# Flippo the Robo-Shoe-Fly: a Foot Dwelling Social Wearable Companion

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*CHI'20*,, April 25–30, 2020, Honolulu, HI, USA
ACM 978-1-4503-6819-3/20/04.
https://doi.org/10.1145/3334480.3382928

## Abstract

Here we present Flippo: a social wearable creature prototype. This design is meant to support people to take breaks away from their desk and move, as well as to socialize with others by caring for their creature. Flippo takes the shape of a soft and fuzzy bug-like creature. It lives on people's shoes and occasionally nudges them when it needs to move and have social interaction with another creature from its species. It does this by making sounds and visual effects, and requires that the wearers coordinate shaking their feet and helping the creatures face each other. If Flippo is satisfied with the interaction it displays a light animation and plays 'happy' tunes, and if not it nudges the wearer again. We ran a field study with 13 participants, preliminary results show potential of the design to encourage and facilitate co-located social interaction.

## Author Keywords

Social Wearables; shoe-accessory; robotic companion; co-located; social interaction; RtD; breaks; foot interaction.

## CCS Concepts

•**Human-centered computing** → **Human computer interaction (HCI);** User studies; Please use the 2012 Classifiers and see this link to embed them in the text: https://dl.acm.org/ccs/ccs_flat.cfm

**Figure 1:** The Flippo design

**Figure 2:** In this image, two participants are wearing Flippo and demonstrating how the creatures interact by facing each other.

## Introduction

Nowadays people engage with various screens many hours of their day, and rarely use computer-based technology in co-located social interactions other than passively watching a shared screen together. The motivation for this project was to explore potential changes to current sociospatial practices by creating and testing the use of a social wearable 'creature'. As wearables are worn on our bodies and accompany us when we are co-located with other people, they hold potential for positively supporting our co-located social interactions.

Previous research [10] has begun to identify questions and areas to consider for designers who work in the space of Social Wearables (defined in [26] as wearable technology that augments co-located social interactions). Research that explores social affordances for co-located interactions [21, 26] and research on using movement to create playful interactions [28] is inspiring. In this project we wanted to design a wearable that utilizes the benefits of movement and co-located social experiences in a playful manner. Our research extends previous work by looking at an everyday situation–working indoors in front of a computer–and enhancing it with playful social wearable creatures that encourages those who wear them to take short breaks with co-located others, and move their bodies. We were motivated by research establishing the benefits of taking breaks from work [36], and in particular of movement [38] and social breaks [40] for knowledge workers [14].

In this work we continue to unpack and study the design space of Social Wearables following a Research through Design (RtD) approach [43, 44, 17]. We designed, created, and tested the social wearable creature to assess its impact on wearers' co-located social experience. We were particularly interested in whether such a social wearable creature would facilitate the emergence of social interaction between wearers, whether it would support people to take social breaks, and we also wanted to explore how they would feel about the driver being the creature–that it is something they need to care for (as in [37]) and something that engenders interdependence (as in [20] and [9]).

The wearable is designed as a little animated creature that needs to move and have social interaction with other creatures of its species in order to thrive. It signals to its wearer when it needs this interaction, but it will also respond to interaction with other creatures if this is initiated by the wearers. We adopted the name one participant gave it: Flippo (when they wore it while riding their bike its wings were flapping). Flippo is a social wearable companion that lets its wearer (or say 'carer') know when it needs to move and interact with other creatures of its kind. It provides sound and visual feedback to communicate its needs, to 'nudge' its wearer to take care of it. It then displays visual feedback and sound effects when it experiences the interaction and movement it needs by playing a short tune and light animation to signal being content. It 'wakes' up for these experience every now and then.

Here we present the Flippo design concept (Fig. 1 and 2) and preliminary results from its field study deployment: 13 participants wore Flippo for consecutive 5 - 7 hours. They were instructed to work on their own computer/desk-work, while still paying some attention to the creature's needs and take care of it. Initial results show that these devices have the potential to encourage and facilitate interaction between co-located people.

