RESEARCH REVIEW

Building a Chatbot to Support Habit Formation with Multi-Modal Rewards

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Executive Summary

Habits are automatic actions that require little effort. Such as automatically washing your hands, after using the toilet. Forming new positive habits gives us lots of benefits, in health and other areas. Forming a new habit requires 3 elements. Repetition, contextual cues and positive reinforcement. On average, habits take 66 days of repetitive use to become automatic.

Mobile technology can help form habits, by reminding use to repeat the habit, giving us contextual cues and rewarding us to form positive reinforcement. But, most existing systems are not grounded in theory and build repetitive actions rather than habit automaticity. People then become dependent on the technology, rather than the habit. This is bad because when we remove the system, the habit stops. Therefore, successful habit forming systems need to build habit automaticity.

The current state of habit-forming mobile systems use apps for interaction, encouraging the user to repeat tasks using the app. This creates a dependancy between the app and the user. Where the users are dependaent on the app to continue to repeat the habit. When the app is removed, the user stops repeating the habit as they are dependent on the app. This has been shown to decrease habit automaticity.

This project aims to explore a different method of forming habits, by using a chatbot.
Chatbots are a method of communicating with a computer system using natural language. They provide a better mobile phone integration for users, as they hook into messaging services users are familiar with, and when the system is removed, instead of removing an app, the users stops having a conversation with the chatbot.

The literature presents us with a set of design requirements for habit forming apps that build habit automaticity, focused on routine-based remembering strategies. Combining this with another study, showing that good reminder and remembering systems should also interact with the user across different modalities. To allow delivery of triggers and rewards across a modality to suit different types of users.
This project will base the design of the chatbot on these requirements and principles to deliver reminders and rewards across multiple modalities.

This project aims to build a chatbot that supports habit formation, by building habit automaticity with multi-modal interaction over 66 days. After removing the chatbot, users should continue to perform the habit. The chatbot will provide habit tracking by means of reminders as a trigger, and rewards in three modalities, visual, auditory and tactile. A 66 day user study, and a 1 week follow up study, will test the success of the chatbot by evaluating effectiveness of each modality on habit automaticity. Chatbot interaction will be removed during the follow up study to test if users continue with the habit. Three groups, and a control group, will each receive reminders and rewards from a different modality.

The project will deliver a chatbot, design recommendations and analysis of the effectiveness of different modalities on habit automaticity.

Definitions

Human-Computer Interaction (HCI) - Field of computer science that studies how people interact with computers.

Modality - In the context of HCI, a modality or mode is the classification of a single independent channel of sensory input or output between a computer and a human.

Multi-Modal Interaction - Provides the user with multiple modalities or modes for interacting with a system.

Chatbot - A method of communicating with a computer system via a conversation using natural language.

Contents

1 Introduction

Background

There are many goals people want to achieve, such as losing weight, that require repetitive tasks, such as regular exercise. Habits can be used to perform these actions with almost no conscious thought in a automatic-like way. Forming a positive habit can increase the chance people achieve these goals by changing their behaviour [1]. There are three elements of habit formation. Repetition, contextual cues and positive reinforcement [2]. Associating the cue with performance and grounding the process with a reward encourages regular repetition, leading to automatic behaviour [3]. Building a new habit requires a contextual cue, to trigger the start of the habit (action), and a reward for positive reinforcement [2]. For example, when you eat breakfast (trigger), you might write in a journal (action), and then reflect on last week (reward). Studies have shown that the process of creating a new habit takes on average up to 66 days of repetitive use [4]. This is a long time for people to remember, perform and sustain a new habit without any help, if only the majority of people carried around a contexually aware device that could aid us...

Motivation

Habit Formation

Technology can solve this problem, by reminding and building motivation for repetitive tasks. Mobile phones provide us with an interactive platform that can help with habit formation. Plenty of existing habit-formation systems use apps that guide users through a series of experiences to form a new habit. Although, literature shows these apps are unsuccessful at forming habits because they are not grounded in habit formation theory [2]. The apps create a dependence on the technology and do not build the automatic reaction to a trigger (habit automaticity) e.g. when people stop using habit forming mobile apps, they also stop performing the habit.

Studies have shown that routine-based remembering strategies are good for building habit automaticity. [5] has produced a set of design requirements for building mobile apps grounded in habit formation theory. These requirements aim to facilitate the formation of reliable routine-based remembering strategies.

