Designing for Mindful Human-Computer Interaction

Theories in Digital Wellbeing Research

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Where the Contemporary End-User Perspective Falls Short

- Researchers have criticized the reductionist approaches of equating digital wellbeing with user engagement metrics (screen time) and individual selfcontrol responsibilities, upon which DSCTs are largely based:
 - measures like screen time are too coarse, and they do not reflect the variety of goals and different kinds of tech usage of the users;
 - providing users with an indication of their screen time, e.g., for selfregulation purposes, may in turn produce **negative reactions**, thus inducing users to stop using the DSCT.

Where the Contemporary End-User Perspective Falls Short

- Reducing engagement may not be sufficient if one does not address "the deeper psychosocial problems causing problematic engagements in the first place" (<u>Docherty and Biega, 2022</u>).
 - **Behavioral theories and constructs** are needed to understand and address these problems.
- The digital wellbeing research area suffer from a theoretical gap:
 - $\circ~$ Most of the works do not refer to any behavioral theory.
 - Other works use a "pick & mix" approach, mixing together different behavioral theories.

Understanding technology (over)use through conscious vs. unconscious behaviors



System 1 control is when our behaviour results from habits or instinctive responses that get triggered by external stimuli and internal states, with no need for conscious attention.



System 2 control is when our behaviour is triggered by goals, intentions, and rules held in conscious working memory.



Sometimes we fail at self-control, even when we're aware of if in the moment. Neuroscientists think this comes down to the **expected value of control**, which is a cost-benefit analysis of what you might gain from exerting self-control.



The three different components of the expected value of control:

- the amount of **reward** you could obtain (or loss you may avoid);
- how likely you think it is that you will be successful in exerting selfcontrol (expectancy)
 - the **delay** before you get the potential reward.



System 1 and System 2 **competes** to activate a given behavior.





5h 44m

44h 25m

2 hr

The Habit Alteration Model







The Habit Alteration Model



Interventions in the Filter Phase

- Alter context: add or remove cues in order to affect which impulses and intentions arise in the Potential Response stack;
 - "with our unhealthy snacking example, a DBCI could suggest to the user to not buy the snacks in the first place, or suggest replacing them with a healthy snack whilst watching television."
- Alter cue saliency: reduce the salience of contextual cues for unwanted responses, whilst also increasing the salience of cues for wanted responses, e.g., using Cognitive Bias Modification (CBM) techniques for attention biases;
 - "with our unhealthy snacking example, a DBCI could try to reduce attention bias for the snack by giving the user a serious game to pair images of their problematic snack with something they find revolting."

Interventions in the Prepare Phase

- Non-conscious goals: unobtrusive presentation of cues to activate relevant mental representations, by using technology that users carry as part of their personal context, e.g., smartphones;
 - "with our unwanted snacking example, a DBCI could support the user by displaying the prime of a photo of themselves consuming an alternative, wanted snack."

Interventions in the Prepare Phase

- Just-in-time reminders: leverage pervasive context-aware technology to provide just-in-time reminders to behave in a particular way;
 - "with the unhealthy snacking example above, a user's phone could alert them to the unwanted eating behaviour and suggest an alternative."
- Train self-control: computer-based training to enhance self-control and make
 - it a System 1 impulse;
 - "with our unhealthy snacking example, a DBCI could be designed to support the user to train themselves to resist the snacks by using go/no go serious games."

Interventions in the Act Phase

- Self monitoring: using information from self-tracking to form alternative intentions to act; it can be helpful to reveal the consequences of automatic Type 1 processes to Type 2 behavioural override mechanisms;
 - "with our snacking example, the user could record the amount of unhealthy snacks that they eat in front of the television using a simple self-monitoring app to inform different behavioural decisions."
- Revalue outcome: providing rewards for 'correct' behaviour or punishments for 'incorrect' behaviour, following the operant conditioning theory;
 - "with our unhealthy snacking example, the user could reward themselves for consuming healthy snacks as an alternative, e.g., by transferring a small amount of money into a virtual jar for each healthy snack consumed, and/or punish themselves for consuming unhealthy snacks by giving a small amount of money away."





Table 1: The interventions associated with Don't Use and Use For paths, respectively.

Path Intervention

Don't Use Ask users to put an unusual object

near the smartphone, i.e., a visual cue

to make them remember their goal.



Use For Use slight vibrations, i.e., a haptic cue, as long as users use the smartphone or specific apps, to spur them to check the time and respect their usage intention.





The Self-Determination Theory

Taking into account our psychological needs for autonomy, competence, and relatedness

The Self-Determination Theory

- One of the most frequently used and well-validated theories used in HCI research
- It provides a minimum set of wellbeing requirements that can be applied to all technologies, regard-less of context or activity.