## Related Work

Commercial development of wearables for shoes has mostly focused on biometrics measures for health, performance

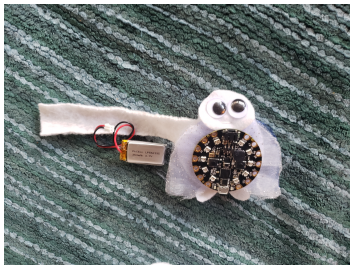

**Figure 3:** CPX, lithium battery and the Flippo cover.

**Figure 4:** We made 7 working Flippo prototypes.

**Figure 5:** In this image, seven participants are wearing Flippo at the same time.

and training (e.g., [13, 32]), tracking GPS signals for safety measures (e.g. [12]), or comfort (e.g. Nike's self-lacing shoes [5]). There are a few commercial wearable shoe-accessories designed as game controllers to support screen based interaction (e.g. [2]) or virtual-reality (e.g. [3]). There is research on foot-based interaction [39] with various kinds of screens (e.g., [15, 33, 25]), in virtual and mixed environments (e.g., [42, 29]), and using tangibles (e.g. balls in [34]). Wearable fitness trackers that attempt to encourage and support people's physical activity are abundant (e.g.[4, 1]), and there are also research projects using wearables to track and encourage movement (e.g., [18, 30, 19, 27]). Pediluma [24] is a shoe-accessory wearable that aims to encourage physical activity by tracking and visualizing the wearer's movement.

There are many apps that aim to encourage and support people to take breaks away from their screens [16]. The research design concept the Break-Time Barometer [22] takes into account the social benefit of taking breaks with other people in the workplace, and the UpTime research project focused on supporting "workers' transition from breaks back to work" [14]. Regarding wearables that aim to facilitate co-located social interactions, [8] used wearables to support icebreaking activity to augment conversation.

There are a few smart pet/robotic companion commercial products and design research projects. 'Ref' is a design concept of a wearable wrist worn creature [23] that responds to the wearer's pulse measures by changing its shape, with the purpose of making its wearer more aware of their emotional state. 'Hooze' is a fashion accessory design artifact with playful and zoomorphic qualities, which entices people to touch it [41]. The prototype design used in the research project [37], is an interactive hand-crafted plush toy which has a backstory of being a 'worried pet'. It was used as a technology probe for children and their parents. Paro is a commercial product designed as a cute, furry robotic seal companion for elderly people. It was "found to reduce patient stress", and to support and improve the "socialization of patients with each other and with caregivers" [6]. Finally, Tamagotchi [7], is a well known commercial product designed as a display of a virtual pet enclosed in a small plastic device. It is worn on a keychain and the virtual pet needs to be taken care of, by having daily interaction with its user. The Tamagotchi Connection [35] was introduced in 2004 and in this version, the virtual pets need to interact with other virtual pets, by employing Infrared (IR) sensing. Below we describe the concept prototype of our design in more detail.

## Concept Prototype

Flippo the Robo-Shoe-Fly social wearable companion is designed to look and feel like a cute bug-like creature. It was inspired by fuzzy moths, and was intended to be non-gendered. Intrigued by the timer interaction modality in [9], which uses a timer to trigger signals of change in the wearable's state, we decided to design Flippo to need social interaction and movement *occasionally*. We were inspired to develop a fictional backstory from [11] who presented flower-like social wearable creatures, which thrived based on balancing of the wearers' speaking participation levels in a group discussion. In our case, we expected Flippo to be used in an office/desk job-like setting, where people usually spend their time sitting in front of a computer. We speculated that having an external reason to move around and socialize might benefit the users and serve as a short 'brain break'. Therefore, Flippo 'nudges' its wearer by playing sounds and light effects when it needs interaction. Then, their wearer, should care for it by finding another creature of its species and let the two creatures engage through shaking their foot close by another wearer.

