Investigating how Different Multimodal Rewards Controlled by a Chatbot Effects Habit Formation

Harry Mumford-Turner

School of Engineering
University of Bristol
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Supervision from
Dr. Oussama Metatla &
Dr. Katarzyna Stawarz.

I hereby declare that this dissertation is all my own work,
except as indicated in the text:

Signature _____

Date _____/_____/_____

University of
BRISTOL

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Abstract

Habits are automatic actions that require little effort. For example, washing your hands automatically after using the toilet. Forming new positives habit needs three elements: contextual cues, positive reinforcement and repetition. The contextual cue acts as a trigger and the positive reinforcement rewards the person, encouraging them to perform the action again when triggered by the cue. A study measured repetition to show a habit takes on average, 66 days to form [1]. However, people still fail at forming new positive habits and give up because they don't stick to a routine [2, 3].

Mobile technology can help people stick to a routine by focusing on the three elements. Using reminders as triggers to repeat an action, helping us associate contextual information around the action and rewarding us with positive reinforcement. Yet most existing mobile systems aren't built on theory, leading to repetitive actions rather than habit automaticity. Therefore, people become dependent on technology and habit performance decreases when the system is eventually removed.

Building habit automaticity removes this dependency. We can increase automaticity by building motivation to complete the action [4, 5]. We can encourage motivation by rewarding users with positive reinforcement by granting user's satisfaction after completing the action. However, reward type and delivery type are important. Giving money (extrinsic rewards) hinders motivation. Giving satisfaction (intrinsic rewards) benefits the person and should be preferred. The type of delivery should suit each individual user so a choice of delivery should be available. Different research [6] shows how interaction with users should span different modalities to suit the needs to users. This project will combine this knowledge from these two domains to focus on how intrinsic rewards from different modalities affect people's habit strength.

This project will use the three elements of habit formation to build a mobile technology tool to deliver rewards from different modalities. These rewards will be delivered using a chatbot instead of a mobile app to present a novel method of interacting with users. Chatbots are a method of communicating with a computer system using natural language, providing deeper integration into users mobile phone and can hook into messaging services users are familiar with, such as Facebook Messenger. The chatbot will be built using the three elements of habit formation, delivering: contextual cues, positive reinforcement and repetition. The chatbot design will be based on a combined set of theory-based design requirements; one for building habit formation apps that aim to increase habit automaticity and one for increasing motivation with intrinsic rewards.

An evaluation trial will test the chatbot tool during a 4-week controlled period to measure user's habit strength. Participants will engage daily with the bot for 4 weeks, then for a further 1-week all interaction with the bot will be stopped to test if users continue to perform their chosen habit after the bot is removed. The chatbot will provide habit tracking using reminders as triggers, and rewards from three modalities, visual, auditory and tactile vibration. Participants will split into four groups, a control group that will not receive any rewards and the remaining three groups that will each receive rewards from a single different modality. The evaluation trial will test the success of the chatbot by measuring user's habit strength after the study, comparing the results with the control group.

The project aims to deliver insight into how rewards from different modalities effect habit strength and opens up new research avenues for investigating the use of chatbots as vehicles for promoting behaviour change.

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.

Multimodal System - A system that provides the user with multiple modes of interaction.

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

Contents

1 Introduction

Background

People have goals they want to achieve that require repetitive actions, such as regular exercise or losing weight. Habits can be used to perform these actions with almost no conscious thought in a automatic-like way. Forming a positive habit increases the chance people can achieve these type of goals, by changing their behaviour [2]. Evidence [7] suggests there are three elements of habit formation: repetition, contextual cues and positive reinforcement. Associating the cue with performance and grounding the process with a reward encourages regular repetition, leading to automatic behaviour [8]. Building a new habit requires a contextual cue, to trigger the start of the habit (action), and a reward for positive reinforcement [7, 1]. For example, a reminder on your phone (trigger) reminds you to stretch (action), relaxing you and removing back pain (reward). Studies have shown that the process of creating a new habit takes on average up to 66 days of repetitive use [1]. But, anyone who has ever made a new years resolution knows the difficulties in changing behaviour. People try to create new positive habits only to drop them a few days into their new routine.