The Self-Determination Theory

- SDT defines these three "basic psychological needs:"
 - 1. Autonomy a sense of willingness/endorsement, acting in accordance with one's goals and values
 - 2. Competence feeling able and effective
 - 3. Relatedness feeling connected to and involved with others
- The advantages of SDT for use in HCI include:
 - A significant evidence base
 - Existing validated measures
 - The fact that the three basic psychological needs at the theory's core provide safe targets for design

Self-Determination Theory and DSCTs

- Self-determination theory posits that motivation ranges from amotivation (the least autonomous) to intrinsic motivation (the most autonomous)
- DSCTs leverage extrinsic motivation to help users stay focused on tasks that are not intrinsically motivating and avoid distractions
- At present, many DSCTs fall towards the externally controlled end of the spectrum of extrinsic motivation ("I have to use the DSCT") and often trigger reactance

Lukoff et al., Designing to Support Autonomy and Reduce Psychological Reactance in Digital Self-Control Tools, <u>https://drive.google.com/file/d/12-aHni72CD_PZq3ypVMHSvysablZelvw/view?usp=sharing</u>

Using the Self-Determination Theory for (Digital) Wellbeing

	More autonomy					
Type of regulation	Amotivation	Extrinsic Motivation				Intrinsic Motivation
	Absence of intentional regulation	External Contingencies of reward and punishment	Introjected Self-worth contingent on performance	Identified Importance of goals, values, & regulations	Integrated Coherence among goals, values, & regulations	Intrinsic interest and enjoyment of the task
Source of motivation	No motivation	Externally controlled	Moderately externally controlled	Moderately autonomous	Autonomous	Autonomous
Examples of user experience	"The DSCT doesn't interest me/isn't relevant to me.''	"I have to use the DSCT."	"I should use the DSCT because if I don't I'll feel bad about myself."	"I use the DSCT because I believe it's worthwhile."	"I use the DSCT because it helps me achieve my goals and values."	"I use the DSCT because it is fun!"
		for DSCTs				

Lukoff et al., Designing to Support Autonomy and Reduce Psychological Reactance in Digital Self-Control Tools, <u>https://drive.google.com/file/d/12-aHni72CD_PZq3ypVMHSvysablZelvw/view?usp=sharing</u>

A New Lens for the Digital Wellbeing: the Sense of Agency

Promoting meaningful and mindful digital experiences

Definition

- "The experience of controlling one's actions, and, through them, events in the external world":
 - A subjective experience of control
 - Propositional form: "I did that!"

Sense of agency vs. Judgments of agency



Measuring Judgments of Agency

- Judgments of agency are typically measured in HCI through the Experience Sampling Method:
 - Open-ended questions, e.g., "What are 3 things about the mobile app that lead you to feel MOST/LEAST in control over how you spend your time on YouTube?" (Lukoff et al., 2021)
 - The Sense of Agency Scale (Tapal et al., 2017), which includes items such as "I am in full control of what I do" and "My actions just happen without my intention"
 - Custom scales/questions, e.g., "For this SwitchTube use, how much did you feel out of or in control? (1=very out of control, 7=very in control)" (Lukoff et al., 2023)

Measuring Sense of Agency

- There are two measurable perceptual phenomena often assumed to correlate with agency that can be measured:
 - sensory attenuation is based on the observation that self-caused stimuli are experienced less strongly than stimuli caused by external factors
 - temporal binding refers to causally connected events being experienced as closer in time than unrelated ones.

Temporal Binding

- Measuring the experienced time interval between an action and its result can provide indicators of agency:
 - Libet clock: participants estimate the timing of their actions during an experiments looking at a rotating clock hand (it requires visual attention)
 - Interval estimation: participants judge the duration, typically in milliseconds, between two events (see <u>Didion et al., 2024</u> for an application in the Generative AI domain)

- Sense of agency matters for digital wellbeing because (<u>Lukoff, 2022</u>):
 - Supporting user control is a common principle in HCI design guidelines (e.g., see the <u>Shneiderman and Plaisant's Eight Golden Rules of Interface</u> <u>Design</u>)
 - A low sense of agency over technology use predicts greater negative life effects:
 - Scales of problematic technology use generally measure both (a) lack of control and (b) negative life impacts, suggesting that 'the problem' is a combination of these two factors
 - Feeling in control of one's actions is integral to autonomy, one of the three universal basic human needs in self-determination theory.

- We can think beyond 'screen time' and use sense of agency as an alternative lens for addressing user frustrations.
- We can promote a greater sense of agency without reducing users' time spent in an app, e.g., by promoting instrumental use rather than habitual use.
- Most of the works focus on judgments of agency.



Lukoff et al., How the Design of YouTube Influences User Sense of Agency, https://dl.acm.org/doi/10.1145/3411764.3445467



- Participants' sense of agency depended on whether it felt like they had 'agreed' to the actions of the app
- Participants felt more in control when they planned their consumption in advance (e.g., through playlists)
- The accuracy of algorithms influence users' control, e.g., irrelevant recommendations negatively influence sense of agency

Lukoff et al., How the Design of YouTube Influences User Sense of Agency, https://dl.acm.org/doi/10.1145/3411764.3445467





Lukoff et al., SwitchTube: A Proof-of-Concept System Introducing "Adaptable Commitment Interfaces" as a Tool for Digital Wellbeing, <u>https://dl.acm.org/doi/10.1145/3544548.3580703</u>

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Explanation of the Dual Sytem Theory taken from <u>https://www.youtube.com/watch?v=sJf_F7faczU</u>

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