## Positioning

The design prototype presented in this paper, is positioned at the intersection of: (i) technology to facilitate co-located social interaction, (ii) technology to support people to take breaks, (iii) shoe-accessory wearable technology, (iv) movement/foot interaction, and (v) smart pet/robotic companion.

This interaction uses the strong concept of *Interdependent Wearables*: "wearables designed to require shared attention and mutual awareness, with interdependent functionality that encourages and rewards collocated interaction" [20]. We chose to use the Adafruit's Circuit Playground Express (CPX) for its prototyping flexibility, its 10 built-in LEDs ring for visual feedback, its speaker, accelerator, internal clock, and IR sensing. We created a soft cover with the creature's design to fit the CPX and the lithium battery, which we could also attach to wearers' shoelaces (Fig. 3). We programmed the CPX to utilize its internal clock as a timer. It turns on the first 'nudge' (by playing sound effects and a visual light animation) after 60 min, and then again between 30 to 100 min intervals, depending on its previous interactions (adjusted from [31]). This first nudge was meant to let the wearer (and co-located others) know the creature needed interaction. Within 10 min of this nudge, if the device does not register the required interaction (by receiving IR signal) it nudges again (changing the color of the flashing light display from green to red). However, if the wearer has found another wearer and their device has sensed the IR signal then the creatures will flash scattered rainbow animation lights and a 'happy tune' as feedback to their wearers that they are content with the interaction. Two wearers of the creatures need to coordinating shaking their right feet, and face the creatures toward each other in order to send the IR signal. Wearers could also find each other and let their creatures interact by shaking their feet even if the creatures did not nudge them to do so. This would also satisfy the creatures' need to interact and would reset their timers to delay their next nudges.

Finally, we programmed the device to display how many times the creature had interactions in which it was content, by displaying the number (1-5) of green LEDs on the right side of the CPX ring. We also had it display how many times it nudged the wearer to interact but did not register a satisfying interaction by displaying the number (1-5) of red LEDs on the left side of the ring (Fig. 6).

## Method

We followed a RtD [43, 44, 17] approach to explore how wearable technology could encourage co-located social interaction, movement and taking breaks. We made 7 functioning wearable prototypes (Fig. 4) and iterated the initial prototypes several times, exploring different interaction modalities, timings and feedback. Variations of the prototype were tested during in-lab group discussions by lab members and invited guests. Here we report on a preliminary results from our field study of the potential value of a social wearable creature-like device: Flippo. We collected feedback from 13 external users on our current prototype. We were interested in people's opinion about their co-located social experience, the wearable creature and its story, and about the interaction and feedback modalities chosen. The study required that we would have at least 2 people participating during the same time and in the same space, and for at least a few consecutive hours, so that using the wearable would be experienced as an actual break from their computer/desk work.

We recruited 13 participants (4 graduate and 9 undergraduate students, 7 cis female- and 6 cis male-seeming). We divided them into 3 groups (2x, 4x, and 7x participants) based on their overlapping schedule availability to afford at least 5 consecutive hrs with other participants. On the day of their participation, we met in our lab space, provided participants, and collected, consent forms, explained verbally and demoed the use of the wearable. We attached each wearable to the right outer side of their shoe by threading through their shoelaces (Fig. 5), let them move a little bit with it on and answered their questions regrading its

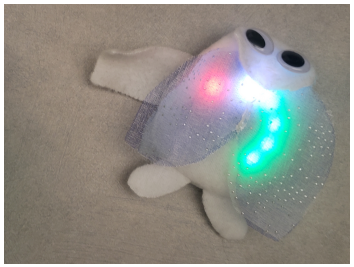

**Figure 6:** In this image, the green LED lights on the right represent four interactions that were registered as making the creature content. The red LED light on the left, represents one time in which the device was nudging the wearer but did not register the required interaction within the designated time frame.

use. We then let them go about their work, either in our lab space, or in nearby lab spaces. We told participants that the wearable will let them know by making a short sound and light effects when it needs to interact with other creatures of its kind and move. We explained that it will happen every now and then, and when it does, it would like them to find another person who wears a creature and coordinate with them shaking their feet (we demoed how they should shake them, noting that the creatures need to face each other). We told them it will light up and make sounds to let them know it is satisfied. We also told them they could let the creatures interact even if they did not signal they needed the interaction yet.

