Behavior Change Design Sprints

Lucas Colusso, Tien Do, Gary Hsieh
Human Centered Design and Engineering
DUB Group, University of Washington, Seattle, USA
{colusso, nttd, garyhs}@uw.edu

ABSTRACT
While numerous design methods used in industry help designers rapidly brainstorm design ideas, few help them to use theory in the design process. Behavior change theories can support such design activities as understanding, ideating, sketching, and prototyping. We present the Behavior Change Design Sprint (BCDS), a design process for applying behavior change theories to the design process and for prototyping behavior change technologies. BCDS facilitates the application of theories into the design process through a series of exercises that help designers identify intervention placement and project behavioral outcomes, conduct more focused ideation, and advocate for their design rationale. We present our process to create the sprint and findings from a series of sprint deployments.

Author Keywords
Design process; Behavior Change.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
User experience (UX) and interaction designers are often faced with the task of creating products and services intended to help people perform desired behaviors, such as exercising more frequently or eating healthier [6, 14]. The process of creating behavior change technologies and designs is commonly referred to as Behavior Change Design [23, 30, 54, 59]. However, changing one's behavior is not easy [46], and behavior change designs often fail.

Research on behavior change from social sciences offers insights that can support behavior change designs. Design and Human-Computer Interaction (HCI) has explored the use of numerous behavior change theories, and offer design guidelines on how to use them (for example, there are numerous [2, 8, 14, 19, 44, 45]). There are other efforts to digest and suggest the use of behavior change theories coming from industry, such as the creation of design cards based on theory [4, 40], as well as books on human behavior and how to affect it [3, 20, 55]. However, despite the purported benefits of using behavioral theories and research in Design and HCI to design, there continues to be gaps between theory and its application in practice [26, 30, 50, 38]. Many UX and interaction designers do not use resources that describe theories and their applications when designing [13, 47].

Research has found that one of the main reasons why practitioners do not incorporate theory into their design processes, despite being interested in doing so, is that academic findings are often presented in a way that is hard for practitioners to apply [13, 26, 47]. For example, practitioners think that theories are often too abstract, and real-world constraints, such as budgets, undermine the "proper" application of theory [26].

To address the challenge of designing for behavior change, frameworks and processes inspired by behavior change research have been proposed [21, 22, 59]. However, there are two major limitations with existing frameworks for facilitating behavior change design. First, they fall short in providing designers a breadth of behavior change theories and explanations for how to use them. Second, these frameworks require the use of foreign terminology and exercises which may not be easily incorporated into designers' workflows, a known barrier for the adoption of new knowledge [52]. Therefore, in this work, we take a different approach; we modified the common design sprint format [35], adding exercises to facilitate the use of insights from behavior change theories in the design process.

We contribute the Behavior Change Design Sprint (BCDS), a process for quickly applying behavior change theories into the design process, and learnings from deploying the sprint during multiple sessions. We learned that the sprint process facilitates the application of theory into the design process, mainly by helping designers identify behavior change design intervention placement, project behavioral outcomes, practice convergent brainstorming, and facilitate design advocacy.

In the following sections, we engage with related work that explores how behavior change theories can inform design and other work on behavior change design frameworks; we report our process in developing the Behavior Change Design Sprint; detail what we learned from utilizing the process through surveys, observations, and interviews with users of the process; and discuss ramifications of this work.

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RELATED WORK

We draw on past work to guide the creation of a theory-driven sprint for designing *behavior change technologies*[1].

Design plays a growing role in improving people's lives as tools such as smartphones and the Internet expand the reach of products and services [45]. Designers excel at creating aesthetically pleasing and usable products and services, however, designing to address problems with behavior[2] requires another set of understanding than what is core to UX, interaction, and visual design. In this context, UX and interaction (UX/I) designers can benefit from theories based on research on human behavior to better understand people's behaviors and how to affect it through designs [6]. As research from fields such as psychology, economics, communication, public health, design and HCI proliferates, different communities interested in informing design practice with behavior change theories (BCTs) have translated and organized research findings into resources to inform practice, such as taxonomies, cards, books, and frameworks.

Academic researchers have organized taxonomies of behavior change techniques based on established theories that facilitate search and reference [8, 14, 19, 44]. In addition, behavior change theories have been condensed into design cards (e.g.; Artefacts' Behavior Change Strategy Cards [4] and Lockton's cognitive biases cards [40]), that can support brainstorming of behavior change designs. Academics and practitioners have written books with recommendations based on social psychology and BCTs to communicate research. The book Building Successful Online Communities [36], for example, describes a set of actionable design claims supported with scientific evidence. Similarly, books labelled as "pop psych" (e.g., Ariely's Predictably Irrational [3], Eyal's Hooked [20], Thaler's Nudges [55]) share academic work blended with personal industry experience.

While BCTs condensed into resources such as taxonomies, cards, and books can offer rich ideas for designs, instantiating research into an intervention is a difficult task, as theoretical constructs lack specificity for concrete design situations [30, 50]. UX/I Designers referencing these resources cannot find ways to fit theories into their process apart from 'inspiration' [13], and researchers say that theory instantiations produced by designers are often 'wrong' [47].