Chatbots

Interaction with current habit-formation systems is often via a mobile app. This creates a notable difference in the person when the system is removed, as people personalise their phone and it becomes a part of them [6]. Removing the habit formation app, has shown to stop people performing the habit.

Chatbots are a method of communicating with a computer system via a conversation using natural language. They provide a better mobile phone integration for users, as they hook into messaging services users are familiar with. When removing the system, instead of removing an app, users stop messaging a person (the chatbot). This project will build a chatbot to deliver reminders and rewards to users, to test if users sustain habit automaticity.

Multi-Modal

Studies have shown that good reminder systems should be multi-modal [7], providing alternative ways to interact with the user, either visual, auditory or tactile. This increases the likelihood that the delivery method will be pleasant and satisfactory to the user. Incorporating this technique

into the chatbot by delivering rewards to users across multiple modalities ensures rewards are intrinsic. But, reminders will be issued on a single mode to limit the scope of this project to test test how rewards are effected.

Aims

This project aims to support habit formation by building a chatbot that delivers reminders and rewards to users. The reminders will be on a single mode and the rewards will be multi-modal.

Objectives

The chatbot will provide habit tracking with reminder messages as triggers, and rewards as positive reinforcement in three modalities, visual, auditory and tactile.

The rewards will provide the user with the satisfaction of completing the habit action and encourage them to build user habit automaticity. The visual reward will be a photo, the auditory reward will be a audio clip and the tactile reward will integrate with a wearable to provide tactile feedback.

Methodology

To net the largest amount of users to test, the chatbot will be built using a popular messaging platform, Facebook Messenger.

A 30 day user study, and a 1 week follow up study, will test the success of the chatbot by evaluating effectiveness of each modality on habit automaticity. Chatbot interaction will be removed during the follow up study to test if users continue with the habit. Three groups, and a control group, will each receive reminders and rewards from a different modality.

The user study will gather the following:

- quantitative analysis of chatbot interaction
- qualitative survey of habit interaction at the end of the study, and end of follow up study
- automaticity test at beginning and end of study

Deliverables

- A chatbot that supports habits formation, using notification reminders as triggers and for rewards uses a combination of these 3 rewards
  - visual rewards as photos
  - auditory rewards as audio clips
  - tactile rewards as vibrations integrated with a wearable
- Analysis of the effectiveness of different modalities on habit automaticity
- Design recommendations for building a habit formation chatbot

Added value

The design recommendations will aid further research into building habit formation systems. The user study will show how effective chatbots are for delivering reminders and rewards and show how different types of reward deliveries through different modalities effect user habit automaticity.

This research review looks at the literature around multi-modal rewards and habit formation, summarising with design guidelines and a project plan, to test if multi-modal rewards provided by a chatbot support habit formation.

2 Habit Formation

To understand how to build an app that supports habit formation, we must discuss how people fundamentally form habits.

To change a persons behaviour an action needs to be repeated performed to turn into a habit and ensure that the behaviour persists in the future.

2.1 What are Habits

Within Psychology, Habits are learned automatic cue-response actions, such actions that will perform automatically in response to another action or trigger that has been actioned repeatedly in the past [8].

2.2 Forming Habits

Studies have shown people must keep to strict strategies and perform an action repeatedly before it turns into a action that occurs with little concious thought [1].

2.3 Three Elements of Habit Formation

Forming a habit occurs similarly to how a person changes their behaviour. Research [2] shows that using these 3 elements ensures an action becomes permanent.

1. Repetition
2. Contextual Cues
3. Positive Reinforcement

Repetition

Lally et al. (2010) states that the process of creating a new habit takes on average up to 66 days of repetitive use. The easier the action, the shorter time before the action turns into a habit, from drinking water (18 days), to going to the gym (254 days) [4]. Although repeating an action is not enough to form a habit.

