

CIV1399: Using technology, sensors and human habits for global good

Instructor: Prof. David Taylor

Schedule: Wednesday 2-4pm, *Synchronous Online*.

Description

Global engineering projects often fail because they do not account for how and why people change their behaviours and habits. Understanding and changing habits can improve health and wellbeing globally and locally (e.g., preventing bullying, increasing handwashing, ending open defecation). Similarly, creating habits can cause technologies to scale rapidly and profitably (e.g. smart phones, fidget spinners).

To understand how and why humans change their habits and/or behaviour, this course draws on theories from health sciences, social sciences, and behavioural economics. Case studies will focus primarily on successful and unsuccessful examples of behavior change projects in the international development sector. **Case study and theory readings will form the foundation for weekly seminar discussions.**

In a hands-on, **independent design project**, students will learn how hard changing habits can be when they try to one of their own habits and build a sensor to measure if their habit changes. This course will leave students with a deepened understanding of how hard it can be to change humans' habits and of the promise and limitations of sensors and technology in global engineering and health.

Learning Outcomes:

- Describe and critique common theories of how to change human behaviour and habits
- Argue where and why sensors can benefit behaviour change programs
- Compare behaviour change theories in health sciences vs. global engineering & design
- Create and deploy an Arduino-based sensor to monitor your own behaviour
- Analyze your behaviour using classic and emerging frameworks for behaviour
- Apply learned theories of behaviour change to attempt to change your own behaviour
- Question the ethics of classic behaviour change techniques and interventions

Format:

A two-hour seminar each week. 10 of 12 seminars will be discussion based; during these all students are expected to actively participate. Each week's discussion will be led by three students (two scheduled leaders and one randomly selected third student). Students will apply the discussed theories in a hands-on design project.

Prerequisites:

Students must be ready to read and reflect weekly. An engineering background is not required, but students are expected to be able to independently learn how to use an Arduino and basic sensors (an applied textbook targeting total beginners is provided, but not taught). Hobbyists provide an abundance of resources Online and I think anyone can learn this, really.

Course Shopping:

I understand that many students try out courses in the first two weeks of the semester. This class starts week 1. Students joining late will be responsible for doing the readings for missed weeks and submitting the assignments anyways.

In any case, students need to order their Arduino starter kits ASAP. If you wait until the second week of term, it may be too late. Order it now! (You'll enjoy it even if you drop the class!)

Grading Scheme:

Weekly, written reflections on assigned readings – 35%

Seminar participation (leading and participating) – 20%

Project: Proposing a target behaviour and sensor demo – 10%

Project: Behaviour change proposal – 15%

Project Final presentation – 10%

Project Final report – 10%

Deliverables:

In addition to graded participation, students will:

1. Submit 250-300 word analysis of the assigned readings **before** each reading-based seminar. These should assume the reader has also read the reading, analyzing and reflecting (rather than summarizing) the readings' content.
2. Propose a target behaviour they wish to focus on and demonstrate a sensor for that behaviour
3. Present a behaviour change proposal and show baseline behaviour data
4. Final project presentations
5. Final project report

MATERIALS to Purchase:

Students will require an Arduino Starter Kit available on robotshop.com/ca and Amazon.

Recommended to get a UNO R3 kit with many sensors \$50-\$100. I recommend against the UCTronics ones. Opt perhaps for this one <https://www.amazon.ca/ELEGOO-Project-Complete-Starter-Tutorial/dp/B01M9CHF1J>

TEXTS to Purchase:

(Wood 2019)

Topics:

Wk.	Topic	Learning outcome	Evaluation method
1	Motivation & Overview	Describe and critique common theories of how to change human behaviour	Written reflections and class participation
2	Classic Health Behaviour Change Theories	Describe and critique common theories of how to change human behaviour	Written reflections and class participation
3	Sensing and behaviour change	Argue where and why sensors can benefit behaviour change programs	Written reflections and class participation
4	Arduino Intro + Examples of simple sensors	Argue where and why sensors can benefit behaviour change programs; <i>Building towards:</i> Create an Arduino-based sensor	Written reflections and class participation
5	Arduino show and tell	Create and deploy an Arduino-based sensor to monitor your own behaviour	Present target behaviour and sensor
6	Habits vs. Behaviours	Describe and critique common theories of how to change human habits	Written reflections and class participation
7	Water, Sanitation, and Hygiene-specific theories	Compare behaviour change theories in health sciences vs. global engineering & design	Written reflections and class participation
8	Tools for Designers	Compare behaviour change theories in health sciences vs. global engineering & design	Written reflections and class participation
9	Behaviour Change Proposal Presentations	Analyze your behaviour using classic and emerging frameworks for behaviour Apply learned theories of behaviour change to attempt to change your own behaviour	In “class” project proposal presentation
10	Critiques of Behaviour Change	Question the ethics of classic behaviour change techniques and interventions	Written reflections and class participation
11	Farmer Behaviour and Technology Adoption	Compare behaviour change theories in health sciences vs. global engineering & design	Written reflections and class participation
12	Final Project Presentations	Apply learned theories of behaviour change to attempt to change your own behaviour	In “class” project proposal presentation Final written report