As an attempt to fill in this application gap, academics with a foot in industry and practitioners have created behavior change design frameworks. The most prominent frameworks were created by BJ Fogg, who published the Eight-step design process and the Behavior model for Persuasive Design [21, 22]. Fogg's work guided the creation of other frameworks, such as Wendel's 'behavior change process' [59] and Eyal's 'Hooked' guide [20]. These frameworks have drawbacks that may have hindered their use in practice — authors do not show how frameworks were evaluated, raising questions about their effectiveness; frameworks may be disruptive to designers' workflow as introducing foreign exercises and terminology is a barrier for adopting new knowledge [13, 52]). More important, these frameworks again offer little to no guidance on how to use findings from behavior change research.

Supporting the application of BCTs into UX/I design may require processes that do not disrupt practitioners' workflow. Practice matters and adapting theories to designers' ways of thinking and doing is crucial. To speed up the design process, sprints were adapted from programming practices [53] and established as a key design method. Design sprints are a sequence of time-constrained design activities that lower barriers for participation. Sprints support an iterative design process, and afford their use in a variety of contexts, with activities that can be performed by diverse stakeholders, promoting constructive and engaging discussions [5, 35]. Banfield focuses on the experience of agency designers working with both startups and established clients, and Knapp et al. capture the evolution of design sprints at Google [35]. Judging by discussions in online design forums and with fellow UX/I designers, a method such as Knapp et al.'s Sprint seem to be popular, and a promising avenue for us to explore.

BEHAVIOR CHANGE DESIGN SPRINT

We created the Behavior Change Design Sprint (BCDS) – a design process that fits into UX/I design workflows and facilitates the application of BCTs. We *adapted Google's sprints [35] instead of creating a new process*. While sprints usually do not take into account theory, *we created exercises to infuse theory into the design process*, helping designers quickly generate prototypes of behavior change technologies.

Input resources

Before describing the steps in BCDS, we first explain what inputs are required (based on [32]). See examples and descriptions of the resources on the next page. Figure 1 describes the project briefing, and Figure 2 and Figure 3 show the models of personas and scenarios we use in the sprint. Finally, Table 1 is the list of theories that we used in the sprint.

We propose BCDS as a flexible process that any design team can appropriate for their own needs/design contexts. Design teams can use their own input materials if they wish, or if they want to use the process for learning purposes, we provide standard sample personas, scenarios, briefings, and theory cards along with a step-by-step guide in a downloadable resource package[3].

[1] Following past work [30], we refer to systems and artifacts developed to foster and assist behavior change and sustainment as *behavior change technologies*. Find an extensive discussion on the controversies around this terminology in [23, 30, 59].

[2] According to the World Health Organization, a significant number of chronic health problems such as obesity, diabetes, addictions, continue to ail societies because of their behavioral causes [43].

[3] Download the resource package here [tiny.cc/bcds]. We encourage Interaction design, UX, and HCI researchers, lecturers, and practitioners to download, use, modify, and provide feedback on the resources and sprint.

Behavior Change Design Sprint input resources examples and descriptions

Figure 1. Project briefing with Design challenge, client, deliverable, and scenario. The sprint starts off with a problem statement framed as a design challenge, which was connected to a specific behavioral outcome (e.g. 'read more diverse news on the New York Times'; 'take the bus instead of driving'). We believe that a clear design challenge is the single piece of information that should always exist for the sprint to work, as it can be derived into a goal (BCDS is a goal-oriented pocess). Second, briefings disclosed a fictitious client and the specific design deliverables that is expected at the end of the sprint.

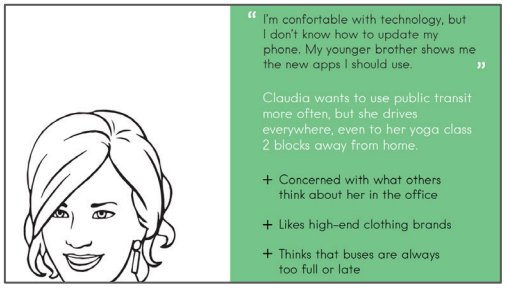

Figure 2. Persona cards. Personas are characters created based upon research to represent different user types. They help to understand users' needs, experiences, behaviors and goals, and help designers build empathy with their users, recognizing that different people have different needs and expectations. Personas are a compelling material to rapidly engage the empathy of design teams with a user characterization. We include in our resources personas that we generated following guidelines from past work on how to create personas for interaction design projects [27, 15].

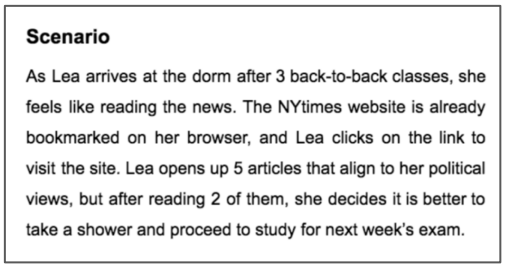

Figure 3. Scenario write-ups. Persona-based scenarios are concise narrative descriptions from the persona's perspective of using a product or service to achieve specific goals. Scenarios describe the persona's thought process and sequence of behaviors, rather than focusing on technology or business goals. Based on recommendations, the scenarios we used contain a "day in the life" of the persona [15].

Theory	Summary
Goal Setting [39]	Setting clear goals will motivate to actually achieving the goals.
Health Belief Model [10]	Attitudes and beliefs of individuals predict their health behaviors.
Intrinsic and Extrinsic Motivations; Incentives [31, 51]	Intrinsic: doing something because it is enjoyable. Extrinsic: doing something because of the outcome.
Social Cognitive Theory [41]	Having a sense of self control and forethought motivates behavior change
Social Comparison [12]	Closeness to comparison to improve performance feedback.
Target Behaviors [21]	Matching target behaviors with solutions to achieve the behavior change.
Theory of Planned Behavior [1, 18]	Predicting deliberate behavior through intention.
Trans theoretical Model- Stages of Change [49]	Health behavior change through six stages of change: pre-contemplation, contemplation, preparation, action, maintenance, and termination.