At the end of their group session, we conducted semi-structured interview with each participant lasting 10-20 minutes. We also asked them to fill out an online questionnaire confidentially which had 9 open questions such as: *“What did you like about the device?", "What did you like least about using the device?", "Did the device affect the social interactions or communications you had while you were wearing it?"*, and *"Were there any particularly interesting moments you remember?"*. In the following sections we report on the preliminary findings from the analysis of the 13 participants’ answers to the questionnaire.

## Wearing The Social Robo-Shoe-Fly

Participants described the creature as a bug or a fly-like cute little robot creature. Flippo’s appearance was liked and considered to be cute due to its googly eyes, sparkly wings, and its soft and fuzzy texture (N=7). Participants thought it looked ‘goofy’, ‘playful’, ‘friendly’, ‘sweet’, and ‘whimsical’. Some **compared it to a pet** (N=4), and enjoyed having it with them as a companion/buddy (N=4). P12 enjoyed having the responsibility to take care of it, they wrote *“having that sort of dependency, where the device was dependent on me, made me oddly happy”*. A few participants anthropomorphized Flippo and projected feeling states onto it (N=2). When reflecting about their experience of wearing the creature, some felt they paid special attention to it (N=5). P12 thought the placement of the wearable on the shoe made it easy to dismiss the creature’s nudges when they were occupied. P11 took a preventative approached and changed the manner they sat in order to be able to see their feet (and the creature) *"at all times"*. A few participants commented that they liked the feedback modalities (N=3). P1 liked that it did not feel intrusive, and P12 thought it was *“easy to learn and straightforward to use”*. Suggestions for improvements included adding vibration to the nudges to better attract the wearer’s attention, tuning the audio feedback, and adding more complexity in the type of movements required and the intensity of the nudges. P3 felt that the creatures *“could be a little more annoying"*, and P4 wished the sensing interaction between the creatures would happen simultaneously. Some participants commented that they became more **aware of their environment** and more **self conscious**. P9 noticed their surroundings more, and *"got many weird looks throughout the day"*, and that *“the most interesting part"* for them was the attention they *"received for wearing the creature"*. P3 expected to be noticed and found it funny that no one commented on their wearable, and P7 was curious if they were noticed by other people, they wrote *“I was also wondering if people had noticed the device, even if they didn’t specifically ask about it"*.

## Interactive Experience

The majority of participants **enjoyed aspects of the experience** (N=8), for example, P8 wrote it was *“a fun little game to keep them fed and happy”*. Some participants particularly liked being encouraged to take breaks, and doing so with others. Some liked **being nudged to move** (N=3), and some liked that it gave them an external reason to socialize

## Acknowledgments

We thank the people who run the Science Internship Program (SIP) at UC Santa Cruz, and Eleanor Bangs, who participated in it and helped us brainstorm ideas for the design prototype. We also extend our thanks to Peter Cottrell for his valuable advice. We thank Leila Takayama for her support with recruiting participants for this study, and most importantly the participants, who shared with us their thoughts and feedback. Finally, we thank the reviewers for their thoughtful reviews.

(N=4), and even brought them in contact with new people. P11 felt they were *"more playful and less serious about stuff overall, which was nice"*. P12 wrote that wearing the creature *"created this newfound sense of responsibility, with relatively low-stakes such that it was not anxiety-inducing"* and commented how it improved their day quite a bit. They felt it was satisfying *"being able to intermittently complete that goal in midst of larger and more stressful academic goals"*.