Motivation

Habit Formation

Technology can help solve this problem. Coaching us through a new routine until an action becomes a habit. Mobile technology provides us with an interactive platform that can help support habit formation. Issuing reminders and build motivation for repetitive tasks. Plenty of existing habit formation mobile systems use apps to guide users through a series of experiences to form a new habit. But the majority of these apps are unsuccessful because they don't ground themselves in habit formation theory [7, 9]. These apps create a dependency on the technology and don't build the automatic reaction to a trigger (habit automaticity) [10]. For example, the dependence is highlihgted whent he apps are removed as people stop the habit altogether.

Research [11] shows that routine-based remembering strategies are good for building habit automaticity. Stawarz et al. [12] produced a set of design requirements for building mobile apps grounded in habit formation theory that aim to build habit automaticity. Other literature [13] shows how intrinsic rewards build habit automaticity, producing a set of real-world implementation requirements. Combined these two requirements form a new set focused on rewards. This project will use these requirements to build a tool to help measure the effect of rewards on habit automaticity.

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 [14]. This is also the case with many mobile feedback systems that aid with behaviour change. When we remove the system any improved performance is lost [10, 15].

Chatbots are a method of communicating with a computer system via a conversation using natural language. They hook into messaging services users are familiar with, providing a better mobile phone integration for users. 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, acting as a novel tool to facilitate interaction with users.

Reward Modalities

Habit formation systems use reminders and rewards. Studies have shown that good reminder systems should be multi-modal [16], that is providing alternative ways to interact with the user, either visual, auditory or tactile vibration. This increases the likelihood that the delivery method will be pleasant and satisfactory to the user. This project will use this idea for rewards, incorporating this technique into the chatbot by delivering rewards to users across multiple modalities. However, reminders will still be issued on a single mode (visual) to limit the scope of this project to test how rewards from different modalities effect peoples habit strength.

Aims

This project aims to evaluate how users habit strength is effected by rewards from different modalities using a chatbot as the tool to deliver these rewards.

Objectives

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

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 an audio clip and the tactile reward will integrate with a wearable to provide tactile feedback from vibrations. Each reward mode content will be comparable with another, using crossmodal mapping across all rewards modalities. Different types of mappings will be explored during the implementation of rewards. For example, a visual picture of a bird could be mapped with the sound (auditory) of a bird.

Methodology

The literature review enabled the construction of theory-based requirements that are focused on rewards for habit formation. Next a tool can be built that uses these requirements, to ensure that the system is based on theory. A chatbot will be constructed as a tool to track habits, deliver reminders as notifications and deliver rewards from three modalities, visual, auditory and tactile vibration. To utilise participant availability, the chatbot will be built using a popular messaging platform, Facebook Messenger.

A 4-week evaluation trial will test the success of the chatbot by evaluating the tool and the effectiveness of each modality on users habit strength using a validated questionnaire. Chatbot interaction will be removed during a 1-week follow up trial to test if users continue with the habit. Participants will split into four groups, all groups will receive reminders, three groups will receive rewards each from a different modality, and one group (control group) will not recieve any rewards.

Deliverables

To summarise, these are the following key project deliverables.

- A chatbot to serve as a tool that tracks habits by delivering rewards from three modalities, visual, auditory and tactile vibration.
- Analysis about how rewards from different modalities effect habit strength.
- Design recommendations for building chatbots that deliver rewards in different modalities.

Added value

Evaluation from real-users will reveal positive and negative aspects of the requirements. The follow-up trail in determines if the requirements were effective for building habit automaticity and will test the validity of the hypothesis. If user's habit automaticity does not increase, the project still presents a novel method of interacting with users and track habits. A system evaluation provides value on how to build a chatbot to deliver rewards from different modalities to support habit formation. Finally, the project opens up new research avenues for investigating the use of chatbots as vehicles for promoting behaviour change.

This research review looks at the literature around habit formation and rewards from different modalities, summarising with design guidelines and a project plan.

2 Habit Formation

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

Psychology defines habits as 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 [3]. 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 [2].

2.1 Three Elements of Habit Formation

Forming a habit occurs similarly to how a person changes their behaviour. A study into how habits are formed [8] shows that using the following three elements ensures an action becomes permanent.

1. Repetition
2. Contextual Cues
3. Positive Reinforcement

Repetition

Lally et al. [1] conducted a test on how long it takes for an action to become automatic, showing that the process of creating a new habit takes on average 66 days of repetitive use. The easier the action, the shorter the before the action turns into a habit, from drinking water (18 days), to going to the gym (254 days) [1]. However, applying the other two elements is needed before the action develops into a habit.

