Designing an Interactive Web Application to Enhance Weight Loss

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Abstract

Obesity is a serious health crisis facing the public worldwide. In the age of technology, more and more people are turning to health weight loss apps to tackle obesity. Yet a number of studies have brought into question the effectiveness of these apps.

This project assesses the suitability of the most popular weight loss apps currently available in order to identify improvements and formulate recommendations for developers that would make weight loss apps more effective and user friendly.

Using the results of a feature review, BCT analysis and a user survey, a prototype was designed and developed which aimed to improve on the apps currently available in order to provide a more suitable weight loss solution. User testing was then conducted on the prototype in order to increase the design's user friendliness.

Acknowledgements

Contents

1.0 Introduction

The world is currently facing a major public health crisis. Since 1975, obesity has nearly tripled worldwide [1]. More than 1.9 billion adults were overweight in 2016 and, of those, over 650 million were obese [1]. In 2017, 64% of adults in England were obese or overweight and morbid obesity had increased to nearly 4%, up from less than 1% in 1993 [2]. Obesity poses a serious health risk that can lead to further health complications, some of which can even be fatal. Obesity has been linked to chronic diseases such as hypertension, high cholesterol, stroke, heart disease, certain cancers, and diabetes [3]. In 2017, 8% of global deaths were attributed to obesity [4].

But as the world's obesity rates have increased, so has its access to technology. Currently, there are 3.5 billion smartphone users in the world today which accounts for 45% of the world's population. This is an increase of 1 billion users from 2016 [5]. With this rise in smartphone ownership, more and more people are turning to health apps in an effort to combat their health problems, and supply certainly meets the demand. A total of 325,000 mobile health (mHealth) apps were available in major app stores in 2017. That was an increase of 78,000 from 2016 [6]. Many of these apps target fitness and nutrition in a bid to help users lose weight. As of May 2018, the three most popular health and fitness apps in the US (Fitbit, MyFitnessPal and Samsung Health) had over 64 million monthly active users between them [7]. In the UK, the most popular iPhone health and fitness app by daily active users in February 2020 was MyFitnessPal which had over 253,000 active users every day [8].

But just how effective are these apps in helping users achieve weight loss? One study of MyFitnessPal found that, after 6 months of use, the app made no difference to the rate of weight loss [9]. In fact, a wide number of studies have found that, despite their popularity, the majority of the most popular weight management apps demonstrate limited incorporation of evidence-based content, established behaviour change theories and behavioural change techniques (BCTs) [10-16]. It has been shown that interventions which incorporate a greater number of BCTs are more effective than those that incorporate fewer [11, 14, 17], therefore making the rate of BCT inclusion an indicator of potential effectiveness. This brings into question the suitability of these apps for facilitating effective weight management for their users.

Moreover, the usability of these apps is also an important consideration. Continued user engagement is vital for an app to facilitate long term behaviour change. However, an online survey found that one quarter of downloaded weight loss apps are only used once and three quarters are discontinued after ten uses [18]. In a study of MyFitnessPal, of 58 participants that stopped using the app, 84% cited that the app was too tedious too use and 24% reported that it was not easy to use [9]. The study suggested that apps such as MyFitnessPal may need to be more engaging and less time consuming in order to produce more effective weight management solutions.

This project aimed to provide a comprehensive assessment of the most popular weight management apps currently available for their suitability in providing effective interventions for obesity and weight issues. Apps were assessed for the features they provide as well as their inclusion of behavioural change techniques and strategies. Areas for improvement were identified and potential features were suggested. The findings were used to design a new web application that aimed to implement these improvements to provide a more suitable solution to enhance weight loss.

1.1 Project Scope

The scope of the project evolved as the project progressed. Initially, only a feature review of the existing apps was to be carried out in order to gain an understanding of what features the apps provide and to identify areas where they could be improved. However, after further research was completed and based on the findings of previous studies into the effectiveness of weight loss apps, it was realised that assessing apps for their inclusion of behavioural change techniques, alongside the feature review, would present a more comprehensive and accurate reflection of the suitability of the apps and would provide a greater insight into how these apps could be improved. Therefore, the BCT assessment was incorporated into the project.

The project aimed to design and develop a prototype of a web app that would improve on existing apps based on the outcomes and findings of the app assessments and user testing. However, due to time restrictions of the project, this was only to be a prototype and did not intend to be a fully functional product that could be released on the app market but rather a proof of concept on which user testing could be performed to derive further improvements and to act as a basis for future work that would ultimately result in a finished product.

It can be viewed that there are two main elements of weight loss; physical activity and nutrition. There are weight loss apps available that focus on just one of these two aspects, and some that focus on both. Again, due to time restrictions, this project only focused on one of these two aspects. It was decided that the project would focus on the nutritional aspect of weight loss as research has shown that nutrition alone is more important for weight loss than physical activity alone [19]. Of course, it should be noted however, that a holistic approach that encompasses both nutrition and physical activity together is the most effective strategy for losing weight. Therefore, for the purposes of this project, only those apps that focused solely on nutrition were assessed and, similarly, the prototype was designed to only consider nutrition, with the incorporation of physical activity content a task for future work.

1.2 Project Aims and Objectives

The overarching aims of this project were to investigate the suitability of existing apps for facilitating weight loss, to identify and recommend improvements, and to develop a solution that implements these recommendations. In order for this project to be successful, there were a number of objectives that needed to be achieved. As the project progressed, some of the objectives set out in the initial plan were amended and some new objectives were introduced. The revised list of objectives is as follows:

Objective 1 – Research previous studies into the effectiveness of weight management apps in order to gain an understanding of the existing work that has occurred in this subject area.

Objective 2 – Conduct a series of assessments of the most popular weight management apps in order to assess them for their suitability in providing weight management solutions. This includes:

- A feature review to gain an understanding of how the existing apps operate, the features they provide, and users' opinions of the apps.
- An analysis of the behaviour change techniques (BCTs) that the apps incorporate.

Objective 3 – Provide recommendations, based on the findings of the assessments, for how these apps could improve and conceptualise features that may implement these improvements.

Objective 4 – Develop a prototype weight management app that improves upon the existing apps and provides a more suitable solution, informed by the findings of the app assessments.

Objective 5 – Conduct iterative user-testing to increase the user friendliness of the app's design.

1.3 Approach

The project was split into two main phases. The first phase was the research and assessment phase where research into the existing literature surrounding the problem was conducted and the assessments of the apps currently available were performed. The purpose of this phase was to gain an understanding of the research that has already been carried out in this area, to capture an overview of the most popular apps currently available, to identify their shortcomings and to formulate improvements that could be made in order to enhance their suitability for facilitating weight loss and combating obesity. The knowledge discovered during this phase guided and informed the direction of the second phase.

The second phase was the design and development phase. Using the data gathered from phase one, a prototype was be designed that implemented the improvements proposed. As previously discussed, user engagement plays a significant role in the success of a weight management app. Therefore, usability was an important consideration. As such, a user centred design approach was adopted where user testing was conducted on the initial iteration of the prototype. Doing so allowed the user's thoughts and feelings to guide and inform the design of the app in order to increase user friendliness. A Scrum approach was utilised for development as the flexibility it offers was well suited to reacting to the results of the user testing. Each iteration of the prototype, which were to be based on the feedback from the user testing, could be viewed as a sprint to implement the suggestions and potential improvements identified. However, due to time restrictions of the project, only one round of user testing was completed.

1.4 Tools Used

This project utilised a number of tools in order to achieve its objectives.

Task Management

Trello was used to organise tasks and track their progress. A Trello board was created for each phase and listed each task associated with that phase in order of priority. Descriptions were added outlining what each tasks entailed and a traffic light system was implemented using labels in order to track the tasks' progress.

Version Control

As there were to be a number of iterations and versions of the prototype, version control was important consideration. A Git repository was created to facilitate version control in order to track and manage various versions of the prototype.

Survey Tools

A survey was conducted in order to gain an insight into people's expectations and perceptions of existing weight loss apps and weight loss strategies in general. Microsoft Forms was used to host the survey. Forms is an ideal tool as it allows surveys to be easily shared with users and it handles all data collected through the surveys.

Video Conferencing Tools

Microsoft Teams was used to conduct remote user testing. Microsoft Teams is ideal for user testing as it allows screen sharing meaning users can share their screen with researchers as they complete the testing procedure. It also allows sessions to be recorded which is important as this allowed researchers to reflect on the sessions at a later date.