All participants but one (P3, who mostly interacted with people they already knew) discussed how the device **facilitate co-located social interaction**. Some mentioned that wearing the creature encouraged them and gave them **external reasons to socialize**, and some commented how it **increased the number of interactions** they had with other people. P8 wrote they *"interacted with people a lot more than I would on a normal weekday"* and that *"it's a good way to find an excuse to interact with other people on a regular basis"*. P2 wrote *"it made me take breaks and socialize. Without it, I probably wouldn't have spoken to anyone or left my computer"*, and similarly P4 wrote *"I probably would have stayed behind the desk if I didn't have it on my shoe"*. P12 commented that *"it was nice having a mutually defined reason to interact with another person"* which they identified as *"something that is usually absent in everyday life"*. P5 wrote that *"the device encouraged social interaction. If the device wasn't there, there would most definitely have been less social interaction. The fact that the device needed to be shook in front of another device on another person meant that I was forced to interact with the other participant to satisfy the needs of the device"*, and P10 wrote: *"I interacted with more people than I would have otherwise"*. Wearing the creature was used as **a conversation piece** (N=6). It triggered conversations between participants (*"it gave me a reason to talk with strangers (beyond small-talk) who also wore the device"* - P1), and also served as a conversation starter between participants and people outside the study (*"lots of people not in the study asked about the creature. It was a good talking point"* - P8). Some participants mentioned how Flippo **worked as an icebreaker**: P13 commented that by supporting them to be *"goofy and vulnerable"*, it helped *"form relationships with new people"*, and P2 thought *"it made the first interaction with everyone else in the group go a little smoother"*.

Finally, P2 thought that the foot shaking interaction was awkward, they worried to accidentally kick the other person. P6 and P8 were not pleased with the foot shaking especially when the IR sensing of the device was not working smoothly. P1 did not like that it *"tired one leg asymmetrically"*, and P9 was frustrated they had to *"run around a lot"* to find other creatures near them. P10 felt forced to move, and P1 felt forced to stay close by to other creatures. Interestingly, only three participants (N=3) mentioned the concept of 'taking breaks' in their questionnaire responses.

## Conclusion

We have presented the Flippo design concept, a social wearable companion to encourage in-person social interaction, moving, and taking short breaks form work. Preliminary analysis shows promising results–the device worked to encourage and facilitate co-located social interaction–it served as an external reason to interact with others, it increased the number of interactions for some participants, and was used as a conversation piece. Next we will analyse the interview responses and conduct further studies with more participants, in different office environments, and for longer periods of time, to investigate the impact of Flippo past the initial novelty effect. In future iterations of the prototype, we hope to develop the feedback modalities further, experiment with adding haptic feedback, and refine the overall interaction.

## REFERENCES


[1] 2019. Apple Watch: All of the health and fitness features, explained. (2019).

[2] 2019. Bcon. (2019). https://bcon.zone/

[3] 2019. Cybershoes. (2019). https://www.cybershoes.io/

[4] 2019. Fitbit Official Site for Activity Trackers More. (2019). https://www.fitbit.com/home

[5] 2019. NIKE HYPERADAPT. (2019). https://www.nike.com/us/en_us/c/innovation/hyperadapt

[6] 2019. PARO Therapeutic Robot. (2019). http://www.parorobots.com/

[7] 2019. Tamagotchi. (Dec 2019). https://en.wikipedia.org/w/index.php?title=Tamagotchi&oldid=930819711 Page Version ID: 930819711.