Contextual Cues

Context from information around the action, serves as a cue to 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 habit like brushing your teeth. The contextual cue of brushing your teeth will trigger you to stretch.

Behaviour change literature [17] 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 information with the action and builds habit automaticity [18]. Further research into the design implications of contextual cues shows how multi-cue routines are more effective that a single cue [11].

Positive Reinforcement

Self-efficacy, the belief in ones ability to succeed, plays a large part in forming habits and is a main part of behaviour change [4]. Rewards give people this experience by feeding back their success of their action. Rewarding a person with positive reinforcement, strengthens the habit by giving the feeling of satisfaction [2]. However, the type of reward matters, as rewards that benefit the person with satisfaction (intrinsic rewards) should be used over monetary gains (extrinsic rewards), due to issues with extrinsic rewards hindering motivation [5].

2.2 Technology

Research into how mobile systems can support habit formation and behaviour change, shows a large number of habit forming systems are mobile apps. Studies into the effectiveness of these apps has been recently conducted [7, 10] revealing that although most of these apps are rated highly, they do not ground themselves in behaviour change theory. Research into some of these apps show that habits are not sustained when the app is removed, due to the lack of habit automaticity [7].

Two pieces of literature discuss different concrete strategies for building habit forming mobile apps that do ground themselves in theory [19, 13]. Stawarz [19] presented formal requirements for building habit forming apps, based on the above three elements of habit formation with the aim to build habit automaticity. Weiser et al. [13] shows that 'motivation is a key requirement for behaviour change' presenting five design principle requirements and six requirements about the implementation mechanics of habit forming systems that focus on rewards and motivational needs. This project will build upon this set of requirements, combing them into a new set of design requirements for habit formation systems that focuses on rewards.

2.3 Combined Requirements

Combining information from the above two sources [19, 13], produces the following list of methods to build a habit forming app.

The system must:

1. Help users define a memorable strategy
2. Give users small difficult tasks (challenges)
3. Give them Competition & Comparison & Cooperation
4. Give insights for strategy improvements and support changes
5. Remind them about cues and remembering strategies
6. Reward Users
7. Disable cue reminders when behaviour is routine
8. Check if the action has already happened

The following table shows how the two sources [19, 13] were combined.

REQ	Stawarz. [19]	Weiser et al. [13]	Combined Requirement
1.	REQ 1. Help users define a good remembering strategy. REQ 2. Provide examples of good remembering strategies	Design REQ 2. Support User Choice. Design REQ 4. Provide personalized experience.	Help users define a memorable strategy.
1a.	NA	Mechanic REQ 3. Offer challenges	Give users small difficult tasks (challenges).
1b.	NA	Mechanic REQ 5. Competition & Comparison. Mechanic REQ 6. Cooperation	Give them Competition & Comparison & Cooperation.
2.	REQ 3. Provide suggestions for strategy improvements and support changes.	Design REQ 1. Offer meaningful suggestions. Mechanic REQ 2. User Education.	Give insights for strategy improvements and support changes.
3.	REQ 4. Remind about cues and remembering strategies.	Design REQ 3. Provide User Guidance. Mechanic REQ 2. User Education.	Remind them about cues and remembering strategies.
4.	NA	Mechanic REQ 4. Rewards.	Reward users.
5.	REQ 5. Disable cue reminders when the behaviour becomes a part of a routine.	Design REQ 5. Design for every stage of behaviour change.	Disable cue reminders when behaviour is routine.
6.	REQ 6. Help users check whether the habit has already happened.	Mechanic REQ 1. Feedback.	Check if the action has already happened.

Figure 1: The combined table of requirements for designing mobile systems focused on rewards.

2.4 Requirements Overview

The combined requirements based on methods from [19, 13] create a list grounded in habit formation theory and focused on rewards. Each requirement provides detailed breakdown about why it's used and what mechanics it relates to from theory.

1. Help users define a memorable strategy

- Make personalized, well defined, structured multi-cue routines & also support users choice of not setting remembering strategies.
- Provide examples of some strategies to users.

1a. Give users small difficult tasks (challenges)

- Assignments: Turn the bigger habit into smaller assignments to make it more enjoyable, being careful to not make them forced.
- Quests: Same as assignments, but optional.
- Goals: User specified to support user autonomy. Should be specific and challenging to get better results.