Prototyping

An online tool called Marvel App was used to realise early designs of the app. Marvel facilitates rapid prototyping and allows designs and ideas to be visualised on screen. The proposed features were implemented in Marvel which were then linked together to provide interactivity. This formed the initial version of the prototype. This was then used for user testing in order to gain an insight into the user's thoughts and feelings towards the design. This data was then be used to derive further improvements for subsequent iterations.

Programming Languages

A number of programming languages were employed to develop and construct the app. The primary languages that were used to construct the frontend were HTML5, CSS3, JavaScript and Bootstrap. These are all highly common, standard web programming languages that provided the framework and interactivity of the frontend. PHP was used to handle all backend operations and implement the functionality of the app. MySQL provided the database of the app.

2.0 Background

As we have seen, obesity is a serious challenge facing public health worldwide. In an attempt to combat this health risk, fitness and weight loss app usage is higher than ever. However, there have been many studies that have highlighted the shortcomings of these apps and that have brought into question their suitability and effectiveness for facilitating weight loss. One study investigated the effectiveness of one of the most popular and widely used weight management apps, MyFitnessPal (MFP), by administering it as a weight loss intervention to patients in a primary care clinic [9]. The study was a randomized controlled trial where half of the participants received usual primary care for weight loss without use of MFP and the other half received the same usual primary care alongside use of MFP. The results showed that there was no difference in the rate of weight loss between the two groups, indicating that MFP provided no additional benefits or effectivity to a traditional weight loss program. Another study in 2015 by Chen et al. reviewed the quality of the most popular weight loss smartphone apps by assessing them on their accountability, scientific coverage, content accuracy and relevance, technology-enhanced features, usability, and incorporation of behaviour change techniques (BCTs) [20]. The study concluded that, overall, the apps were suboptimal in quality due to their lack of science based content and relative absence of BCTs.

The incorporation of BCTs in apps is an important factor for their success in facilitating weight loss and the rate of BCT inclusion is a good indicator of an app's ability to induce behaviour change. A 2010 study into which characteristics of Internet-based interventions best promote health behaviour change found that interventions which incorporated more BCTs were more effective than those that incorporated fewer BCTs [17]. Yet, despite this, a number of studies have highlighted that there is a limited inclusion of BCTs in weight loss apps. The study by Chen et al. [20] identified an average inclusion rate of 6.3 of the 26 BCTs defined in Abraham and Michie's 26 BCT Taxonomy [21]. Similarly, a 2014 study by Direito et al. [15] which investigated the presence of BCTs in physical activity and dietary apps found an average inclusion rate of 8.1 BCTs, using the same 26 BCT Taxonomy. However, as pointed out by Chen et al., this study included only 6 dietary apps with the remaining apps reviewed being focused on physical activity. Chen et al., therefore, called for a comprehensive assessment of the quality of dietary apps which this project aims to provide. Furthermore, a study by Azar et al. [13] evaluated the inclusion of features consistent with traditional and contemporary health behaviour theories and strategies in nutrition tracking apps. Apps were evaluated and assigned two scores using instruments based on traditional behaviour theory and the Fogg Behavioural Model [22]. All apps that were evaluated received low overall scores and the study determined that there was a distinct lack of theory-based behavioural strategies included as components in nutrition tracking apps.

Although it has been shown that app developers prioritise aesthetics and functionality over evidence-based theories and strategies, app usability is still an important consideration and should not be neglected. An app could include a vast amount of BCTs and evidence-based content but if it is unable to engage it's users for a sustained period of time then it will be unsuccessful in facilitating behaviour change and weight loss. The study of MFP by Laing et al. [9], for example, noted that login frequency among users rapidly declined after enrolment. The number of active users reported in the first month of the study was 94 compared to 32 active users reported in the sixth month. One of the main reasons attributed to the decline in user engagement was usability issues such as the app being too tedious, difficult or time consuming to use. Further research has also found that 25% of downloaded health apps are only used once and 75% are abandoned after their tenth use [18].

This project aimed to build on the body of work that has already been undertaken in this subject area through the continuation of research into the effectiveness and suitability of weight loss apps, and by

considering the suggestions and conclusions that have been made when designing a new app in order to develop a more suitable and effective solution for weight loss. Following on from the investigations into the inclusion of BCTs in weight loss apps and the observation that this is an area where apps are falling short, this project assessed the most popular weight loss apps for BCTs to provide an updated review whilst focusing on dietary apps exclusively, as recommended by Chen et al. This project as a whole aimed to answer Breton et al.'s call for researchers to evaluate, develop and improve weight loss apps. Finally, in response to the significance of usability in the success of weight loss apps that has been highlighted, this project adopted a user centred design approach by analysing user comments of the most popular weight loss apps and by surveying users in order to gain an understanding of their perceptions and expectations, and through the use of iterative prototype testing.

3.0 Assessments of Existing App

This section will detail the protocols, results and conclusions of the assessments that were performed on the existing weight loss apps, including the feature review and BCT assessment.

3.1 Feature Review of Popular Weight Loss Apps

A feature review was conducted in order to gather an overview of the most popular weight loss apps currently available on the market and to understand how they operate, the types of features they provide and their users' perceptions of them. It was decided to review the apps available on the Google Play store as this is the most popular app market place and has the greatest availability of apps. To achieve this, the most popular apps first had to be identified. The most popular apps were defined as those apps which had the greatest number of downloads. However, the Google Play store could not be used to search for these apps as it does provide functionality for searching for app by number of downloads. Therefore, an open source search engine called KPlaySearch [23] which harvests data from the Google Play store was used to search for the apps as it allows apps to be filtered based on number of downloads. The terms "*weight loss, nutrition, diet, lose weight, calorie counter, food diary, healthy eating*" were used as the search query which returned 120 results. All apps with less than 5 million downloads were discarder, leaving 13 apps. The following inclusion criteria was then applied in order to ensure relevance and suitability of the apps for the study:

- Must use the English language.
- Must be available in the UK.
- Must be free to download and provide a free basic service.
- Must have a rating greater than 3.
- Core functionality must not be dependent on any additional devices (eg. wearables such as FitBit)
- Must provide functionality for recording meals in order to ensure there is a nutritional focus.

4 of these apps failed to meet the inclusion criteria, reducing the final list of apps to be reviewed to 9. The list of 13 apps with the inclusion criteria applied can be viewed in Table 1. These 9 apps were then downloaded and reviewed individually. Through the exploration and use of the apps, a comprehension of the 'feel' of these apps and how they operate was attained which would become important when designing the new app. Each feature identified was recorded. This provided an understanding of the types of features these apps supplied and allowed analysis of which features were the most and least common. A sample of the user reviews for each app were then collected. 3 positive and 3 negative reviews were selected for each app, with positive reviews being those that awarded more than 3 stars and negative reviews being those that left less than 3 stars. The identified features, user's reviews and in-app screenshots were collated in order to build a profile of each app which would serve as an overview of each app. The user comments were then categorised using affinity diagrams with one affinity diagram for positive comments and another affinity diagram for negative comments. Doing so allowed the users comments to be analysed for the perceived strengths, weaknesses, likes and dislikes of the apps which could then be used to gain an insight into what the users expect from weight loss apps and where they feel these apps could be improved.