[8] Richard Borovoy, Fred Martin, Sunil Vemuri, Mitchel Resnick, Brian Silverman, and Chris Hancock. 1998. Meme Tags and Community Mirrors: Moving from Conferences to Collaboration. In *Proceedings of the 1998 ACM Conference on Computer Supported Cooperative Work (CSCW '98)*. ACM, New York, NY, USA, 159–168. DOI: http://dx.doi.org/10.1145/289444.289490

[9] Ella Dagan, Elena Márquez Segura, Ferran Altarriba Bertran, Miguel Flores, and Katherine Isbister. 2019a. Designing 'True Colors': A Social Wearable That Affords Vulnerability. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19)*. ACM, New York, NY, USA, Article 33, 14 pages. DOI: http://dx.doi.org/10.1145/3290605.3300263

[10] Ella Dagan, Elena Márquez Segura, Ferran Altarriba Bertran, Miguel Flores, Robb Mitchell, and Katherine Isbister. 2019b. Design Framework for Social Wearables. In *Proceedings of the 2019 on Designing Interactive Systems Conference (DIS '19)*. ACM, New York, NY, USA, 1001–1015. DOI: http://dx.doi.org/10.1145/3322276.3322291

[11] Ella Dagan, Elena Márquez Segura, Miguel Flores, and Katherine Isbister. 2018. "Not Too Much, Not Too Little" Wearables For Group Discussions. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems (CHI EA '18)*. Association for Computing Machinery, New York, NY, USA, Article Paper LBW129, 6 pages. DOI: http://dx.doi.org/10.1145/3170427.3188500

[12] Sam Draper. 2018a. GTX Corp Debuts SmartSole and Invisabelt GPS Trackers for Children. (Jul 2018). https://tinyurl.com/rdbrjcy

[13] Sam Draper. 2018b. Puma is Bringing Back its 80s Smart Shoe with Updated Technology. (Dec 2018). https://tinyurl.com/tl2zmhy

[14] Daniel A. Epstein, Daniel Avrahami, and Jacob T. Biehl. 2016. Taking 5: Work-Breaks, Productivity, and Opportunities for Personal Informatics for Knowledge Workers. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16)*. ACM, New York, NY, USA, 673–684. DOI: http://dx.doi.org/10.1145/2858036.2858066

[15] Yasmin Felberbaum and Joel Lanir. 2018. Better Understanding of Foot Gestures: An Elicitation Study. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. ACM, New York, NY, USA, Article 334, 12 pages. DOI: http://dx.doi.org/10.1145/3173574.3173908

[16] Hayden Field. 2018. Add Years to Your Life with These 4 “Work Break” Apps. (Jul 2018). https://www.entrepreneur.com/article/313416

[17] William Gaver. 2012. What Should We Expect from Research Through Design?. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI ’12)*. ACM, New York, NY, USA, 937–946. DOI: http://dx.doi.org/10.1145/2207676.2208538

[18] Emmi Harjuniemi, Ashley Colley, Piia Rytilahti, Hong Li, Jesse Forest, and Jonna Häkkilä. 2018. Idle Stripes Shirt: Ambient Wearable Display for Activity Tracking. In *Proceedings of the 2018 ACM International Symposium on Wearable Computers (ISWC ’18)*. Association for Computing Machinery, New York, NY, USA, 254–259. DOI: http://dx.doi.org/10.1145/3267242.3267303

[19] Katherine Isbister. 2012. How to Stop Being a Buzzkill: Designing Yamove!, a Mobile Tech Mash-up to Truly Augment Social Play. In *Proceedings of the 14th International Conference on Human-computer Interaction with Mobile Devices and Services Companion (MobileHCI ’12)*. ACM, New York, NY, USA, 1–4. DOI: http://dx.doi.org/10.1145/2371664.2371666

[20] Katherine Isbister, Kaho Abe, and Michael Karlesky. 2017. Interdependent Wearables (for Play): A Strong Concept for Design. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI ’17)*. ACM, New York, NY, USA, 465–471. DOI: http://dx.doi.org/10.1145/3025453.3025939

[21] Katherine Isbister, Elena Márquez Segura, and Edward F. Melcer. 2018. Social Affordances at Play: Game Design Toward Socio-Technical Innovation. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI ’18)*. ACM, New York, NY, USA, Article 372, 10 pages. DOI: http://dx.doi.org/10.1145/3173574.3173946