Contextual Cues

Contextual Cues are actions attached to a context. These act as trigger events to push the person onto performing the action. For example, if you wanted to adopt a stretching habit, you could attach it onto an existing context like brushing your teeth. The contextual cue of brushing your teeth will trigger you to stretch. Literature [2] shows that attaching habits onto existing event-based cues are easier to remember, when compared with time-based habits, e.g. stretch every 4 hours. These help connect the contextual cue with the habit and builds habit automaticity (CITE: In Beyond self tracking, ref 12.). Further research also shows how multi-cue routines are the most effective. (CITE: Kathys PhD, cant find paper on it)

Positive Reinforcement

Rewarding a person with positive reinforcement after the action, builds the habit by giving the feeling of satisfaction. Rewards that benefit the person with satisfaction (intrinsic) should be used over monetary gains (extrinsic), due to isseus with extrinsic rewards hindering motivation [2].

Automaticity

- Big up needing technology for this process, 'if only we could do this automatically'

2.4 Technology

People find it difficult to change their behaviour. They find it hard to sustain positive habits. Can we use technology to help us?

There has been little research into how systems can support habit formation and behaviour change. A large number of these systems are mobile apps and are highly rated on app stores. However, most are not grounded in behaviour change theory with research showing habits are not sustained when the app is removed. This is because the apps do not build habit automaticity. Further research shows multi-cue routines develop automaticity and how multiple modalities encourage users to maintain performance [9].

This project will build upon requirements based on habit-formation theory, presenting a new method of delivering habit-forming techniques to people across multiple modalities using a Chatbot.

- How can we use tech for this problem Later research discusses concrete strategies for use with mobile technology [2].

Current State

- Current apps available - Kathys Research

Problems

- Not grounded in science

- Kathys research, state

- Lack of automaticity

- Doesn't develop when you remove the system

- Dependant ond tech

- To do with lack of automaticity - However, chatbots are not dependant on tech, as everyone will have a messaging platform, e.g. fb messenger

2.5 Requirements

- Kathys Research

- Design requirements

- Taxonomy of...

- Reward focused requirements

Finilised requirements

Requirements for Habit-Formation systems - List of combined requirements - However still lack of retention, but, there is hope, ¡ table of requirements - Foucs on just rewards - I will use kathys reqs for tracking requirements ¿ - @TODO multimodal research says using multiple modalities improves retention / automaticity

3 Multi-Modal

- What is a Modalitiy - Research into how multiple modalities improve retention - Different types, most common and @TODO research says these are most effective

3.1 Methods of Interaction

Audio

- What is it - Why are we choosing it - Examples

- Why is it good?

- What does it give to us - @TODO research

- Reward

- Cross check with my requirements

Visual

- What is it - Why are we choosing it - Examples

- Why is it good?

- @TODO research

- Reward

- Cross check with my requirements

Tactile

- What is it - Why are we chosing it - Examples - Wearables, Fitbit

Why is it good?

- @TODO research

Reward

- Cross check with requirements

3.2 Delivering Rewards

- Table of multimodal reward implementation strategies - Table of requirements matched with modalities - If you could implement this, you could increase users automaticity for habits

4 Chatbot Design

4.1 Design Considerations

- Setup: - Setup the bot via a messaging platform, such as fb messenger - Trigger: - Either A, certain configured time of the day - B: No trigger - C: Around a specific time - Action: - Choose habit from list of habits - Perform - Use app to track the action - Reward: - You get one of these rewards, based on modalitiy selected - Vision - Through message, of an image or gif - Could be: App, or message, gif - Audatory - Through phone via bot, link to mp3/spotify/apple music - Could be: App - Tactic - Through wearable - Could be: App, bot triggers wearbale alarm

4.2 User Flow

- Pre-Start - Choose daily habit type from list of X, e.g. 1 press up before breakfast - Enable notifications or fitbit if chosen - Time action / reward, variable rewards, e.g. then work out average time to send, or none - Start: - New day - @ trigger time, send reminder, if set, notification - Open notification, do habit, press tracked - Get reward type

5 Evaluating the System

5.1 User studies

5.2 Testing automaticity

6 Conclusion

Will this be a successful project?
Can we obtain the value that this project adds?