Table 1. Behavior Change Theories (BCTs) used in the sprints as theory cards. Insights from the BCTs were translated into design cards based on layout references and recommendations from [4, 58, 40, 13]. Each card focused on a single insight from a BCT, containing a short and prescriptive title, a figure that was meant to exemplify a theory instantiation, or a theoretical model, and a short paragraph explaining how the theoretical insights and instantiation are connected. The card also showed a reference to the particular publication that outlined the BCT at hand. The cards creation process can be a pre-step involving sprint participants, but it does not have to be. We offer the cards we generated in the resource package for anyone to use. Sprint facilitators can also adapt other behavior change related cards to use, such as [4, 40].

The Sprint

Steps	Exercises
1.Map	Understanding **User flow**
2.Sketch	**Linking** **Brainstorming** **Sketching**
3.Decide	Discussion **Checklist**
4.Prototype	Design **Advocacy**

Table 2. The Behavior Change Design Sprint steps. Exercises in bold and blue help to infuse behavior change theory into the process.

The sprint lasts for *95 minutes* and contains 4 steps based on the Google sprint [35]: Map, Sketch, Decide, Prototype; each with their own exercises (table 2, above). We detached testing from BCDS, as it is a more complex and time-consuming task, and outside of our scope to create a quick and easy way to apply BCTs into design.

1. Map

In the first step, participants are tasked with understanding input materials, and working on the user flow exercise.

Understanding (Individual, 5 minutes). Participants define the sprint goals, based on the constraints presented in briefing, persona, and scenarios. Initially, participants read the materials individually and take notes about persona, scenario, and behavioral goals they need to achieve with their design intervention.

User flow (Individual, 5 minutes; and Group, 10 minutes). By adding this exercise to the sprint, we wanted to help participants design interventions with a focus on the specific behavioral outcome presented in the challenge and design interventions at the right time and location [19]. Participants convert scenarios into visual representations in the form of a diagram that we called a "user flow" and then consolidate their user flows as a team. Since *scenarios* need to be concise, they do not focus on why personas perform certain actions or go into detail on obstacles or triggers for personas' actions.

Regarding behavioral outcomes, participants transform the scenario into what we called the current behavior path (in black, Figure 4), which shows the sequence of actions to be changed. Participants are then asked to create an alternative path in the flow, displaying the target behavior that personas would be nudged to perform (in green, Figure 4), informed by the design challenge (e.g. take stairs instead of elevator), making the target behavior a concrete and visible design goal. Participants also mark where interventions could work as nudges or obstacles on the flow.

Finally, groups discuss and compare the user flows generated by each member. Participants combine their perspectives into one user flow, drawn on the whiteboard, as recommended by [15]). Hence, the user flow exercise helps participants to quickly visualize important behavior aspects, and an agreed-upon diagram provides a solid setting for the steps that were yet to come [23].

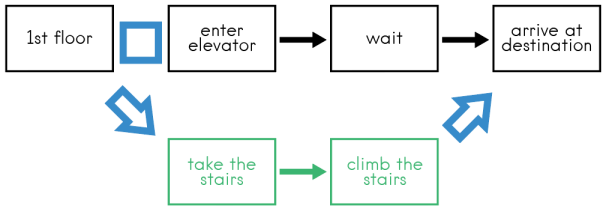

Figure 4. User flow. Green are behaviors to be encouraged. Blue arrows represent path that designers want to

2. Sketch

In the second step, participants are given a behavior change card deck to explore. As mentioned, these cards could either be generated by participants in a pre-step, or they could use the cards we have already generated available in the BCDS materials. Participants are prompted to brainstorm how the cards may be used to address their design challenge and design interventions. Then, they individually sketch out potential solutions for the design challenge.

Linking (Group, 10 minutes). Participants connect a theory-driven insight to particular locations of the user flow on the whiteboard. Participants are given the behavior change cards and select the cards that they think are more useful to their current design challenge. After linking cards to the user flow, the groups use the behavior change techniques outlined in the cards as inspiration to **brainstorm** design interventions that could encourage personas to perform the target behaviors or put barriers to perform undesired behaviors.

Sketching (Individual, 15 minutes). In the previous step, participants brainstorm ideas to affect the user flow with a design intervention. Now, individually, participants sketch how these design interventions would solve the design challenge. We offer prompts to influence sketching with a behavior change perspective. Google's sprint does not inform how to leverage theoretical standpoints to generate ideas. First, our prompts focus on functional perspectives such as, "*Design an intervention to maximize the benefits of performing a certain action*;" "*Could someone else help the persona engage in behavior change?"*. Second, we also wanted to incentivize designers to examine the ethical boundaries of behavior change design, prompting participants to explore extremes "*Propose a design that would make people uncomfortable*;" In addition, we provide more traditional prompts for designers to explore diverse solutions ("*What would you create with technology from 100 years ago?" "What would you create with tech that doesn't exist yet?"*).