After analysing the user comments, a number of suggestions for developers were derived that would help improve the existing apps and which would also be used to inform the design of the new app. For instance, food logging is an important and widespread aspect of weight loss apps but it can also be the most time consuming activity. Users expressed that they sometimes found this activity to be tedious which would deter them from doing so. They, therefore, were pleased when an app provided

	= Included
	= Excluded

Table 1: Included and Excluded Apps for Feature Review

App Name	Abbreviation	Installs	Rating (0 – 5)
Lose Weight in 30 Days	LW	50,000,000+	4.8
Calorie Counter-MyFitnessPal	MFP	50,000,000+	4.5
8fit Workouts & Meal Planner	8F	10,000,000+	4.5
WW (Weight Watchers Reimagined	WW	10,000,000+	4.5
Noom: Health & Weight	NHW	10,000,000+	4.1
HealthifyMe: Calorie Counter, Weight Loss Diet Plan	HM	10,000,000+	4.6
Calorie Counter by FatSecret	CC	10,000,000+	4.7
YAZIO Calorie Counter, Nutrition Diary & Diet Plan	YZO	10,000,000+	4.3
Lifesum – Diet Plan, Macro Calculator & Food Diary	LS	10,000,000+	4.3
My Diet Coach - Weight Loss Motivation & Tracker	MDC	10,000,000+	4.5
Calorie Counter by Lose It! for Diet and Weight Loss	LI	10,000,000+	4.6
Weight Loss Tracker & BMI – aktiBMI	WLT	5,000,000+	4.6
BodyFast Intermittent Fasting: Coach, Diet Tracker	BF	5,000,000+	4.6

functionality that made food logging more convenient such as the ability to save custom meals for easy logging at a later date, and when they could quickly enter nutritional information using a barcode scanner. However, they expressed disdain when these features were absent from an app. Therefore, these features which add convenience are important to users and developers should look to incorporate them into their apps. Convenience was an important quality of calorie tracking, which is arguably the most important function of a weight loss app. Users expressed a desire to be able to add calories to their calorie tracker without having to enter an entire meal, again due to the time

consuming nature of food logging. It was therefore recommended for developers to provide functionality to add 'simple calories' directly to the calorie tracker. This would also be a useful feature for users who wished to add calories from drinks. Users found it very useful when an app provided and displayed a personal daily calorie allowance as this informed users of how many calories they may consume a day in order to reach their target weight. It was therefore recommended that a calorie allowance should be calculated based on the user's current weight, target weight and a healthy rate of weight loss in accordance with expert guidance of a reputable health agency. Consistency and accuracy were very important to users with regards to calorie tracking as there were instances of tracked calories changing after being saved, to which users expressed great disdain. Developers should, therefore, ensure that tracked calories remain consistent. It was recommended that the HCI principle of progressive disclosure be used when presenting large amounts of detailed information such as recipes and nutritional information as users were sometimes overwhelmed. Using progressive disclosure would avoid this as less information would be presented on the interface at a given time but users would still be able to access further information when they desired. Users indicated that notifications were useful but sometimes found there to be too many notifications and too often which would be overwhelming, frustrating, and on some occasions even negatively impact the user interface. In response, it was recommended that developers allow app notifications to be switched on or off at the user's discretion. This could extend to notifications for individual features. Many users liked it when an app would provide feedback and encouragement, however, some users identified instances of messaging that promoted gender bias and anorexia. Developers should be mindful of the messages that they promulgate and it may be necessary to have messaging reviewed by health experts and psychologists before release. It was also suggested that apps should allow users to record an unlimited number of meals per day as some apps limited users to 4 meals a day which a number of users found restrictive. Furthermore, apps should provide a variety of weight measurements when creating and recoding meals such as grams and ounces as some users were unable to use the measurement that they are used to or the measurement that is used in their recipes.

Through analysis of the user reviews, three main qualities were discerned that users repeatedly expressed were important to them in weight loss apps; convenience, accuracy and intuitiveness. Developers should prioritise these properties when designing apps in order to satisfy their users. Convenience and intuitiveness are vital for sustained user engagement which, as has been demonstrated, is necessary for a weight loss app to be successful. Developers should, therefore, adopt a user-centred design approach when developing an app through iterative user testing as having a user's perspective and critique to inform design decisions can help ensure the app is user friendly, convenient and intuitive. It is also the responsibility of developers to ensure that all information and data in their apps are accurate as failure to do so can result in misinforming the user which can actually be detrimental to a user's progress.

The feature review was extremely beneficial in gaining an understanding of the current landscape of weight loss apps and what is available on the market. This provided the necessary foundational knowledge that is required before designing a new app and the recommendations identified in light of the user reviews will be used to inform the design process. The full feature review can be viewed in Appendix A.

3.2 Review of Popular Weight Loss Apps for their Inclusion of Behavioural Change Techniques

Introduction

A review was conducted in which the most popular apps for weight loss were assessed for their inclusion of behavioural change techniques (BCTs). Studies have shown that BCTs are an important factor in the ability of health apps to change the behaviours of their users, with apps that include an increased number of BCTs demonstrating greater effectiveness than apps that include fewer BCTs [17]. However, there have been numerous studies that have identified a deficiency of BCTs present in the most popular weight loss apps [15, 20]. The review aimed to determine which apps included the greatest and fewest number of BCTs, which were the most common and least common BCTs being utilised, and to then suggest and devise features that would incorporate the least common BCTs which future weight loss apps could implement in order to improve. This review would also extend the body of work that has already investigated this area by providing an updated assessment of the latest apps.

Method

Apps were assessed for the BCTs described by Abraham and Michie in their 26 BCT Taxonomy [21]. This taxonomy presents a standardised list of well-defined BCTs which were derived from a vast array of theory-based behaviour change interventions. It provides a framework with which to assess interventions for their inclusion of theory-based BCTs in a systematic manner and there has been a large body of work published which has utilised the taxonomy to quantify BCT incorporation. The taxonomy is described in Table 2.

The apps assessed were those which were selected in the feature review. The list of apps and their abbreviations is as follows: *Calorie Counter-MyFitnessPal (**MFP**), 8Fit Workout and Meal Planner (**8F**), Noon: Health and Weight (**NHW**), HealthifyMe: Calorie Counter, Weight Loss Diet Plan (**HM**), Calorie Counter by FatSecret (**CC**), YAZIO Calorie Counter, Nutrition Diary & Diet Plan (**YZO**), Lifesum – Diet Plan, Macro Calculator & Food Diary (**LS**), My Diet Coach - Weight Loss Motivation & Tracker (**MDC**), Calorie Counter by Lose It! for Diet and Weight Loss (**LI**)*. In order to quantify the BCTs in the apps, each app was downloaded from the Google Play Store to an Android device. Each app was then assessed individually for each BCT in turn by reading the BCT definition and then exploring the app to identify the presence or absence of the BCT. A table was used to record the presence or absence of the BCT in the app, with '1' indicating the BCT's presence and '0' indicating it's absence from the app. The results are presented in Table 3.

Table 2: Abraham and Michie's 26 BCT Taxonomy

Behavioural Change Technique	Description
1. Provide information about behaviour health link.	General information about behaviour risk, for example, susceptibility to poor health outcomes or mortal risk in relation to the behaviour.
2. Provide information on consequences.	Information about the benefits and costs of action or inaction, focusing on what will happen if the person does or does not perform the behaviour.
3. Provide information about others' approval.	Information about what others think about the person's behaviour and whether others will approve or disapprove of any proposed behaviour change.
4. Prompt intention formation.	Encouraging the person to decide to act or set a general goal, for example, to make a behavioural resolution such as "I will take more exercise next week".
5. Prompt barrier identification.	Identify barrier to performing the behaviour and plan ways of overcoming them.
6. Provide general encouragement.	Praising or rewarding the person for effort or performance without this being contingent on specified behaviours or standards of performance.
7. Set graded tasks.	Set easy tasks, and increase difficulty until target behaviour is performed.
8. Provide instruction.	Telling the person how to perform a behaviour and/or preparatory behaviours.
9. Model or demonstrate the behaviour.	An expert shows the person how to correctly perform a behaviour, for example, in class or on video.
10. Prompt specific goal setting.	Involves detailed planning of what the person will do, including a definition of the behaviour specifying frequency, intensity, or duration and specification of at least one context, that is, where, when, how or with whom.
11. Prompt review of behavioural goals.	Review and/or reconsideration of previously set goals or intentions.
12. Prompt self-monitoring of behaviour.	The person is asked to keep a record of specified behaviour(s) (e.g., in a diary)
13. Provide feedback on performance.	Providing data about recorded behaviour or evaluating performance in relation to a set standard or other's performance, i.e., the person received feedback on their behaviour.
14. Provide contingent rewards.	Praise, encouragement, or material rewards that are explicitly linked to the achievement of specified behaviours.
15. Teach to use prompts or cues.	Teach the person to identify environmental cues that can be used to remind them to perform a behaviour, including times of day or elements of contexts.
16. Agree on behavioural contract.	Agreement (e.g., signing) of a contract specifying behaviour to be performed so that there is a written record of the person's resolution witnessed by another.
17. Prompt practice.	Prompt the person to rehearse and repeat the behaviour or preparatory behaviours.
18. Use follow-up prompts.	Contacting the person again after the main part of the intervention is complete.
19. Provide opportunities for social comparison.	Facilitate observation of non-expert others' performance for example, in a group class or using video or case study.
20. Plan social support or social change.	Prompting consideration of how others could change their behaviour to offer the person help or (instrumental) social support, including "buddy" systems and/or providing social support.
21. Prompt identification as a role model.	Indicating how the person may be an example to others and influence their behaviour or provide an opportunity for the person to set a good example.
22. Prompt self-talk.	Encourage use of self-instruction and self-encouragement (aloud or silently) to support action.
23. Relapse prevention.	Following initial change, help identify situations likely to result in readopting risk behaviours or failure to maintain new behaviours and help the person to avoid or manage these situations.