1b. Give them Competition & Comparison & Cooperation

- Friends, teams & groups.
- Leader-boards and collections.

2. Give insights for strategy improvements and support changes

- Give users meaningful instant feedback & accumulated feedback based on their system usage.

3. Remind them about cues and remembering strategies

- Reminders can effectively support prospective memory in the short term.
- Educate them about what they should perform.

4. Rewards

- A good form of external motivation because they don't change the ability to perform a behaviour, unless the reward itself is a tool that increases ability.
- Provide a strong motivational source, but like all extrinsic motivators, these are less effective for changing behaviour in the long run, because externally motivated behaviour lasts as long as the external motivator exists.
- Identifying methods that enable internalisation of externally motivated behaviour.
- Achievements and badges.

5. Disable cue reminders when behaviour is routine

- Relying on reminders in the long term can hinder habit development.
- Ease off from reminders later.

6. Check if the action has already happened

- Easy to forget whether a task done automatically, completed.

Summary

These requirements will act as the basis for this project. The are guidelines for building habit formation systems that focus on delivering rewards to build habit automaticity and motivation. This project aims to test how different types of rewards from different modalities effects users habit strength.

3 Multimodal

Habit formation research [11] shows multiple contextual cues better support behaviour change, compared with a single mode. If we combine this with research [20] into crossmodal interaction, i.e. the process of signals we receive through a single sense affecting how we process information perceived through a different sense. We can map habit rewards across different modalities, enabling us to present users with the same type of reward on different modalities. This allows us to test the different types of modalities and how they effect behaviour change. The next section discusses methods of interaction in practice.

3.1 Why Multimodal Interaction

'Multimodal systems are required for user interaction' [6] states research into comparing unimodal reminders systems with multimodal. They suggests a need for 'highly flexible and contextualised multimodal and multi-device reminder systems' [6]. Although this study focused on the elderly, so the need to multiple modalities was important because some peoples sensory modalities decline with age, this principle still holds true for general case reminder systems. The study presents design guidelines for reminder systems. These are mainly focused on users needing a choice of modalities for interacting with users, as users want a highly configurable system. These aspects will be implemented into our project and adapted for delivering rewards.

Research into designing multimodal reminders for the home, states that 'Good reminder systems should be multimodal, because they provide alternative ways to interact with a user' [16]. Multimodal interaction increases the likelihood that the information users are receiving are more pleasant to them, and decreases the chance the interaction will be disruptive or annoying [16]. Habit rewards should not be annoying, they should give users a feeling of satisfaction, therefore reducing the chance of disruption is another justification for using multiple modalities.

3.2 Modality Types

Next we look at literature discussing the three main modality types and how they change peoples behaviour.

Visual

One study looked at improving habit consistency for how often patients took medication, by using a visual display device that gave constant feedback [15]. They found that this feedback improved consistency of the habit and increasing rating of self-efficacy. But when the device was removed, their performance dropped (from a 2-month follow up study), because users integrated the feedback display with their routines. This habit-forming system used visual feedback to encourage consistency, however, this system shouldn't integrate visual cues into the system, otherwise users will become dependent on the technology. Users should instead build these cues outside of the system to build performance longevity after removing the system.

Auditory

Another key paper, discussed their need for multimodal applications when designing for the elderly [21], combing different sounds with high visual contrast to suit their needs, given deteriorating senses due to age. The study showed that multimodal interaction gives a means of communication to people

with varying levels of sense ability. But studies have also shown people need a choice of mode when designing for multimodal interaction [6], and thus the design requirements produced from this study can be applied to general multimodal applications, such as this project. The design guidelines discuss the need for interaction consistency, such as using similar audio interaction. Therefore the mapping between the visual, auditory and tactile vibration will be mapped identifying a pattern across the modalities.

Tactile Vibration

The majority of electronic activity monitors have behaviour change techniques and these monitors present a medium which behaviour change interventions could occur [22]. This provides us with a final modality to explore reward delivery techniques, implemented with a wearable device using vibration. A survey on activity monitors [22] ranked Fitbit devices 'Good vehicles for behaviour change techniques'. Thus, the Fibit, will be the primary platform for integrating tactile vibration for rewards.