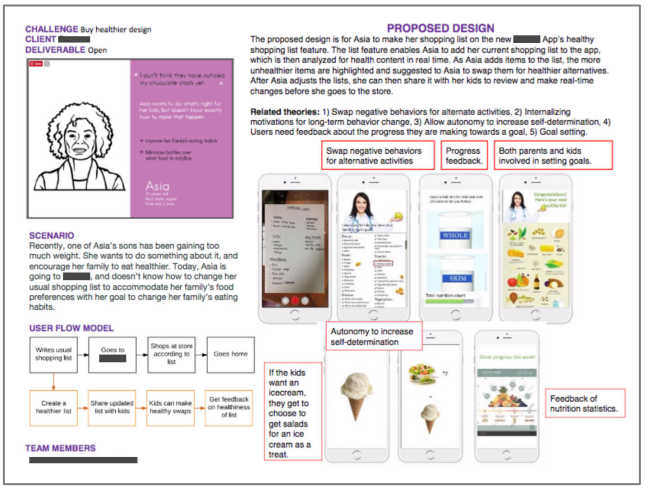

Figure 5. Sprint deliverable. See it in full-size in tiny.cc/bcds.

3. Decide

In this penultimate step, participants gather together, present their designs, and decide on one to prototype.

Discussion (Group work, 10 minutes). This exercise guides the group towards narrowing down their list of ideas and focusing on one single design for which to create a low-fidelity prototype. To guide decision-making, we provide a **checklist** to prevent teams from prototyping ideas that do not address the behavior change design challenge properly, which could reduce development cost. The checklist has two parts. The first part has behavior change informed prompts: *"1. How is your proposed design encouraging the ideal behavior? Or are you discouraging a negative behavior? How?"; "2. How is your proposed design connected to a behavior change theory?"* The second part reminds participants of the persona's goals: *"3. Is your proposed design appropriate to solve the persona's needs and constraints?; 4. How are you making it easier for the user to perform the ideal behavior?"*

4. Prototype

In this final step, participants generate a prototype of their proposed solution, including an explanation of how theory supports the proposed designs.

Design (Group, 30 minutes). Participants create a prototype to demonstrate how the design works. Given the time constraint, participants are free to explore different design tools and levels of fidelity to present their concepts.

Annotate (Group, 10 minutes). We added an emphasis on advocacy, as it is suggested as a key design activity in [13], particularly one that designers have difficulty with. With support from the BCTs, participants annotate their work, explaining the rationale for design choices and how the design is connected to a theory. Participants are prompted but not required to reflect on the ethical implications of the designs they propose. We provide a template to support a quick turnaround of the sprint deliverable (figure 5). The template contains a summary of the design, user flow, and an annotated design prototype.

Participants	Design	Behavior Change theory
High school **7 total**	little to no experience	no experience
Masters **(P, S)** **18 total**	3 advanced 6 intermediates 5 novices 4 no experience	7 no experience 6 novice 4 intermediate 1 advanced
Tech (T) **3 total**	Avg. 9 years of experience	1 novice 1 intermediate 1 advanced

Table 3. P is used for interviewees, S for survey respondents, and T for participants of our last deployment in a Tech company.

Participants, Data Collection and Analysis

We led a series of 7 sprint sessions. 5 with human-centered design master's students, 1 with high schoolers, and 1 with professional designers from a large tech company (table 3).

We first used the sprint in a master's course in the first semester of 2007 in our academic department. Each week, the students were given a different design sprint briefing and a theory to design with. We tested the realism of the sprint other contexts. The design sprint was used with a group of high school students during a summer camp. The deployment with high school students was less constrained – we removed personas, challenges, and clients, while keeping theory cards. Students only worked with themes, which still yielded interesting results. In addition, the design sprint was performed by 3 professional designers at a large tech company. With industry designers, we tailored inputs to the design challenges they face at work and only removed personas as they had aversion to it.

Participants were split into small groups of 3-4 combining design, development, and research skills. As seen in the previous section, we alternated between individual and group exercises to enable individual creativity but also to help participants build on each other's ideas [17].

Most data come from the 5 sessions with master's students. Students were invited to take a tracking survey throughout the course: once at the beginning, another midterm, and an exit survey. Not all students answered the surveys. After the course ended and grades were submitted, students were invited to participate in an interview. We conducted, audio recorded, and transcribed 10 interviews (13+ hours of content). In the other 2 contexts, we gathered data through field notes and informal dialogues. After each sprint, we analyzed how participants used materials and searched for emergent cross-group patterns to iterate on the sprint format. We open coded raw interview transcripts, field notes, and survey answers with the patterns to gather important aspects of the sprint.

Data from master's students is labelled in terms of interviews (I) and survey answers (S). Data coming from designers from the tech company are labelled as (T).

RESULTS

We use the BCDS step by step structure to describe our findings. We focus our accounts on exercises to support behavior change design.

User flow helped to design interventions with a specific behavior outcome, delivered at the right time and location

The goal of the Map step is to help participants understand the input design resources of briefing, personas, and scenarios. We designed the user flow to help participants focus on designing interventions for specific behavioral outcomes, and on placing design interventions at the right time and location. The exercise seemed to be successful, with some drawbacks.

Participants mentioned that the user flow exercise was helpful because it helped them to 'ideate with more focus' [I6, I8, I10]. "*How do I change one step of the behavior? This user flow helps with focus and ideate and sketch many ways to influence that one step*." [I1]. The user flow helped participants to design for a specific behavioral outcome. "*Having the flow helped us be like, ok, what do we actually want to do, what's going to be more effective? What is our goal? So, it allowed us to break the design rationale down and be more intentional about designing to encourage the ideal behavior.*" [I8]. Designers from the tech company drew a funnel, showing the proportion of 'users' that would be left behind or encouraged to change their behavior after their design interventions came into play. The 'funnel' also spurred a conversation about design measurement. One participant mentioned that designers are not trained to understand 'cause and effect' – "*It took me a while to get experimental design and how it affects my work. It took a lot of talking with data scientists. This exercise helps to design for an exact consequence so nicely. I wish I was taught this earlier in my career*" [T3].