Behavioural Change Technique	Description
24. Stress management (stress theories)	May involve a variety of specific techniques (e.g., progressive relaxation) that do not target the behaviour but seek to reduce anxiety and stress.
25. Motivational interviewing.	Prompting the person to provide self-motivating statements and evaluations of their own behaviour to minimize resistance to change.
26. Time management.	Helping the person make time for the behaviour (e.g., to fit into a daily schedule)

Results and Analysis

The most frequently implemented BCTs were 'Prompt specific goal setting' and 'Prompt self-monitoring of behaviour' which were present in every app, and 'Time Management' which was present in 8 of the 9 apps. This is consistent with findings from previous studies, such as Chen et al's study which cited BCTs associated with goal striving and behaviour monitoring among the most prevalent techniques [20]. 'Prompt intention formation', 'Provide opportunities for social comparison' and 'Plan social support or social change' were also implemented fairly frequently with each appearing in 6 apps. The least frequently implemented BCTs were 'Prompt barrier identification', 'Teach to use prompts or cues', 'Agree on behavioural contract', 'Prompt practice', and 'Prompt identification as a role model' with all of them being absent from every app. This also largely agrees with Chen et al's study as they too found that 'Agree on behavioural contract' and 'Prompt identification as a role model' were absent from all of the apps they reviewed. Similarly, Chen et al found that 'Use follow-up prompts', 'Relapse prevention' and 'Stress Management' were also absent from every app they reviewed. In this study, those BCTs were found to have limited inclusion too, with each only being present in 2 apps. The inclusion rate of each BCT can be viewed in Graph 1.

Graph 1: Rate of BCT Inclusion

Behaviour Change Technique	MFP	8F	NHW	HM	CC	YZO	LS	MDC	LI	Total
1. Provide information about behaviour-health link	0	0	0	1	1	0	0	0	1	3
2. Provide information on consequences	0	0	0	1	1	0	0	0	1	3
3. Provide information about others' approval	1	0	1	1	1	0	0	0	1	5
4.Prompt intention formation	1	1	0	1	1	1	0	1	0	6
5. Prompt barrier identification	0	0	0	0	0	0	0	0	0	0
6. Provide general encouragement	1	1	0	0	0	0	1	1	1	5
7. Set graded tasks	1	0	0	1	0	1	0	1	1	5
8. Provide instruction	0	1	0	0	0	0	0	1	1	3
9. Model or demonstrate the behaviour	0	1	0	1	1	0	0	0	1	4
10. Prompt specific goal setting	1	1	1	1	1	1	1	1	1	9
11. Prompt review of behavioural goals	1	0	0	1	0	0	0	1	1	4
12. Prompt self-monitoring of behaviour	1	1	1	1	1	1	1	1	1	9
13. Provide feedback on performance	0	0	0	1	1	1	1	0	0	4
14. Provide contingent rewards	1	0	0	1	0	1	0	1	1	5
15. Teach to use prompts or cues	0	0	0	0	0	0	0	0	0	0
16. Agree on behavioural contract	0	0	0	0	0	0	0	0	0	0
17. Prompt practice	0	0	0	0	0	0	0	0	0	0
18. Use follow-up prompts	0	0	0	1	1	0	0	0	0	2
19. Provide opportunities for social Comparison	1	0	1	1	1	1	0	0	1	6
20. Plan social support or social change	1	0	1	1	1	1	0	0	1	6
21. Prompt identification as a role model	0	0	0	0	0	0	0	0	0	0
22. Prompt self-talk	1	0	0	0	0	0	0	1	0	2

Table 3: The presence or absence of BCTs in weight loss apps.

Behaviour Change Technique	MFP	8F	NHW	HM	CC	YZO	LS	MDC	LI	Total
23. Relapse prevention	0	0	0	1	1	0	0	1	0	3
24. Stress management	0	1	0	0	0	1	0	0	0	2
25. Motivational Interviewing	1	1	0	0	0	0	0	1	0	3
26. Time Management	1	1	1	1	1	1	1	0	1	8
Total	13	9	6	16	13	10	5	11	14	

The apps which included the greatest number of BCTs were HM and LI which included 16 and 14 BCTs, respectively. The apps which included the fewest number of BCTs were LS and NHW which included 5 and 6 BCTs, respectively. The total number of BCTs included in each app can be viewed in Graph 2. The assessment found that there was an average inclusion rate of 11 BCTs, which accounts for 42% of the total 26 BCTs. This is an improvement on the average inclusion rate found by previous studies. For example, Chen et al's 2014 study found an average inclusion rate of 6.3 BCTs in weight loss apps [20]. However, this difference could be explained by that fact that their study reviewed 28 apps rather than 9, as was the case in this study.

Graph 2: Total BCTs Identified in Apps

Total BCTs Identified in Apps
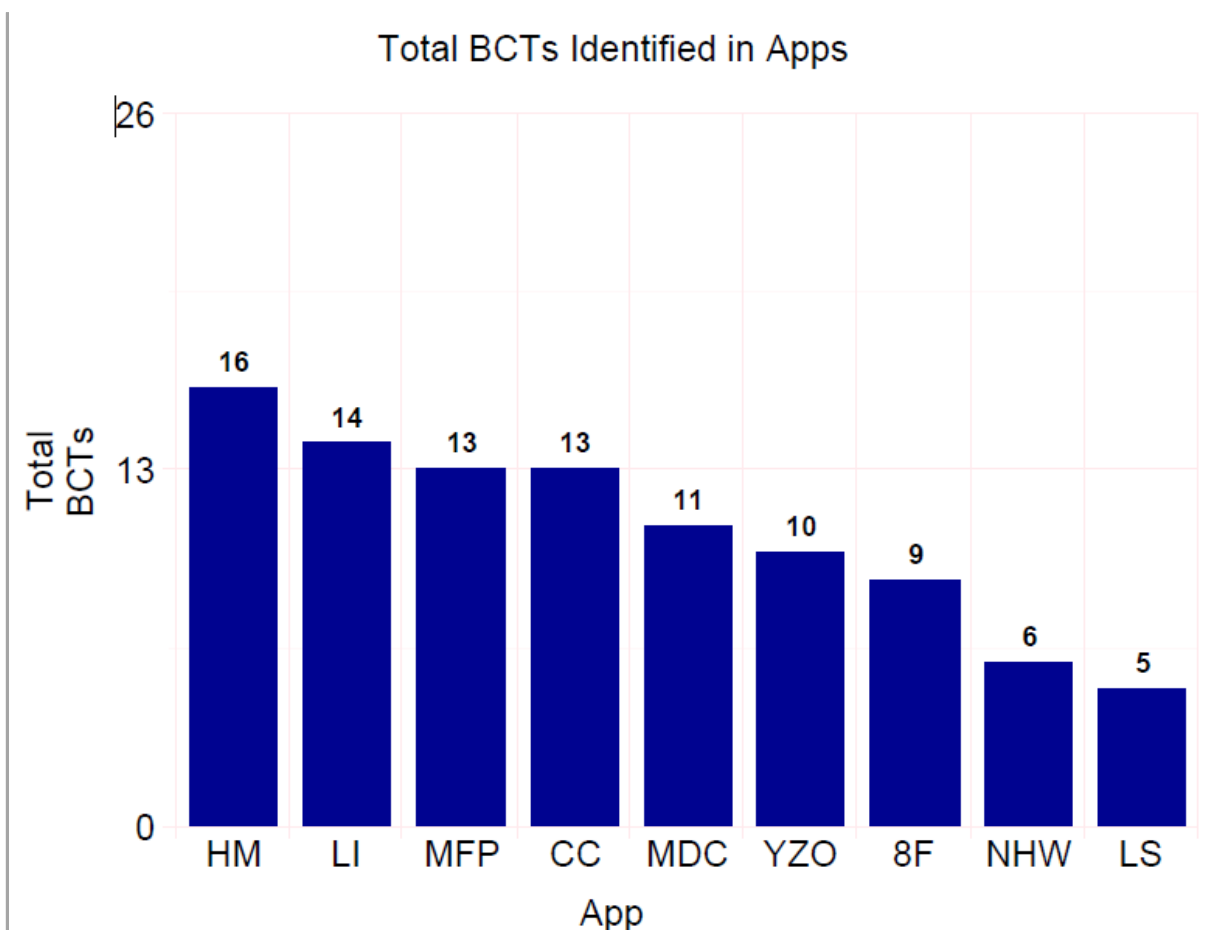
Therefore, it is not clear if this difference is due to weight loss apps improving over time and including more BCTs or if it's due to the difference in the number of apps reviewed. Furthermore, despite the increase in average inclusion rate, the majority of the apps reviewed incorporated less than half of the 26 BCTs meaning there is still scope for improvement.