3.3 Reward Types

Rewards will be delivered from each modality, with the content based on requirements created in Chapter 2. Visual rewards will present the user with a photo that gives users satisfaction after completing the action, auditory rewards will provide a similar result but via the auditory mode, finally vibration patterns will represent the tactile mode. The next section discusses design recommendations for delivery methods for these rewards.

4 Design

'Mobile phone adoption presents us with highly available, contextually aware and interactive platforms' [23]. Research into designing systems for mobile behaviour change technology, presents us with some implementation design requirements. Implementing a chatbot using these design considerations produces a solid ground for building this system.

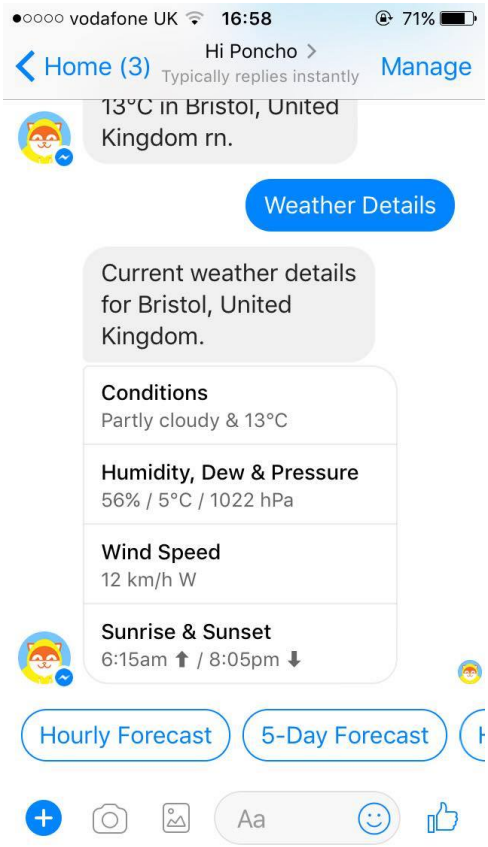

Figure 2: Poncho: An example of Facebook Messenger Weather Chatbot

4.1 Design Considerations

Current mobile systems use apps to interact with users, but a recent study showed apps fall into a low behavioural theory adherence scale [23]. Research into how to build systems that are theory-based, suggest four main stages for designing mobile health solutions. Conceptualisation, Formative Research and Pretesting, Pilot trials and Evaluation trials [23]. The first two stages use the Behaviour Change Wheel [24] (a framework for planning health behaviour interventions), to understand the behaviour, better define the characteristics and form the mobile concept into a prototype. The pilot trials tests the prototype before it moves to a finalised app with the commitment of a full trial. The final stage tests the finalised app with a wider range of participants. This project will use these four stages as design steps to build the prototype.

There are many different types of chatbots available today, however, to utilise participant availability, Facebook Messenger – a popular messenging platform – will provide the framework to build the chatbot.

4.2 Implementing Rewards

The types of rewards are separated into three categories, visual, auditory and tactile vibration. Different types of these rewards will be experiemented with, and test if they provide user satisfaction. These rewards will be displayed to the user within the chatbot, e.g. a photo or GIF. Auditory rewards will provide a link to a soundtrack and tactile vibration rewards will link with a wearable device to provide vibration patterns.

5 Evaluation

Many people agree about the importance of designing systems for health and behaviour change [23, 25, 26]. But each have varying opinions about how to evaluate these systems. Klasnja et al. [27] focuses on system usability and does it meet the needs of users. Whereas, Stawarz and Cox [26] argue evaluating a system of this type requires information from other fields to properly consider the systems effectiveness. The validated Behaviour Change Wheel Framework [24] does just this. Evaluating the system with validated behaviour change techniques from multiple domains. This project will use this framework to evaluate the chatbot with evaluation trials. These will test the long-term effect and efficiency of the bot, with information from two fields of study, HCI and health psychology.

5.1 Evaluation Trials

Evaluation trials are the final part of the Behaviour Change Wheel Framework [24]. HCI research that focuses on health interventions [23], demonstrates the importance of evaluation trials for evaluating mobile health systems. These trials have three goals to test: objective-quantitative efficacy, subjective-qualitative feedback measures and real-world feedback about how the system is utilised [27]. I will conduct an evaluation trial for this project.