Participants also said that the user flow helped them identify where and when to create interventions to affect the user flow. Participants could glance at the structured diagram and imagine how to intervene with more precision into particular steps of the story. *"The user flow sort of broke down the bare scenario into the workable components of the flow and so then you could surgically say where your design was stepping in."*[P6]*;* and where *"nudge might be more appropriate"* [I9].

Participants mentioned liking the collective user flow exercise. Drawing the user flow as a team promoted agreement on how to approach design challenges. Participants said it is good to work as a team in complex tasks. *"It is hard to decide how the user flow looks like only based on my judgments"* [I7]. Students said having the user flow on the white board facilitated discussions around the interventions, as the visual representation of the scenario with small components facilitated group decision making, whereas with a textual scenario it would also be possible, but not as obvious. Rather than being overwhelmed by the entire scenario, the user flow's visual nature improved the general process of using textual scenarios in the design process. *"Because it's a user flow we could scribble it all over the whiteboard, we could tell this is where nudges will come and how this is how it would affect our design."* [I2] Despite our effort with the user flow to constrain the activity into thinking about behavior change and setting up the ground for theory to come later, some participants began brainstorming "solutions" right away.

Also, in general, participants said that BCTs would support better understanding of design challenges in the long term. [I8] made a point that theory helped to 'frame thinking' that was supported by [I4]: "*I would definitely rely on theory to mold my thought like, if I'm designing something for behavioral change, I would definitely go back and look at like what are the stages of change, what in our product fall into this stage, how do we want to attack this—it would help frame my thinking. I would use theory that way"* [I4]. S15 thinks that BCTs supports developing 'design intuition:' *"As UX professionals we are in the business of facilitating people's lives and behavioral theory seeks to understand how humans behave. This can give us better instinct when approaching problems and help us to form better assumptions which we inevitably bring into our work"* [S15].

However, there were drawbacks. We found that the user flow exercise did not sufficiently support thinking about why the personas would perform an action or their motivations to do so. *"I think that the user flow exercise didn't help thinking about the motivations of users. It focused more on physical actions. It didn't capture the motivational component, it's missing that."* [I3] Additionally, we observed in the sessions that participants never asked for more details on personas' motivations; or scenarios' and theories' details. Participants were biased for action and quickly took design constraints without questioning. However, some participants described how using theories brought more certainty to the design process: "*I think that using academic theories in sprints can cut a lot of the guesswork out initially and help scope down and formulate ideas better because we have a better understanding of users* [I3]. It seems like knowing about "people" can take different forms in the words of participants. Sometimes, theory may have an insight that tells about how people behave and helps designers to better understand the design context, sometimes personas' goals seem to be enough.

Design cards acted as reminders of theories and encourage focused brainstorming

In the Sketch step, participants first brainstormed using design cards in the linking exercise and then sketched design ideas. Participants mentioned that theory was useful in the brainstorming exercise when it added new perspectives; served as reminders; and helped them to focus their brainstorming as we had planned. Participants saw value in behavior change theories for ideation as it helped them to think 'creatively' [I2]. *"It makes you think outside of the box for a solution that may not have been your first instinct."* [I9]; and have 'better ideas' [I7]. For some participants with experience reading behavior change literature, using theory cards at this stage reminded them what they already knew. [I1, I3, T2]. Regarding focus, participants said that *"The design cards helped us narrow down which aspect of the design to address in the brainstorming."* [I6], helping to do 'faster brainstorming' [I4, I6, I8]. Tangentially, participants thought that the best behavior change theories to inform design are those that are 'simple' and focus on single constructs rather than on multiple constructs [I3, I5, I8].

Examples of recent designs are useful for sketching possible interventions

Participants said that behavior change cards were not helpful in the sketching/ideation exercise, when they had often already decided which idea to pursue [I1, I3, I8, I10]. However, participants mentioned that cards with examples of interface designs were most helpful. Half of the interviewees specifically mentioned (without being prompted) that the card about Self-determination theory communicated information well and felt 'applicable' (Figure 6). The card mapped onto 2 specific constructs (competency and autonomy), using a tax return app as an example. Participants thought that the interface example facilitated thinking about design ideas.

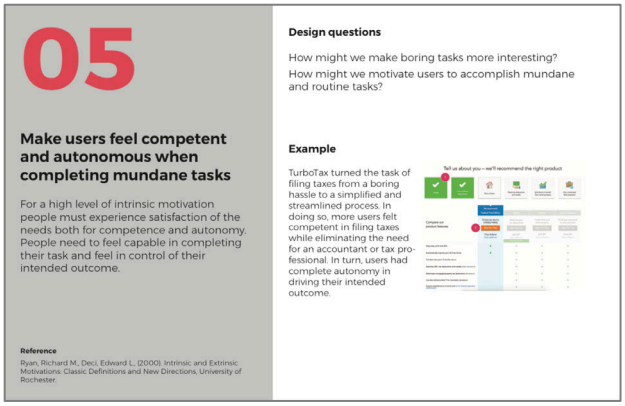

Figure 6. Behavior change card on Self-determination theory (SDT). Participants said that it was easy to understand how to apply this example showing a user interface. Participants thought that it clearly mapped into the theory. Whether the original designers were influenced by SDT or not, it is unclear.