[22] Reuben Kirkham, Sebastian Mellor, David Green, Jiun-Shian Lin, Karim Ladha, Cassim Ladha, Daniel Jackson, Patrick Olivier, Peter Wright, and Thomas Ploetz. 2013. The Break-time Barometer: An Exploratory System Forworkplace Break-time Social Awareness. In *Proceedings of the 2013 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp ’13)*. ACM, New York, NY, USA, 73–82. DOI: http://dx.doi.org/10.1145/2493432.2493468

[23] Suzanne LaBarre and Suzanne LaBarre. 2010. Almost Genius: Robotic Arm Cuff Works Like a Wearable Therapist. (Dec 2010). https://tinyurl.com/rg54yur

[24] Brian Y. Lim, Aubrey Shick, Chris Harrison, and Scott E. Hudson. 2011. Pediluma: Motivating Physical Activity Through Contextual Information and Social Influence. In *Proceedings of the Fifth International Conference on Tangible, Embedded, and Embodied Interaction (TEI ’11)*. ACM, New York, NY, USA, 173–180. DOI: http://dx.doi.org/10.1145/1935701.1935736

[25] Zhihan Lv, Shengzhong Feng, Muhammad Sikandar Lal Khan, Shafiq Ur Réhman, and Haibo Li. 2014. Foot Motion Sensing: Augmented Game Interface Based on Foot Interaction for Smartphone. In *CHI ’14 Extended Abstracts on Human Factors in Computing Systems (CHI EA ’14)*. ACM, New York, NY, USA, 293–296. DOI: http://dx.doi.org/10.1145/2559206.2580096

[26] Elena Márquez Segura, James Fey, Ella Dagan, Samvid Niravbhai Jhaveri, Jared Pettitt, Miguel Flores, and Katherine Isbister. 2018. Designing Future Social Wearables with Live Action Role Play (Larp) Designers. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, 462.

[27] Jin Moen. 2007. From Hand-held to Body-worn: Embodied Experiences of the Design and Use of a Wearable Movement-based Interaction Concept. In *Proceedings of the 1st International Conference on Tangible and Embedded Interaction (TEI '07)*. ACM, New York, NY, USA, 251–258. DOI: http://dx.doi.org/10.1145/1226969.1227021

[28] Florian Mueller and Katherine Isbister. 2014. Movement-based Game Guidelines. In *Proceedings of the 32Nd Annual ACM Conference on Human Factors in Computing Systems (CHI '14)*. ACM, New York, NY, USA, 2191–2200. DOI: http://dx.doi.org/10.1145/2556288.2557163

[29] Florian Müller, Joshua McManus, Sebastian Günther, Martin Schmitz, Max Mühlhäuser, and Markus Funk. 2019. Mind the Tap: Assessing Foot-Taps for Interacting with Head-Mounted Displays. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19)*. ACM, New York, NY, USA, Article 477, 13 pages. DOI: http://dx.doi.org/10.1145/3290605.3300707

[30] Edward Nguyen, Tanmay Modak, Elton Dias, Yang Yu, and Liang Huang. 2014. Fitnamo: Using Bodydata to Encourage Exercise Through Google Glass™. In *CHI '14 Extended Abstracts on Human Factors in Computing Systems (CHI EA '14)*. ACM, New York, NY, USA, 239–244. DOI: http://dx.doi.org/10.1145/2559206.2580933

[31] Neil Patel. 2014. When, How, and How Often to Take a Break. (Dec 2014). https://www.inc.com/neil-patel/when-how-and-how-often-to-take-a-break.html

[32] Cathy Russey. 2019. Alphabet's Verily Developing Health-Tracking Smart Shoes that Can Measure Weight and Detect Falls. (Feb 2019). https://tinyurl.com/t2h8qaz