The length of the trial will be based on two factors, the time needed to form a habit [1] and the results of a previous habit formation trial [7]. First, the number of repetitive days required for an action to be considered a habit varies based on the complexity of the action [1]. Simple actions, such as drinking 2 glasses of water a day, can take a minimum of 18 days to form. The suggested actions used for this project will be considered as simple, e.g. stretching for 30 seconds. Second, a previous evaluation trial on habit-formation systems [1] showed an increase in habit automaticity after 4 weeks. This project will mirror that timeframe.

A 4-week evaluation trial will test the success of the chatbot by evaluating the tool and the effectiveness of each modality on users habit strength. Chatbot interaction will be removed during the follow up study to test if users continue with the habit. Participants will split into four groups, all groups will receive reminders, three groups will receive rewards each from a different modality, and one group (control group) will not recieve any rewards.

5.2 Testing Habit Strength

Habit strength will be measured using a validated 12-question questionnaire that specifically looks at automaticity [28]. Automaticity will also be measured using a validated subset of the questionnaire from [28] to test users habit behavioural automaticity index [29]. This will show the impact each modality has on habit automaticity and test the hypothesis. Participants will fill out the questionnaires [28, 29] at three stages: half-way through the trial (at 2-weeks), after the trial has finished and after the follow up trial.

6 Conclusion

The survey on the relevant literature demonstrates two sets of design requirements for building systems that support habit formation. In particular building habit automaticity is key to building lasting behaviour change and multi-cue routines better support behaviour change than single cues. Rewards from different modalities are key to building habit automaticity and multi-modal interaction increases user interaction. These combine to form new requirements that focus on delivering multimodal rewards.

This will be a successful project because the requirements are based on theory. This gives us a chance of success for the implementation, as long as the construction adheres to those requirements.

A chatbot designed from these requirements will deliver rewards to users from different modalities. A 4-week evaluation trial will test the effectiveness of the chatbot implementation and the design requirements. Finally a 1-week follow up trial will test user's habit automaticity.

Evaluation from real users testing the implementation reveals important positive and negative aspects of the requirements. Following up after the study plays an important part in determining if the requirements were effective for building habit automaticity and testing the validity of our hypothesis. If user's habit automaticity does not increase, the project still presents a novel method of interacting with users to track habits and a system evaluation provides value on how to build a chatbot to deliver rewards from different modalities to support habit formation. Finally, the project opens up new research avenues for investigating the use of chatbots as vehicles for promoting behaviour change.

7 Work Plan

For this project there are four milestones that split into two parts, building and testing.

7.1 Milestones

1. Building
   - 1.1 Build the chatbot.
   - 1.2 Build delivery of rewards from three modalities, visual, auditory and tactile vibration.
2. Testing
   - 2.1 Conduct 4-week evaluation trial.
   - 2.2 Conduct 1-week follow up trial.

7.2 Tasks

1. Building

Tasks for building the chatbot are to implement:

1. Interaction between a user and our system via the Facebook Messenger platform.
2. Question-response statements for the chatbot.
3. Training the chatbot on these responses.
4. Reminder component for habit triggers.
5. Visual rewards.
6. Auditory rewards.
7. Tactile vibration rewards by integrating with FitBit.
8. On-boarding for new users to get started with the chatbot.

2. Testing

1. Test the chatbot using a unit-test harness, to increase the quality of the chatbot.
2. Write 4-week evaluation trial.
3. Write 1-week follow up study.
4. Conduct 4-week evaluation trial, users will use the chatbot daily to track a habit and perform a habit automaticity test before the study starts and after it has finished.
5. Conduct 1-week follow up trial, users will stop using the chatbot, after 7 days will be contacted to perform a habit automaticity test and present how often they performed their habit in the 7 days.
6. Analyse trial results.