Suggested Features

As previously mentioned, the least implemented BCTs were 'Prompt barrier identification', 'Teach to use prompts or cues', 'Agree on behavioural contract', 'Prompt practice', and 'Prompt identification as a role model', which were absent from all apps. Therefore, a feature was suggested for each of these BCTs which would enable weight loss apps to incorporate these BCTs if they were to implement them in the future.

BCT: Prompt barrier identification.

Definition: Identify barrier to performing the behaviour and plan ways of overcoming them.

Feature: A planner in which a user plans their daily/weekly activities and goals. At the end of each day, the planner asks if they managed to complete and achieve all their activities and goals. If they failed to meet one of these, the planner asks them what caused them to fail and to then think about how they could avoid failing in the future which they then record in the planner. When the user next plans that activity or goal which they had previously failed, the planner reminds them of how they could avoid failing again. For example, a user might plan the daily goal of consuming 1800 kcals or less but they consume 2100 kcals. The planner asks what caused them to fail, and the user identifies that it was because they did not have a healthy meal to take with them to work so they had to buy from the canteen, but there were no healthy options available which caused them to exceed their calorie allowance. The planner asks them how they might avoid this happening in the future, and the users says that they should prepare healthy meals to take to work at the start of the week or the night before. The next time the user plans this goal, the planner reminds them to prepare healthy meals in advance.

BCT: Teach to use prompts or cues.

Definition: Teach the person to identify environmental cues that can be used to remind them to perform a behaviour, including times of day or elements of contexts.

Feature: A feature that suggests environmental cues that a user could use as a reminder to complete certain activities. The feature suggests a cue and the user enters activities that they might associate with that cue. Once a number of cues and associated activities have been entered, the user is quizzed on which activities should be performed on each cue in an attempt to engrain the cue-activity associations into the user so that when they encounter those cues, they are reminded to complete the associated activities. For example, the feature might suggest 'Eating breakfast' as a cue. The user enters that, when they eat breakfast, they should record their breakfast in their food diary and then perform their daily

stretches. Once a number of cues have been saved, the feature asks them what they should do when eating breakfast. The user then relays the activities they entered. If they get it wrong, they are reminded of the correct activities in the hope that they will start associating those activities with that cue.

BCT: Agree on behavioural contract

Definition: Agreement (e.g., signing) of a contract specifying behaviour to be performed so that there is a written record of the person's resolution witnessed by another.

Feature: When setting goals and resolutions, include an agreement area for users to sign. This can be given greater significance if done so while in contact with a health professional via the app who can also sign it. For example, under the users goals there could be a statement which reads "I agree to strive to achieve the above goals to the best of my ability" and an area for the user to sign. If the app provides health professional connectivity, there could be a similar statement reading "I agree to help the client achieve their goals to the best of my ability" and an area for the health professional to sign.

BCT: Prompt practice

Definition: Prompt the person to rehearse and repeat the behaviour or preparatory behaviours.

Feature: One possible feature that would implement this BCT would be a feature that allows the user to practice portion control. The user is presented with a number of plates with varying portion sizes. The user then selects the portion size that they think is the healthiest. The feature then judges their selection and provides feedback, informing the user if theirs was a good selection or what a better selection would have been. It might also provide advice on how to make the right selection.

BCT: Prompt identification as a role model

Definition: Indicating how the person may be an example to others and influence their behaviour or provide an opportunity for the person to set a good example.

Feature: In apps that provide a social community, there could be a feature that allows users to cite their friends as a role model to let that friend know they look to them as an example. That friend would receive a notification that they have been cited as a role model. Furthermore, when a user achieves a goal or makes progress towards a goal, they can be given the opportunity to share their achievement with their friends to set an example. In apps that do not provide a social community, this BCT could be implemented through general messaging that prompts users to think about who they might be a role model for, such as messages reading "Think about who depends on you on a daily basis" or "Consider who looks to you for guidance ".

Conclusion

The aim of this review was to assess weight loss apps for their inclusion of BCTs so that the most and least common BCTs could be identified, improvements could be prescribed, and, ultimately, so that it could be established if weight loss apps are lacking in the incorporation of BCTs. It's findings were largely consistent with studies carried out previously, with the most common BCTs being those concerned with goal setting, behaviour monitoring and social comparison, and overall determining that there the rate of BCT inclusion in weight loss apps is limited. The least prevalent BCTs were, again, largely consistent with previous studies and features were suggested that would implement these BCTs. In future, developers should aim to incorporate more BCTs into their apps in order to increase their behaviour change potential and they might do so by implemented the features suggested.

4.0 Survey Analysis – "A Feature Evaluation of Weight Loss Apps"

A survey was conducted that aimed to evaluate the user's attitudes and perceptions towards weight loss apps and their features. The data gathered from this survey would help determine what users expect of weight loss apps, how they feel about the apps they have used in the past, what they like about weight loss apps and where they feel they could be improved, and to also gain and understanding of users' perceptions of and approach to weight loss in general. Users were also asked to rate the features that were identified in the feature review as to establish which features are most and least important to users. These findings would then be used to inform the design of the new app, allowing developers to tailor it towards users in order to meet their needs and expectations. It would also inform developers on which features should be prioritised for implementation.

The survey consisted of 2 main sections with 14 questions between them. The first section sought to gain an understanding of the user's perceptions of weight loss and the weight loss strategies they have employed in the past. It would then go on to establish the user's previous history of weight loss apps, how effective they found them, what they liked and disliked about them, and how they think they could be improved. The second section asked users to rate each of the features identified in the feature review on level of importance, from 'Not at all important' to 'Very Important'. The results from this section would help determine which features are valued most by users and, therefore, which features should be prioritised.

There were 15 respondents to the survey. Respondent were first asked to describe what healthy eating looks like to them. Most respondents provided answers in the vein of eating a balanced diet which incorporates multiple food groups such as carbohydrates, protein, fats, vegetables, fruits, and grains. A number of respondents mentioned limiting certain foods such as processed meat and saturated fat whilst also restricting calories and portion sizes. One user said that healthy eating was an 80/20 balance of good and bad foods. One user viewed healthy eating as a way of feeling good about yourself, while another user said healthy eating looked like "Rabbit food". Respondents were then asked to describe some of the weight loss strategies they had previously employed. Most respondents mentioned strategies akin to restricting calories, dieting, and increasing exercise and physical activity. One respondent said they had used weight loss boot camps in the past. Various diets and weight loss programmes were mentioned such as low carb and low fat diets, Slimming World, Weight Watchers, 5:2 Diets, and Slimfast shakes. Increasing fibre was also mentioned. 2 respondents mentioned using apps, with one specifying an app to count calories. Respondents were then asked about their history of using weight loss apps. 7 respondents had previously used weight loss apps. The most frequent app used was MyFitnessPal which was used by 5 of the respondents. One of those respondents also used Strava. One respondent said they used a generic calorie counting app without specifying a name and another respondent couldn't remember the name of the app they had used. All respondents who had used a weight loss app said that they used the app daily and each of them said they found the app useful. The most commonly cited reason as to why they found the app useful was that it allowed them to track their calories and food intake, with 6 respondents citing this reason. Other reasons given included the ability to track exercise, access to professional advice and suggested meals based on food history. Some complaints included food logging being too time consuming, the need to pay for membership to access the full app, the barcode scanner recognising only a limited number of products, and the app not looking professional. One user added the suggestion to make saving meals for repeat entry easier in order to improve. 4 of the respondents said they has stopped using weight loss apps. 2 of those respondents said they stopped use due to lack of motivation, one

of which also said that using the app was too tedious. Another respondent said that they were fed up of dieting and 1 respondent said they stopped using the app because they had reached their target weight.