In general, participants mentioned that behavior change cards could have more applied examples to support brainstorming. Participants even offered ideas of examples, *"of companies and products that did successful behavior change design"* [I4], or *"more updated work in the current context (not 60s or 70s theories)"* [I10]. In addition, participants mentioned specific design challenges that they think behavior change cards could back up and illustrate, such as getting users to try new features, functionality or services [S8]; and getting users to maintain a "one-time behavior" [S13].

Deciding which idea to be prototyped is an ongoing conversation rather than an event at the end of the sprint

In the Decide step, participants discussed their ideas and decided which one to prototype. The checklist that we provided to support discussion did not work as intended.

Participants mentioned that most of the value in this step came from how they aligned group perspectives in discussions (e.g. "*I don't see anything special about this step other than bringing people together.*" [I2]) rather than from the checklist that we provided with behavior change related items: *"Everybody presented their ideas. We did not use the checklist. When I presented, my group members would ask questions to clarify, and I'd show my sketches. For us it was always a consensus of which design was more well-thought out than the other. After presenting all of our designs we would converge on one, think about which one we would want to use and we would build upon that one. It was a group discussion. Ok how do we flesh out this idea a bit more?"* [I1]. Participants said that the items in the checklist were already discussed *"all along the sprint"* so it did not make sense to repeat. [I1, I2]. Some participants did not even remember using the checklist [I2, I4, I7, I8, I10]. This was concerning, as the goal for using the checklist was to prevent prototyping ideas that do not address the behavior change design challenge, which could reduce development costs.

Theories facilitated explaining the design rationale behind proposed interventions

At last, participants created a design prototype and were asked to explain how theory informed it. We describe how participants saw theory helping explain design rationale, how participants considered theory useful for their professional practice, and a hitch related to time constraints.

After creating the prototype of their proposed behavior change interventions, participants explained how they addressed the design challenge and how the design related to behavior change theories. Participants found that matching theory with their annotations to defend rationale was effective and helped them to *"articulate design intent"* [I10]; "*It gave us a good starting point to even start annotating. It helps your dialogue and it helps you form your thoughts and articulate them in a better way."* [I2]. In addition, [S5] said that the sprint taught her to 'think more about each design choice,' a sentiment that was shared by most participants after doing the sprint.

Participants seemed inspired by the exercise and expressed the goal to use more theory-backed reasoning in their professional work. "*I've tried to bring theories into my design reviews at work. So far it's been well received, especially if I start with context and then cite empirical evidence and can relate it to our business context."* [S6]. Participants mentioned other reasons related to communication for using theory at work – to support reasoning [I4]; defending [S12] or justifying a design [S1]; back up designs [S2]; or even *"to sound smart."* [S11] However, *"It might be hard to get buy in citing a research paper though, that's been like published you know, ten years ago. Where it might be–it might dilute the relevance of it versus findings from user researchers conducting research in the company"* [I4].

All participants said that the time constraints were a significant issue for prototyping. Participants even mentioned that they would often choose to design the *"low hanging fruit"* ideas [S16] as they were easier to express in a short period. In addition, participants felt it was difficult to know if the theory 'application was correct' [I3, I4, I8, S11, S13]. We address these issues in the discussion section.

The ethics of Behavior Change Design

One of the key themes that emerged throughout our interviews is *ethics*. Even though we created prompts to spur conversations on behavior change ethics during the Sketch and Decide steps, these were overlooked by participants who were

rushing to design a prototype. We also noticed that ethics was not addressed in the design annotations presented in the deliverable, as it was not a required piece.

The behavior change ethics theme was revealed as participants tried to disambiguate behavior change design and UX design. Participants shared a view where:

> *"UX Design to me is the idea that the person should just be able to use your design so you try to make it as easy as possible. Like users already have a mental model, and you're going to use that mental model for them to use your product. But designing for behavior change is more like - Ok I have this model from theory, how do we get users' model to change? How to push them towards that ideal behavior model?" [I8]*

Participants also used terms such as "get them to do something"; "force them to behave in a way" to describe behavior change design, which suggested a confusion with coercion. However, in follow-up questions, we understood that the sprint led participants to consider and value ethics as a crucial part of behavior change design. "*I think that's really the challenge with behavior change, deep rooted habits are harder to uproot if you're addressing them so directly because it almost feels like the person is being shamed into changing*. [I4]*";* and "*The focus is on explicitly leveraging psychology to a user interface's advantage, which sadly encourages the design of dark patterns. I'd like an ethics class devoted to that"* [I10]. Participants said that since they were not *"required to address the ethics of designs in the deliverable"* [S13], they chose to avoid the difficult discussions that behavior change design raises, privileging a demonstration of how their design "works." We believe that ethics need to be made more salient in the process, and we discuss possible ways to do so in the next section.

DISCUSSION

We found that BCDS overall facilitated the application of behavior change theories into the design process. Based on our findings, we discuss the breakdowns of what we distinguish as unique aspects of behavior change design, in the four steps of BCDS: Map, Sketch, Decide, and Prototype. In this section we also discuss the issue of ethics in behavior change design.

Map

The goal of the map step is to help participants understand the input design resources of briefing, personas, and scenarios. We added the user flow exercise specifically to help participants translate the scenario into a diagram that could facilitate the use of BCTs later in the process, while encouraging participants to think about the outcomes of their design interventions and how to deliver them to the persona.