7 Work Plan

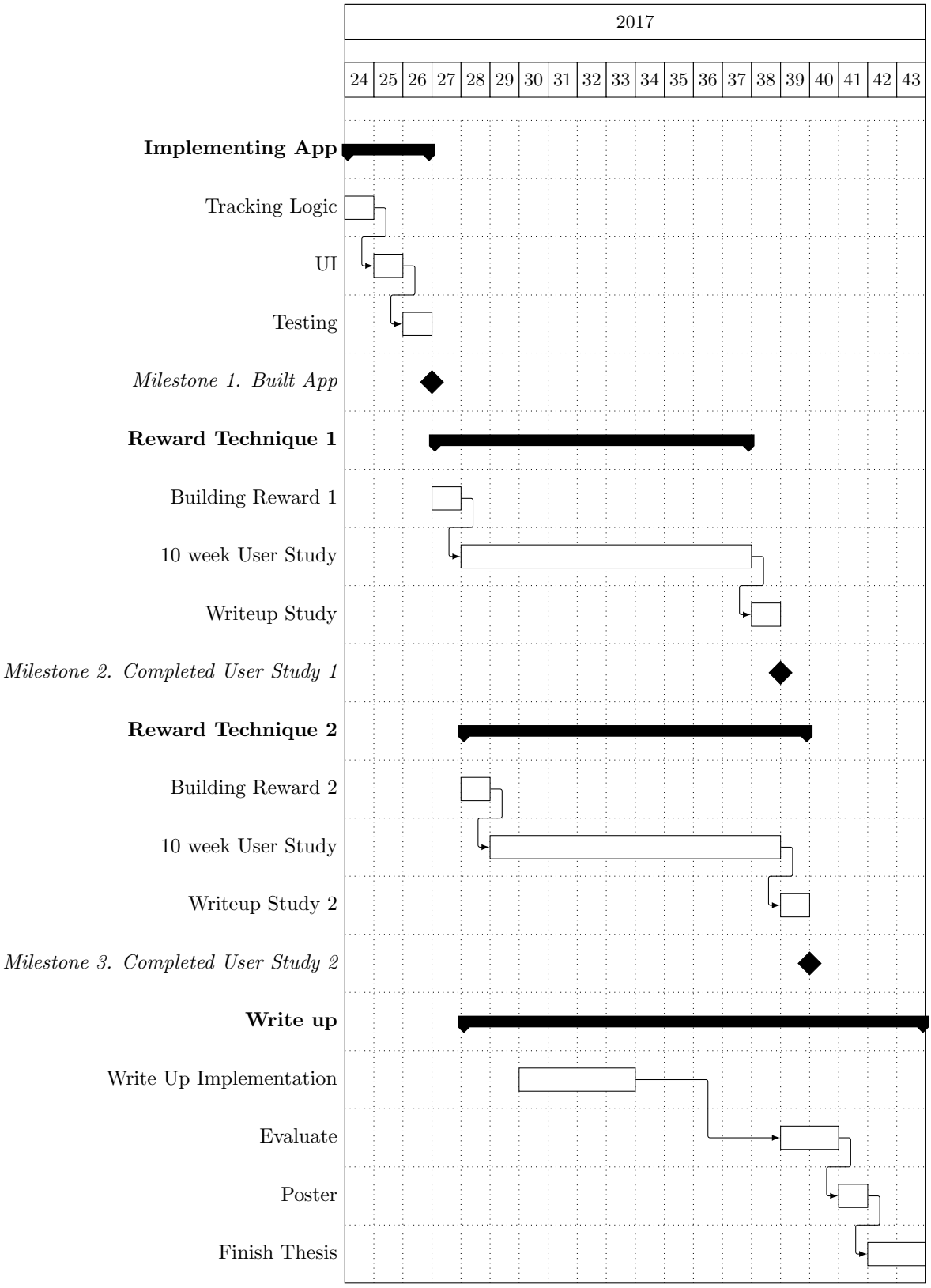
For this project there are X number of milestones to achieve.

Scope

Expected Timeline

The app is to be built, then two 30 day user studies will test the effectiveness of the app techniques.

@TODO find a way to add a title, and 'week' label @TODO only have 1 user study, but have 1 added week as a follow up study with no system interaction @TODO Say only 18/30 day user study as task is easy! Because [4]. See Beyond self tracking page 2, bottom left.


2017
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
Implementing App
Tracking Logic
UI
Testing
Milestone 1. Built App
Reward Technique 1
Building Reward 1
10 week User Study
Writeup Study
Milestone 2. Completed User Study 1
Reward Technique 2
Building Reward 2
10 week User Study
Writeup Study 2
Milestone 3. Completed User Study 2
Write up
Write Up Implementation
Evaluate
Poster
Finish Thesis

Deliverables

7.1 Risk Analysis

Table of risks and mitigation techniques.

8 References

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