Every respondent rated each of the features identified in the feature review on how important they felt the features were for weight loss apps. For each feature, respondents indicated whether they felt the feature was 'Not at all Important', 'Low importance', 'Neutral, 'Important', or 'Very Important'. To analyse this data, a table was created which enumerated the number of times each attribute was assigned to each feature. An 'Importance Score' was then calculated as a weighted average so that the most and least important features, according to respondents, could be identified. This was done by assigning a weight to the attributes. 'Not at all Important' remained as it was, 'Low Importance' was assigned a weight of 1, 'Neutral' was assigned 2, 'Important' was assigned 3, and 'Very Important' was assigned a weight of 4. For each feature, each attribute's occurrence rate was multiplied with the attributes weight before summing the results to give the Importance Score. Features were then sorted by Importance Score so that the most and least important features could be identified. The top 5 most important features were 'Calorie Counter', 'Food Diary', Barcode Scanner', 'Goal Setting', and Food Database'. It is, therefore, recommended that developers prioritise these features in order to be sure that they are providing users with the features that they value and expect the most. The 5 least important features were 'Avatars, 'Photo Food Logging', 'Social Network Connectivity', 'Blogs and Articles', and 'Blood Glucose Tracker'. The full table of features ranked by level of importance can be viewed in Table 4.

The survey was very useful in gaining an understanding of how people approach weight loss, the strategies they use, their perceptions of weight loss apps and which features they most and least value. Respondents indicated a good understanding of healthy eating with the majority describing healthy eating as a balanced diet that incorporates multiple food groups. One user described healthy eating with the negative connotation of "Rabbit food". This highlights an opportunity for weight loss apps to change the perspectives of users who may share this view by educating users on a more accurate representation of healthy eating. This can be done by providing information sources on healthy eating such as blogs and articles, and by also providing users with tasty, healthy meal recipes. What was apparent from the survey was that calorie restriction is an important aspect of weight loss for respondents. This was highlighted by the fact that calorie restriction was one of the most frequently cited strategy applied for losing weight. Furthermore, the ability to track calories was the most cited reasons for why respondents found the apps they had used previously helpful. Also, Calorie Counter was rated as the most important feature in the feature ratings. Therefore, developers should take care in implementing functionality that facilitates calorie tracking and calorie restriction strategies in order to provide the greatest benefit to their users. Respondents mentioned a few reasons why they disliked apps they had used previously. Developers should heed these comments by ensuring app interfaces are professional, food logging is easy and not time consuming, and by providing a range of free features. Respondents were also asked about the reasons that they stopped using weight loss apps which offered insights into how to keep users engaged. A lack of motivation was the main reason provided. Therefore, to encourage users to continue using an app, users should be sent motivational messages and the app's usability should be optimised. Finally, the survey was extremely beneficial in identifying which features users most valued. Those features were found to be 'Calorie Counter', 'Food Diary', Barcode Scanner', 'Goal Setting', and Food Database'. Therefore, these features will be prioritised when developing the new app in order to provide users with the features they most value and expect, and to make the app as beneficial to users as possible.

Table 4: Features Ranked by Level of Importance.

Feature	Not at all Important w(-)	Low Importance w(1)	Neutral w(2)	Important w(3)	Very Important w(4)	Importance Score
Calorie Counter	0	0	0	7	8	53
Food Diary	0	0	3	3	9	51
Barcode Scanner	0	0	3	4	8	50
Goal Setting	0	0	2	9	4	47
Food database	0	1	4	6	4	43
Diet plans	0	1	2	10	2	43
Water Tracker	0	0	4	9	2	43
Connectivity to Additional Devices and Apps	0	1	4	7	3	42
Body Measurements Tracking	0	0	6	6	3	42
App Tour	0	3	2	6	4	41
Weight Tracker	0	3	1	8	3	41
Connectivity to Health Professionals	0	2	4	6	3	40
Diet Insights	1	1	3	8	2	40
Daily Reports	1	0	5	7	2	40
Recipe finder	0	0	6	8	1	40
Macro Nutrient Tracker	1	1	5	5	3	39
Notes	1	2	5	4	3	37
Challenges and Rewards	0	3	3	8	1	37
Reminders	1	2	3	8	1	37
Create meals and recipes	0	3	6	4	2	35
Shopping lists	0	3	6	4	2	35

Feature	Not at all Important w(-)	Low Importance w(1)	Neutral w(2)	Important w(3)	Very Important w(4)	Importance Score
Tips and Advice	1	3	4	7	0	33
Before and After Photos	1	5	3	4	2	32
Moods and Feelings Tracker	2	3	5	3	2	32
Points and Leader Board	3	2	5	3	2	32
Motivational Messages	2	4	5	1	3	31
Social Community	3	1	8	1	2	31
Cravings Panic Button	2	2	7	3	1	31
Blood Pressure Tracker	0	6	4	4	1	30
Blood Glucose Tracker	0	5	6	3	1	30
Blogs and Articles	1	4	6	3	1	30
Social Network Connectivity	3	2	7	2	1	29
Photo Food Logging	7	3	3	2	0	22
Avatars	5	5	4	1	0	21

5.0 Specification and Design

5.1 Requirements

Through the feature review, BCT analysis and the survey, a number of functional and non-functional requirements were identified. Meeting these requirements would be vital for ensuring that the new app incorporates features and traits that are important to users, and for including features that implement a variety of BCTs. This would be necessary in order to improve upon existing weight loss apps and to offer a more suitable weight loss solution.

The feature review and analysis of user reviews were extremely beneficial in identifying a number of features and qualities of weight loss apps that are important for users. These results were used to guide and form a number of the requirements. For example, the ability to add simple calories without recording an entire meal and the provision of a calorie allowance were identified as important features to users. Therefore, the incorporation of these features formed two of the functional requirements. Furthermore, intuitiveness, convenience, consistency and accuracy were all identified as important qualities of weight loss apps. Therefore, these qualities were included as non-functional requirements.

The survey was also highly instrumental in establishing which features were most important to users. The top 5 most important features as ranked by survey participants, which can be viewed in Table 4, were selected for implementation. The incorporation of these features formed 5 of the functional requirements.

Finally, the BCT analysis was used to derive 5 more functional requirements. The implementation of the 5 least incorporated BCTs across weight loss apps would each become a functional requirement in order to ensure that they were included and to showcase to other aps how these BCTs could be implemented. This would be done by implementing the features suggested in the BCT analysis.

Implementing the 5 most important features to users and the 5 least incorporated BCTs would give the initial prototype a good balance between existing features that users care about and value, and the incorporation of a range of BCTs to ensure there is a variety of evidence-based, behaviour change content in the app. Any other features would be for future work when expanding the app.

The full list of requirements is as follows:

Functional Requirement 1 (FR1): Users must be able to create an account through which to use the system and to hold their data.

Justification: Users need an account in order to use the system and to hold their data. Users need to be able to leave the system and have it remember their data when they return at a later date.

Acceptance Criteria: Once a user completes the sign up form, an account is registered for the user in the database using the information they entered. They are able to access and use the system using their account. When the user leaves and then returns to the system, their data is retrieved by signing in on that account.

Functional Requirement 2 (FR2): Users must be able access the system by logging into their accounts using the username and password they specified when creating their account.

Justification: Users will require access to the system in order to use it. The username and password will specify to the system which account a user is trying to access whilst also ensuring privacy.

Acceptance Criteria: When a user enters the correct username and password for their account, they are granted access to the system.

Functional Requirement 3 (FR3): Users must be able to record and track their weight.

Justification: When users are trying to lose weight, they need to be able to monitor their progress by tracking their weight loss or gain so that they can adjust their weight loss strategy accordingly.

Acceptance Criteria: The user is able to enter their current weight and the system keeps a record of this. The user is able to adjust this as they lose or gain weight.

Functional Requirement 4 (FR4): The system must calculate and display the user's daily calorie allowance based on their biometric data and weight goals.