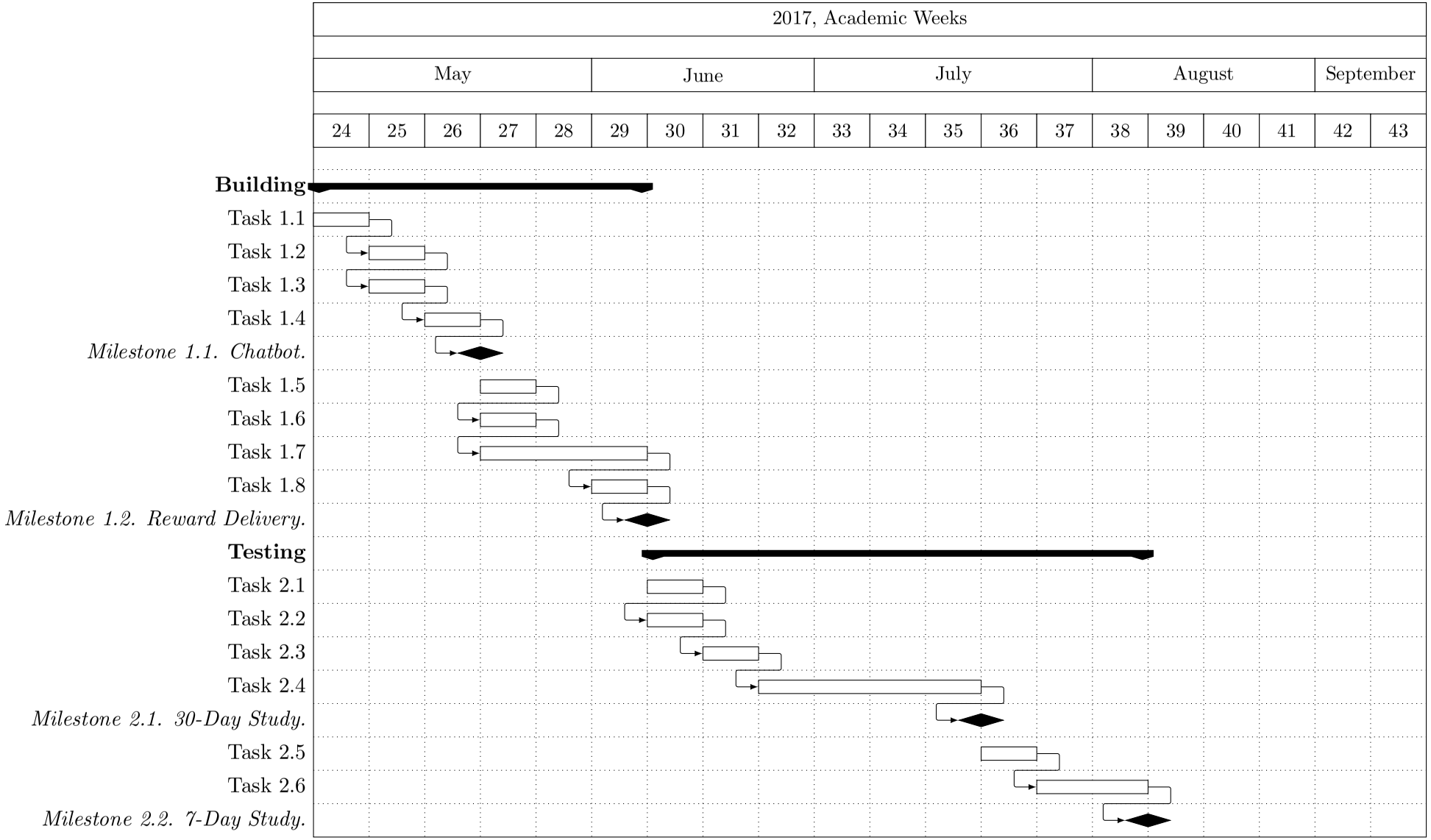

Figure 3: Gantt Chart of estimated project timeline. Starts 01/05/17, ends 21/08/17

7.3 Risk Analysis

Problems that might occur in the project are summarised below with contingency plans and risk mitigation techniques.

Main Project Risks				
Severity	**Likelihood**	**Risk**	**Prevention**	**Contingency**
5	1	Chatbot could break during evaluation trial.	A unit-test harness will be constructed to increase the quality of the prototype.	Design recommendations can still be used from chatbot construction and if the chatbot doesn't completely break, the modalities that work can be tested against users.
4	4	Low sample size of users with wearable devices.	A popular wearable device has been chosen for integration to increase the number of users.	Additional wearable device integrations will be added, such as Jawbone, to increase pool of users.
4	2	Low sample size for evaluation trial.	Participants will be recruited ahead of time and university resources will be utilised.	Qualitative feedback will be gathered and focused upon, rather than quantitative to gleam a better understanding of design recommendations.
3	2	Under-estimate task length.	Contingency-weeks at the end of the project and over-estimation of tasks allow for task slippage.	Modification of project objectives allows for a focus on HCI design recommendations for building chatbots that support habit formation.

Figure 4: Table showing project risks and mitigation techniques.

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