All participants seemed to enjoy the user flow exercise. They said it was helpful to translate the often text-based design scenario into a diagram. Visualizing the scenario facilitated designing for a specific behavioral outcome, as well as identifying where to place interventions. Deeply considering people's motivations is vital to behavior change design, which was partially supported by the exercise.

We found that the user flow exercise helped participants design with a focus on a specific behavioral outcome. The exercise encouraged participants to be more intentional about designing for an exact consequence (behavior) drawn from the design challenge. In practice, the exercise shifted participants' design thinking to goal-oriented topics such as effectiveness of design interventions and thinking about their designs as experimental conditions that can affect behavior (one participant related the exercise to causality - if *design* is used, then *outcome* happens), spurring conversations about behavior measurement. These findings open up interesting areas for exploration, such as using the user flow exercise to educate designers on notions of experimental design [30].

The user flow exercise also helped identify intervention placement. Participants could easily visualize what would be the most effective change triggers in terms of time and place. To impact personas' daily routines, past work has described 'time' and 'place' as critical aspects in designing effective change triggers [2, 29], as, over time, people link specific parts of their routines with actions through the creation of if-then scenarios (e.g., whenever I enter the building, I take the stairs) [7], thus supporting the habit formation [48].

Participants mentioned that BCTs opened pathways of thought and molded the design process. The impact of this was unclear apart from simply making designers more knowledgeable about a behavior change topic. We also noticed that the user flow exercise fixated participants on actions rather than on motivations to perform actions. There are opportunities to help designers think in depth about users' motivations behind behaviors [54]. Understanding why behaviors occur and how designers can tap into or dissuade those motivations is key to design behavior change [19]. Potential improvements to this step include encouraging participants to question the input materials and to investigate lacking or implicit information on behaviors related to the design challenge through quick and informal user research or even invite a user to co-design potential interventions, adding realism to the sprint.

We also imagine other ways that theory may help designers understand more about design context. For example, ethnography results may not provide specific design implications [16]. Models or vignettes drawn from ethnographies [13, 16] could be adapted into personas and scenarios and used as input materials in the sprint[4], but more work needs to be done to understand how these resources can help designers apply theories in their work.

[4] Some design practitioners may not know what personas and scenarios are or choose to not work with them [T1, T2]; and researchers have described personas' implicit tendency to stereotype depictions of "the other" [9].

Sketch

In the second step, participants brainstorm and explore designs through sketches. The key addition in this step to support BCD is the inclusion of behavior change cards to inform the design of interventions. We discuss our findings related to brainstorming behavior change designs and sketching.

Past work [32] mentioned participants getting stuck at the ideation phase, thinking too long about concepts as a critical pitfall in rapid design workshops. We did not see this occur with participants in our sprint sessions. Participants brainstormed quickly as a team. Group brainstorming used the user flow as a basis, promoting agreement and convergence, which are commonly lacking from brainstorming sessions [15]. In addition, participants mentioned that theory cards helped them focus on ideas that aligned with theory. As such, we believe that BCDS encourages convergent group brainstorming of theory-informed design interventions.

In terms of sketching behavior change designs, influencing sketching is inherently difficult because there is a perhaps unavoidable disconnect between what academic research offers (general theories, implications and recommendations) and what a designer is expected to produce (a tangible design idea). We have some learnings that can inform the creation of cards to at least inform and to attempt influencing designers creating theory instantiations. Past work suggests that theory examples are helpful to support different design activities [13]. We elaborate on past work, as we found particular types of examples to be important for sketching. To facilitate the sketching exercise, behavior change cards need examples of theory instantiations in current products, as well as stories of products that may have been influenced by academic research.

Participants asked for more updated examples from applied contexts related to their daily design challenges, rather than study results based on decades old offline experiments (the age of some theories in the behavior change cards). Second, we believe that stories of how design teams leveraged theory to build products or successful companies could be powerful (for example, accessibility research and the iPhone screen reader [37]; Ubifit and Fitbit [14]). We argue that even if academics are not completely confident of links between a specific academic research and a product or a service, applied and current examples are still a powerful way to communicate concepts that designers can understand and apply to their context. Since academic researchers rarely turn their research into products [38, 11], using real-world indirect or derivative examples might be a good strategy.

It seems that translational resources, apart from presenting easy-to-understand takeaways, could be more successful if they drew on common design challenges. Participants seemed to prefer "simple" cards with little text, focusing on specific aspects of a BCT, such as one single construct instead of describing entire models of how people behave. We noticed a clear emphasis on communicating research with "take home messages," which were questioned by Siegel et al. [54]: should research speed up or slow down the design process? Second, designers think that research findings are distant from the "real problems" they face [47], such as the ones our participants mentioned – getting users to try new features and getting users to maintain a "one-time behavior" (more examples from [13]: increasing time spent on an app; increasing sign ups or check out rates; increasing comments). However, researchers often start a study motivated to test a theory or a hypothesis and discuss their research under that backdrop.

Decide

In this step, we tried to inspire group discussions with checklist prompts related to behavior change theories and ethics. The checklist that we provided did not help infuse theory in the sprint as planned, as participants rarely referenced using it. Instead, checklist item questions were seen by participants as guiding questions used throughout the entire sprint. We comprehended that behavior change decision heuristics should exist throughout the design process. We believe there are ways to explore how to make checklist items recurring incursions in the sprint or in sprint iterations, which will require further testing. There is also an opportunity to more emphatically spur discussions about behavior change design ethics in the checklist. We elaborate on the ethics of behavior change design on the next page.