Justification: Being in a calorie deficit is the most important factor for losing weight. Being aware of a calorie allowance helps users ensure they do not consume too many calories.

Acceptance Criteria: A personal calorie allowance is calculated for users based on their age, height, current weight, target weight and target date. The calorie allowance is then clearly displayed to the user.

Functional Requirement 5 (FR5): Users must be able to track their daily calorie consumption in a calorie counter. Users must be able to add and remove simple calories from their calorie counter without having to enter any food. Calories from foods entered in the food diary should also be counted.

Justification: User need to be able to track their daily calorie consumption to ensure they do not exceed their daily calorie allowance. Users need to be able to add simple calories when they don't have the time or energy to record and entire meal.

Acceptance Criteria: The calorie counter increases when a food is recorded in the food diary. It increases by the number of calories in that food. Users are able to add calories to the calorie counter without having to enter a food. They are also able to remove calories from the calorie counter.

Functional Requirement 6 (FR6): Users must be able to record the foods they eat throughout the day in a food diary. When they record a food, its calories must be added to the calorie counter.

Justification: Users need to keep track of the foods they eat so that they can better manage their calorie consumption.

Acceptance Criteria: A food is successfully added to the food diary in the specified meal slot and it can be retrieved at a later date.

Functional Requirement 7 (FR7): User must be able to add a food to their food diary by scanning it using a barcode scanner.

Justification: Scanning foods is a much faster method of entering nutritional information than entering it manually. This reduces the time it takes to log foods in the food diary, making it easier for users which encourages them to engage with the food diary feature.

Acceptance Criteria: When the barcode of a food item is scanned, the system retrieves the correct nutritional information and the food gets added successfully to the food diary.

Functional Requirement 8 (FR8): Users can set goals to aim for, such as a target weight.

Justification: Goal setting is an important behavioural change technique. Users need a goal to strive for to focus their efforts and keep them motivated.

Acceptance Criteria: The user can specify a goal that they wish to achieve and the system remembers what that goal is, allowing the user to view the goal at a later date.

Functional Requirement 9 (FR9): Users must be able to search a food database for food items in order to add them to their food diary.

Justification: A food database that stores a set of food items and their nutritional information allows users to record foods in their food diary much quicker and easier than typing the food in manually. This encourages users to engage with the food diary feature.

Acceptance Criteria: When users search for a food item, they are be presented with a list of foods matching the search term, along with the foods nutritional information. Once selected, a food item is then added to the user's food diary.

Functional Requirement 10 (FR10): Implement a feature that incorporates the BCT, "Prompt barrier identification".

Justification: This is one of the least incorporated BCTs among weight loss apps. It is an important BCT because it makes users think about what is stopping them from reaching their goals. Once they have identified what these barriers are, it is easier to plan to overcome them

Acceptance Criteria: A user is made to think about the barriers stopping them from achieving their goals and plans a way to overcome them.

Functional Requirement 11 (FR11): Implement a feature that incorporates the BCT, "Teach to use prompts or cues".

Justification: This is one of the least incorporated BCTs among weight loss apps. It is an important BCT because prompts and cues can act as useful reminders to performing activities and behaviours. Once a user has been taught how to use prompts and cues, they can use them as reminders to perform activities and behaviours which will help them towards their goals.

Acceptance Criteria: Users are made to think about the activities and behaviours that can be associated with certain prompts and cues.

Functional Requirement 12 (FR12): Implement a feature that incorporates the BCT, "Agree on behavioural contract"**.**

Justification: This is one of the least incorporated BCTs among weight loss apps. It is an important BCT because when a user produces a written record committing to a goal, they feel more of an obligation to uphold it. Increased persistence makes them more likely to achieve the goal.

Acceptance Criteria: Users are able to produce a written record agreeing to their goals.

Functional Requirement 13 (FR13): Implement a feature that incorporates the BCT, "Prompt practice"**.**

Justification: This is one of the least incorporated BCTs among weight loss apps. It is an important BCT because providing users with the opportunity to practice activities and behaviours means they are able to perform them better in a live situation. This makes them more effective when they perform activities and behaviours that will help them achieve their goals.

Acceptance Criteria: Users are able to practice a behaviour that might help them achieve their goals. They are able to fail at it without it having a detrimental effect and they are given feedback on how to improve.

Functional Requirement 14 (FR14): Implement a feature that incorporates the BCT, "Prompt identification as a role model"**.**

Justification: This is one of the least incorporated BCTs among weight loss apps. This is an important BCT because when users realise that they are a role model and that they can set an example for others, it provides them with a degree of responsibility which can encourage them to perform behaviours that are beneficial to meeting their goals.

Acceptance Criteria: Users are provided with an opportunity to set an example to others and are made aware that they are a role model.

Non-functional Requirement 1 (NFR1): The system should be easy, intuitive and convenient to use.

Justification: User friendliness is an important factor in the success of weight loss apps. Intuitiveness and convenience were identified as important traits to users in the feature review. By making the system easy, intuitive and convenient to use, users are encouraged to use the system and are more likely to engage with it for sustained periods of time.

Acceptance Criteria: User testing will be conducted on the app. User should be able to use the app without prior training and with minimal errors.

Non-functional Requirement 2 (NFR2): Data stored and presented by the system must be accurate and consistent.

Justification: Accuracy was identified as an import trait to users in the feature review. If data that is presented to the user is inaccurate then it can have a detrimental effect on the user's progress.

Acceptance Criteria: Data that is entered by the user, such as current weight or calories consumed, remains consistent when retried later. Food nutrition values stored in the database accurately reflect the values for the same foods as agreed by nutritional experts.

Non-functional Requirement 3 (NFR3): Data must be stored securely by the system.

Justification: The system holds sensitive, personal data. This data must be stored securely to protect the privacy of users.

Acceptance Criteria: Data is stored securely in a database. Accounts are password protected. Passwords are hashed in the database.

5.2 Use Cases

The following Use Cases describe how a user would interact with various aspects and features of the app.

ID: UC1
Title: Sign Up
Description: The user uses the Sign Up form on the Sign Up page to create a user account.
Primary Actor: User
Preconditions: The user is on the start page
Main Flow:
1. The user navigates to the Sign Up page by clicking the 'Sign Up' button,
2. The user enters their personal information into each of the input boxes accordingly and then clicks the 'Next' button.
3. The system takes the user to the second Sign Up page.
4. The user fills out the remaining input boxes accordingly and ticks the goal agreement box.
5. The system displays the user's calorie allowance.
6. The user clicks the 'Sign Up' button.
Alternative Flow:
Post Conditions: A user account has been created for the user and they have been logged into the system on the home page.

ID: UC2
Title: Log In
Description: The user uses their log in credentials to log into the system.
Primary Actor: User
Preconditions: The user is on the start page and has a valid user account.
Main Flow:
1. The user enters their username and password into the respective fields in the log in form.
2. The user clicks the 'Log In' button.
Alternative Flow:
Post Conditions: The user is logged into the system on the home page.

ID: UC3
Title: Track Simple Calories
Description: The user adds and removes calories to and from their Calorie Counter without recording any food in their Food Diary.

Primary Actor: User
Preconditions: User is on the home page or food diary page.
Main Flow:
1. The user clicks the plus button.
2. The add quick calories modal opens.
3. The user enters the number of calories they wish to add.
4. The user clicks the 'Add' button.
5. The quick calories modal closes and the Calorie Counter increments by the number of calories specified by the user.
Alternative Flow:
1. The user clicks the minus button.
2. The remove quick calories modal opens.
3. The user enters the number of calories they wish to remove.
4. The user clicks the 'Remove' button.
5. The quick calories modal closes and the Calorie Counter decrements by the number of calories specified by the user.
Post Conditions: The Calorie Counter has incremented or decremented by the number of calories specified by the user.

ID: UC4
Title: Record food in the Food Diary using the Food Database
Description: The user records a food in their Food Diary by searching for it in the Food Database.
Primary Actor: User
Preconditions: The user is on the Food Diary page.
Main Flow:
1. The user types the food they wish to record into the search bar on the meal slot they wish to record the food in.
2. The food database modal opens with a list of food items that match the search term.
3. The user clicks on the item that they wish to add.
4. The food modal for that item opens.
5. The user enters the quantity they wish to add.
6. The user clicks the 'Add Food' button.
Alternative Flow:
Post Conditions: The food item has been added to the specified meal slot in the Food Diary and the calories from the food has been added to the Calorie Counter.