Course Schedule and Assigned Readings:

Week 1. Motivation & Overview

- i. Recently a gold-standard 3-country provision of Water, Sanitation and Hygiene failed to prevent stunting in children (Pickering et al. 2019)
- ii. Review of RCT evidence about risk reduction and of links to behaviour change theories is provided (the latter being much briefer) (Brown, Mobarak, and Zelenska 2013)
- iii. Nudge Example: handwashing in schools in Bangladesh with painted footpath (Dreibelbis et al. 2016)
- iv. Healthy through habits (Wood and Neal 2016)

Week 2. Classic Health Behaviour Change Theories (BCTs)

- i. Theory: Review of BCTs in practice – motivates focus on a few key theories and introduces the problems with surveys (Davis et al. 2015)
- ii. Example: Your Choice of 1 paper cited by (Davis et al. 2015) which uses one of the 4 BCTs they find to be most common
- iii. Introductory Theory: (Noar 2004) An accessible summary of the 5 most common BCTs, with applications
 1. HBM – health belief model
 2. TRA – theory of reasoned action and planned behaviour
 3. Social cognitive theory
 4. Trans theoretic model
- iv. (Rimer and Glanz 2005) Nat'l Cancer Institute primer on individual, social, and community behaviour change.
- v. Theory: Taxonomy of 93 BCTs (Michie et al. 2013)

Week 3. Sensing and behaviour change – surveys, biases, sensors, etc.

- i. Theory: How does being watched change behaviour (Dear, Dutton, and Fox 2019)
- ii. Theory: BCTs behind activity trackers (Sullivan and Lachman 2017)
- iii. Example: Sensing the Adoption of Solar Lights (Rom, Günther, and Borofsky 2019)
- iv. Examples: Innovations in Measuring WASH Progress (CH 4,5) (Thomas et al. 2018)

Week 4. Arduino Intro + Examples of simple sensors in use

- i. Reference Material: Applied Arduino (Cameron, Cameron, and Pao 2019), a straightforward beginners guide to using Arduinos,
- ii. Example: Social Toothbrush (Caraban et al. 2015)
- iii. Examples: Your choice of 2 cited references in last week's readings that used "simple" sensors
- iv. **Project:** Come prepared to discuss one behaviour/habit in your own life you would like to sense, change, and be willing to discuss with the class

Week 5. **Project:** Arduino show and tell

- i. Build an Arduino-based sensor to measure your selected behaviour
- ii. Make a 5-minute presentation of your sensor and the data it gathered
- iii. Receive feedback on its design and how to improve it.

- iv. Improve your sensor and leave running for the remainder of the class!
- Week 6. Habits vs. Behaviours
- i. Theory: Defining habit in psychology (Mazar and Wood 2018)
 - ii. Theory: Popular level overview –selected chapters (Wood 2019)
 - iii. Theory: Maintenance Strategies for changed behaviour (Kwasnicka et al. 2016)
 - iv. Example: Noting cues helped break snacking habits (Verhoeven et al. 2014)
 - v. Example: Planned, motivated and habitual hygiene behaviour – a meta review of their formative research of hand washing (Curtis, Danquah, and Aunger 2009)
- Week 7. WASH-specific Theories
- i. Theory: “RANAS” (Risk Attitude Norm Ability Self-regulation) (Mosler 2012)
 - ii. Example: RANAS applied to toilet cleaning in Uganda: (Tumwebaze and Mosler 2014)
 - iii. Theory: Community-Led Total Sanitation (CLTS) (Sigler, Mahmoudi, and Graham 2015)
 - iv. Practical: (Kar, Chambers, and Plan UK 2008)
- Week 8. Tools for Designers
- i. Theory: Design with Intent (Lockton, Harrison, and Stanton 2010b).
 - ii. Practical: Design with Intent Toolkit (Lockton, Harrison, and Stanton 2010a)
 - iii. Theory + Semi-Practical: Guide to Behaviour Centered Design (Aunger and Curtis 2015). Be sure to note the section on Formative Research – it will help with next week’s assignment.
 - iv. Practical: Other Frameworks
 - 1. Behaviour Wizard – a matrix to classify behaviours (Fogg and Hreha 2010)
 - 2. Motivation Matrix, Appendix in (Srivastava and Shu 2015)
- Week 9. **Project:** Behaviour Change Proposal Presentations
- i. Present:
 - 1. Your analysis of your own behaviour, drawing on theory and design tools from the class
 - 2. Propose a theory-informed intervention to change your behavior
 - 3. Get input/feedback from the class and implement the plan for the remainder of the class
- Week 10. Critiques of Behaviour Change
- i. Theory: Comprehensive critique of behaviour change, especially w.r.t. community empowerment and paternalism. (Tengland 2016)
 - ii. Theory: Terminology for discussing “backfiring” of interventions (Stibe and Cugelman 2016)
 - iii. Example: Ethics critique of coercive nature of CLTS (Bartram et al. 2012)