Prototype

In the final step in BCDS, participants develop prototypes of their designs. Here, we scaffolded the step for the use and discussion of theory to support advocacy.

As mentioned previously, participants said that leveraging BCTs helped them make more 'certain' and confident decisions on what ideas to invest time in and, ultimately, to prototype. Interestingly, participants said that BCTs were also helpful in supporting design advocacy (something that designers struggle with [13]). They confidently defended their design rationales by breaking down components in their design to justify using theory. It is unclear if the feeling of certainty was influenced by the newly discovered ability to leverage theory to back up design decisions. More work is required to understand the relationship between using theory for design advocacy and its impact on other design activities. We acknowledge that our participants did not have to advocate for these designs in a real-world context, so we do not know whether the reported confidence would carry over. We also plan to include a requirement to address the ethics of designs in the annotations.

Second, participants felt rushed in the prototype step, but they were always able to produce deliverables on time. Past work [32] cited participants getting stuck while building ambitious designs as a pitfall in rapid design workshops. We believe that offering a template deliverable aided a quick turnaround, which mitigated this pitfall. To further support prototyping, we imagine that behavior change theories can be factored into design patterns containing tangible parts that designers can use, such as wireframes or code snippets [13]. We believe this to be an exciting area for researchers to explore, following the example of Information visualization findings that are

translated into actionable libraries [57] and even industry design pattern libraries (e.g. UI-patterns.com, iOS, and Material design guidelines [56, 33, 42]).

Ethics

Our sprint facilitated the design of technologies based on BCTs, but doing so raised ethical questions, as our attempts at including ethics discussions in the sprint did not work. Educating designers to become responsible BCTs utilizers is crucial, and we are committed to improving the sprint to address ethics. First, we will change our sketching and checklist prompts. We will add more prompts and make them more central to the sprint step-by-step. Second, there are additional opportunities to raise awareness and discussion about ethics. We will incorporate ethics discussions in the user flow exercise. As outlined previously, we need to help participants talk about motivations for behavior in the user flow. We will also add prompts in the advocacy exercise, with a guide suggesting terminology to explain behavior change designs that do not sound as coercive, while explaining how to avoid coercion (e.g. 'Tell users what you're doing; Make sure the action is optional' [59]).

Future work and limitations

Where exactly academic researchers have more value to add to the design process is still an open question. Throughout this paper, we have proposed a number of different resources with which academics can influence practice, such as cards, scenarios, design pattern libraries, all with an eye on applicability. Nevertheless, as academics are not incentivized to create translational resources [13], we recommend partnering with designers, visual artists, and writers to create these resources. It is also important to question whether academics' role is to exclusively help designers apply theoretical concepts and speed up the design process – perhaps slowing down design is needed [54].

In addition, Hekler et al. [30] cautioned that when behavior change theories are used to design, there is a tendency to treat their recommendations as requirements, when they are more like *hypotheses*. The user flow exercise helped designers to incorporate an experimental design mindset into the behavior change design process – they created prototypes that can be traced back to theoretical constructs – theory instantiations that *can* be used to test *hypotheses*.

However, how to help UX/I designers test behavior change interventions is unclear [2]. Testing is usually a step in sprints [35], but our goal was to facilitate the application of BCTs into design. Participants mentioned not knowing if their behavior change interventions would 'work' as prototypes remained untested. It is important for future work to investigate exercises that help designers plan data collection and measure the effects of behavior change interventions [19, 22, 30]. For Fogg [23], measuring behavioral data is 'more compelling' than attitude because behavior is a concrete outcome and more difficult to change. Adams et al. [2] aligns to Fogg's view, and asserts that self-reported data on behavior can conflict with behavioral data. Siegel [54] argues for capturing both qualitative and quantitative data to 'paint a more realistic picture of a change process and its potential outcome.'

Finally, it is our intention to keep iterating on the sprint. Most of the participants in our sample are practicing UX/I designers, which alleviates external validity concerns. However, we acknowledge that since most of our data comes from a deployment with master's students, we need to expand recruitment of practicing, non-student UX/I designers. While we had a mix of participants in terms of job roles and experiences, we did not explore demographics or role-specific goals in responses.

CONCLUSION

Our paper offers two main contributions. First, we present the Behavior Change Design Sprint (BCDS), a process for quickly applying behavior change theories into the design process to generate ideas for behavior change technologies. We created exercises that facilitate the use of behavior change theories to design, spurring quick prototyping of behavior change interventions. The paper serves as a guide to applying the sprint. Second, we share our findings from the use of BDCS in a series of sessions. Learnings include drawbacks of the sprint and suggestions for future work.

BCDS helped designers of varying experience levels (both with design and behavior change literature) to quickly generate design interventions that clearly map into theoretical constructs. The sprint enabled designers to apply behavior change theories into the design process at different stages. Behavior change theories helped designers ideate behavior change interventions in a focused and more convergent manner, identify placements for their behavior change interventions, and project the behavioral outcomes of their designs. Finally, applying theory with the sprint helped participants to advocate for the design decisions made along the way by leveraging theoretical standpoints from BCTs. We also offer thoughts on how to further support understanding design spaces, prototyping and testing behavior change designs, and generating better cards to communicate behavior change theories to designers.

We hope our contribution is useful to designers looking for ways to quickly and easily incorporate behavioral theories into their design process, as well as to researchers interested in disseminating their research outcomes to practitioners, or in translating behavioral theories for their own studies.

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