[33] William Saunders and Daniel Vogel. 2016. Tap-Kick-Click: Foot Interaction for a Standing Desk. In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems (DIS '16)*. ACM, New York, NY, USA, 323–333. DOI: http://dx.doi.org/10.1145/2901790.2901815

[34] Dominik Schmidt, Raf Ramakers, Esben W. Pedersen, Johannes Jasper, Sven Köhler, Aileen Pohl, Hannes Rantzsch, Andreas Rau, Patrick Schmidt, Christoph Sterz, Yanina Yurchenko, and Patrick Baudisch. 2014. Kickables: Tangibles for Feet. In *Proceedings of the 32Nd Annual ACM Conference on Human Factors in Computing Systems (CHI '14)*. ACM, New York, NY, USA, 3143–3152. DOI: http://dx.doi.org/10.1145/2556288.2557016

[35] Eric Schweikardt and Mark D Gross. 2007. A brief survey of distributed computational toys. In *2007 First IEEE International Workshop on Digital Game and Intelligent Toy Enhanced Learning (DIGITEL'07)*. IEEE, 57–64.

[36] Meg Selig. 2017. How Do Work Breaks Help Your Brain? 5 Surprising Answers. (2017). https://tinyurl.com/wtq77lk

[37] Petr Slovák, Nikki Theofanopoulou, Alessia Cecchet, Peter Cottrell, Ferran Altarriba Bertran, Ella Dagan, Julian Childs, and Katherine Isbister. 2018. I just let him cry...: Designing Socio-Technical Interventions in Families to Prevent Mental Health Disorders. *Proceedings of the ACM on Human-Computer Interaction* 2, CSCW (2018), 160.

[38] Wendell C. Taylor. 2005. Transforming Work Breaks to Promote Health. *American Journal of Preventive Medicine* 29, 5 (Dec 2005), 461–465. DOI: http://dx.doi.org/10.1016/j.amepre.2005.08.040

[39] Eduardo Velloso, Dominik Schmidt, Jason Alexander, Hans Gellersen, and Andreas Bulling. 2015. The Feet in Human–Computer Interaction: A Survey of Foot-Based Interaction. *ACM Comput. Surv.* 48, 2, Article 21 (Sept. 2015), 35 pages. DOI: http://dx.doi.org/10.1145/2816455

[40] Benjamin N. Waber, Daniel Olguin Olguin, Taemie Kim, and Alex Pentland. 2010. *Productivity Through Coffee Breaks: Changing Social Networks by Changing Break Structure*. Number ID 1586375. https://papers.ssrn.com/abstract=1586375

[41] Patrycja Zdziarska, Felix A. Epp, Walther Jensen, Mark D. Gross, and Ellen Yi-Luen Do. 2019. Hooze: A Kinetic Fashion Accessory for Touch and Play. In *Proceedings of the Thirteenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '19)*. Association for Computing Machinery, New York, NY, USA, 407–413. DOI: http://dx.doi.org/10.1145/3294109.3300980

[42] Ye Zheng, Matthew McCaleb, Courtney Strachan, and Betsy Williams. 2012. Exploring a Virtual Environment by Walking in Place Using the Microsoft Kinect. In *Proceedings of the ACM Symposium on Applied Perception (SAP '12)*. ACM, New York, NY, USA, 131–131. DOI: http://dx.doi.org/10.1145/2338676.2338713

[43] John Zimmerman, Jodi Forlizzi, and Shelley Evenson. 2007. Research Through Design As a Method for Interaction Design Research in HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '07)*. ACM, New York, NY, USA, 493–502. DOI: http://dx.doi.org/10.1145/1240624.1240704

[44] John Zimmerman, Erik Stolterman, and Jodi Forlizzi. 2010. An Analysis and Critique of Research Through Design: Towards a Formalization of a Research Approach. In *Proceedings of the 8th ACM Conference on Designing Interactive Systems (DIS '10)*. ACM, New York, NY, USA, 310–319. DOI: http://dx.doi.org/10.1145/1858171.1858228