- iv. Practical: No point in using theories because we don't know enough (Christmas, Michie, and West 2015, sec. 7) – Section 7; short enough online preview works!

Week 11. Understanding Farmer Behaviour and Technology Adoption

- i. Theory: Key overview on economic factors constraining farmers (Bridle et al. 2020)
- ii. Applied Theory: Diffusion of Innovations for International Development (Dearing 2009)
- iii. Examples: Great overview of technology adoption among farmers, with a focus on sub-Saharan Africa (Takahashi, Muraoka, and Otsuka 2020)

Week 12. **Project** Final Presentations

- i. Present:
 1. What was the behaviour?
 2. How did you theorize it?
 3. How did you measure it?
 4. How did you try to change it?
 5. How well did it change?
 6. Do you think the change will last?
 7. What would you propose to implement if long-term habit formation was the goal?

Assigned Readings

- Aunger, Robert, and Valerie Curtis. 2015. "A Guide to Behaviour Centred Design." Hygiene centre, London school of hygiene and tropical medicine. London: London School of Hygiene and Tropical Medicine. <https://www.lshtm.ac.uk/sites/default/files/2017-03/BCD%20Guide.pdf>.
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- Cameron, Neil Cameron, and Pao. 2019. *Arduino Applied*. 1st ed. S.I.: Apress. <http://go.utlib.ca/cat/12579046>.
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- Davis, Rachel, Rona Campbell, Zoe Hildon, Lorna Hobbs, and Susan Michie. 2015. "Theories of Behaviour and Behaviour Change across the Social and Behavioural Sciences: A Scoping Review." *Health Psychology Review* 9 (3): 323–44. <https://doi.org/10.1080/17437199.2014.941722>.
- Dear, Keith, Kevin Dutton, and Elaine Fox. 2019. "Do 'Watching Eyes' Influence Antisocial Behavior? A Systematic Review & Meta-Analysis." *Evolution and Human Behavior* 40 (3): 269–80. <https://doi.org/10.1016/j.evolhumbehav.2019.01.006>.
- Dearing, James W. 2009. "Applying Diffusion of Innovation Theory to Intervention Development." *Research on Social Work Practice* 19 (5): 503–18. <https://doi.org/10.1177/1049731509335569>.

- Dreibelbis, Robert, Anne Kroeger, Kamal Hossain, Mohini Venkatesh, and Pavani K. Ram. 2016. "Behavior Change without Behavior Change Communication: Nudging Handwashing among Primary School Students in Bangladesh." *International Journal of Environmental Research and Public Health* 13 (1): 129. <https://doi.org/10.3390/ijerph13010129>.
- Fogg, B. J., and Jason Hreha. 2010. "Behavior Wizard: A Method for Matching Target Behaviors with Solutions." In *Persuasive Technology*, edited by Thomas Ploug, Per Hasle, and Harri Oinas-Kukkonen, 117–31. Lecture Notes in Computer Science. Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-642-13226-1_13.
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- Rom, Adina, Isabel Günther, and Yael Borofsky. 2019. "Using Sensors to Measure Technology Adoption in the Social Sciences." White Paper. ETH4D: ETH. https://ethz.ch/content/dam/ethz/special-interest/gess/nadel-dam/documents/2019.10.10_Sensors_Tech_Adoption.pdf.
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