna Vallgård, Laurens Boer, Sarah Homewood, and Teresa Almeida. 2019. Careful Devices. In Proceedings of the Halfway to the Future Symposium 2019 (HTTF 2019). Association for Computing Machinery, New York, NY, USA, Article 30, 1–5. DOI: <https://doi.org/10.1145/3363384.3363474>
- [9] Janne van Kollenburg, Sander Bogers, Heleen Rutjes, Eva Deckers, Joep Frens, and Caroline Hummels. 2018. Exploring the Value of Parent Tracked Baby Data in Interactions with Healthcare Professionals: A Data-Enabled Design Exploration. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18). Association for Computing Machinery, New York, NY, USA, Paper 297, 1–12. DOI: <https://doi.org/10.1145/3173574.3173871>
- [10] Dan Lockton, Delanie Ricketts, Shruti Aditya Chowdhury, and Chang Hee Lee. 2017. Exploring Qualitative Displays and Interfaces. In Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '17). Association for Computing Machinery, New York, NY, USA, 1844–1852. DOI: <https://doi.org/10.1145/3027063.3053165>
- [11] Dan Lockton, Devika Singh, Saloni Sabnis, Michelle Chou, Sarah Foley, and Alejandro Pantoja. 2019. New Metaphors: A Workshop Method for Generating Ideas and Reframing Problems in Design and Beyond. In Proceedings of the 2019 ACM Conference on Creativity and Cognition (C&C '19). Association for Computing Machinery, New York, NY, USA, 319–332. DOI: <https://doi.org/10.1145/3325480.3326570>
- [12] Dan Lockton, Tammar Zea-Wolfson, Jackie Chou, Antonio Song, Erin Ryan, C.J. Walsh. 2020. Sleep Ecologies: Tools for Snoozy Autoethnography. In Proceedings of DIS 2020: ACM Conference on Designing Interactive Systems, July 2020, online. DOI: <https://doi.org/10.1145/3357236.3395482> (not enabled at time of writing; alternative link [https://www.researchgate.net/profile/Dan\\_Lockton/publication/341448406\\_Sleep\\_Ecologies\\_Tools\\_for\\_Snoozy\\_Autoethnography/links/5ec1d08392851c11a8703203/Sleep-Ecologies-Tools-for-Snoozy-Autoethnography.pdf](https://www.researchgate.net/profile/Dan_Lockton/publication/341448406_Sleep_Ecologies_Tools_for_Snoozy_Autoethnography/links/5ec1d08392851c11a8703203/Sleep-Ecologies-Tools-for-Snoozy-Autoethnography.pdf))
- [13] Andrés Lucero, Audrey Desjardins, Carman Neustaedter, Kristina Höök, Marc Hassenzahl, and Marta E. Cecchinato. 2019. A Sample of One: First-Person Research Methods in HCI. In Companion Publication of the 2019 on Designing Interactive Systems Conference 2019 Companion (DIS '19 Companion). Association for Computing Machinery, New York, NY, USA, 385–388. DOI: <https://doi.org/10.1145/3301019.3319996>
- [14] Hannah G. Lund, Brian D. Reider, Annie B. Whiting, J. Roxanne Prichard. 2010. Sleep Patterns and Predictors of Disturbed Sleep in a Large Population of College Students. *Journal of Adolescent Health*, 46(2), 124-132. DOI: <https://doi.org/10.1016/j.jadohealth.2009.06.016>
- [15] Giorgia Lupi and Stefanie Posavec. 2016. *Dear Data*. Princeton Architectural Press.
- [16] Thea Ramsey, Amy Athey, Jason Ellis, Andrew Tubbs, Robert Turner, William D S Killgore, Chloe Warlick, Pamela Alfonso-Miller, Michael A Grandner, 0901 Dose-Response Relationship Between Insufficient Sleep and Mental Health Symptoms in Collegiate Student Athletes and Non-Athletes, *Sleep*, Volume 42, Issue Supplement\_1, April 2019, Page A362, DOI: <https://doi.org/10.1093/sleep/zsz067.899>
- [17] Shannon Rodgers, Brittany Maloney, Bernd Ploderer, and Margot Brereton. 2016. Managing stress, sleep and technologies: an exploratory study of Australian university students. In Proceedings of the 28th Australian Conference on Computer-Human Interaction (OzCHI '16). Association for Computing Machinery, New York, NY, USA, 526–530. DOI: <https://doi.org/10.1145/3010915.3010961>
- [18] Jayne Wallace, John McCarthy, Peter C. Wright, and Patrick Olivier. 2013. Making design probes work. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13). Association for Computing Machinery, New York, NY, USA, 3441–3450. DOI: <https://doi.org/10.1145/2470654.2466473>