ID: UC5
Title: Record food in the Food Diary using the Barcode Scanner
Description: The user records a food in their Food Diary by scanning the item using the Barcode Scanner.
Primary Actor: User
Preconditions: The user is on the Food Diary page.
Main Flow:
1. The user clicks the barcode scanner button on the meal slot they wish to add a food to.
2. The Barcode Scanner opens.
3. The user targets the barcode of the food item they wish to record and clicks the scan button.
4. The barcode is processed and the food item is searched for in the Food Database.
5. The food modal for the item opens.
6. The user enters the quantity they wish to add.
7. The user clicks the 'Add Food' button.

Alternative Flow:

Post Conditions: The food item has been added to the specified meal slot in the Food Diary and the calories from the food has been added to the Calorie Counter.

ID: UC6

Title: Update Weight Loss Goals

Description: The user updates their weight loss goals from the Goals page and agrees to them.

Primary Actor: User

Preconditions: The user is on the Goals page. The user's goals have been set from when they signed up.

Main Flow:

1. The user clicks the 'Edit' button on the Weight Goals box.

2. The weight goals modal opens.

3. The user enters their target weight and their target date.

4. The user clicks the 'Save' button.

5. The weight goals modal closes.

6. The user ticks the goal agreement box.

Alternative Flow:

Post Conditions: The user's goals have been saved in the Weight Goals box and the goal agreement box is ticked.

ID: UC7

Title: Add Daily Goals

Description: The user adds a daily goal to their Daily Planner.

Primary Actor: User

Preconditions: The user is on the Daily Planner page.

Main Flow:

1. The user clicks the plus button on the Daily Goals section.

2. The daily goal modal opens.

3. The user enters their daily goal.

4. The user clicks the 'Add Goal' button.

5. The daily goal modal closes and the daily goal is added to the Daily Goals section for the specified day.

Alternative Flow:

1. The user clicks the plus button on the Daily Goals section.

2. The daily goal modal opens.

3. The user enters their daily goal.

4. The user clicks the 'Add Goal' button.

5. The daily goal modal closes and the failure reminder opens.

6. The user clicks the close button.

7. The daily goal is added to the Daily Goals section for the specified day.

Post Conditions: The daily goal is saved in the Daily Goals section for the specified day.

ID: UC8

Title: Update Daily Goals

Description: The user update the progress of their daily goal to specify success or failure.

Primary Actor: User

Preconditions: A daily goal has been saved in the Daily Goals section.

Main Flow:

1. The user clicks the medal button to update the progress of their daily goal.

2. The update daily goal modal opens.

3. The user clicks 'No'.

4. The cause of failure prompt opens.

5. The user specifies why they failed.

6. The user clicks the 'Save' button.

7. The avoid failure prompt opens.

8. The user specifies how they could avoid failing in the future.

9. The user clicks the 'Save' button.

10. The update daily goal modal closes.

11. The daily goal turns red.

Alternative Flow:

1. The user clicks the medal button to update the progress of their daily goal.

2. The update daily goals modal opens.

3. The user clicks 'Yes'.

4 .The update daily goal modal closes.

5. The success prompt opens.

6. The user clicks the close button.

7. The daily goal turns green.

Post Conditions: If failed, the daily goal has turned red and the reasons for failure and ways to avoid repeat failure have been saved. If achieved, the daily goal has turned green.

ID: UC9

Title: Environmental Cues

Description: The user is provided with a number of environmental cues. They enter activities and behaviours that the cues could act as reminders for. They are quizzed on the activities and behaviours they entered for each cue.

Primary Actor: User

Preconditions: The user is on the Environmental Cues page.

Main Flow:

1. The system presents the user with an environmental cue.

2. The user enters an activity or behaviour that they should remember to perform when they encounter that cue.

3. The user clicks the 'Enter' button.

4. The activity or behaviour they entered is saved and the user is prompted for another activity or behaviour.

5 The user continues to enter activities and behaviours until they have entered all those that they can think of.

6. The user clicks the 'Next Cue' button.

7. The system presents the user with another environmental cue.

8. The user enters activities or behaviours they should remember to perform when they encounter that cue.

9. The user clicks the 'Finish' button.

10. The system take the user to the quiz page where they are presented with an environmental cue and a list of activities, some of which are the activities entered by the user for that environmental cue.

11. The user selects all of the activities that they specified for that environmental cue.

12. The user clicks the 'Submit' button

13. The system provides feedback on how many correct answers the user selected.

14. The user clicks the 'Next' button.

15. The system presents the user with the next environmental cue and a list of activities.

16. The user continues to recall the activities they should remember for each of the environmental cues they were presented with.

17. The user clicks the 'Finish' button.

18. The system returns the user to the home page.

Alternative Flow:

Post Conditions: The user is on the home page.

ID: UC10

Title: Portion Sizes

Description: The user practices selecting the healthiest portion size among a series of different portion sizes.

Primary Actor: User

Preconditions:

Main Flow: The user is on the Portion Sizes page.

1. The system presents the user with a series of plates with varying portion sizes and ratios.

2. The user clicks on the plate that they think is the healthiest option.

3. The system takes the user to the feedback page for that plate where they are given feedback on their choice.

4. The user clicks the 'Choose Again' button.

5. The system takes the user back to the Portion Sizes page.

6. The user continues to select plates until they choose the healthiest option.

Alternative Flow:

Post Conditions: The user is on the feedback page for the healthiest option.

ID: UC11

Title: Track Weight

Description: The user updates their current weight using the Track Weight feature.

Primary Actor: User

Preconditions: The user is on the Track Weight page.

Main Flow:

1. The user clicks on the scales icon.

2. The track weight modal opens.

3. The user enters their current weight.

4. The user clicks the 'Save' button.

5. The track weight modal closes.

6. The weight lost label and the weight loss progress bar update to reflect the user's current weight loss progress. The current weight label updates to reflect the user's current weight.

Alternative Flow:

Post Conditions: The weight loss progress bar depicts how close the user is to their weight loss target. The weight lost label shows how much weight the user has lost. The current weight label reflects the user's current weight.

ID: UC12

Title: Share Weight Loss Achievement

Description: The user shares their weight loss achievement with their friends.

Primary Actor: User

Preconditions: The user has just updated their current weight which is half way towards meeting their weight loss target.

Main Flow:

1. The weight loss achievement modal opens.

2. The user clicks the 'Share' button.

3. The achievement is shared with their friends.

4. The achievement sent prompt opens.

5. The user clicks the close button.

6. The weight loss achievement modal and achievement sent prompt closes.

Alternative Flow:

1. The weight loss achievement modal opens.

2. The user clicks the close button.

6. The weight loss achievement modal closes.

Post Conditions: The user is on the Track Weight page and their achievement has or has not been shared with their friends, as determined by the user.

6.0 Prototype Version 1

A high fidelity prototype of the initial version of the app was developed. Marvel was used to design features that would implement the system requirements. The prototype provided a degree of functionality which demonstrated how the system would look, feel and operate. This allowed the prototype to be used in user testing in order to derive improvements to the apps design from a user's perspective. Each feature of the app is described below with screenshots demonstrating how they look and function, along with a list of the system requirements they implement, as well as a reference to the use cases that describe how a user would use the feature.

Feature: Sign Up

Description: This feature allows users to create user accounts. It takes the user's Username, Password, Age, Height, Current Weight, Target Weight, and Target Date as input. This data is used to calculate the user's daily calorie allowance which is displayed to them. There is also a check box which users must tick to indicate that they agree to strive towards their goals.

Requirements: FR1, FR4, FR8, FR12

Use Cases: UC1

Screenshots:

Feature: Log In

Description: This feature grants access to the system when users enter a valid Username and Password combination.

Requirements: FR2

Use Cases: UC2

Screenshots:

Feature: Calorie Counter

Description: The Calorie Counter tracks the number of calories a user has consumed in a day. It allows user to keep to track of how many calories they have consumed to help them remain under their daily calorie allowance. Users are able to add and remove 'simple calories without having to record any food in their Food Diary. When a user does add a food to their Food Diary, the calories from that food are added to the calorie counter.

Requirements: FR4, FR5.

Use Cases: UC3

Screenshots:
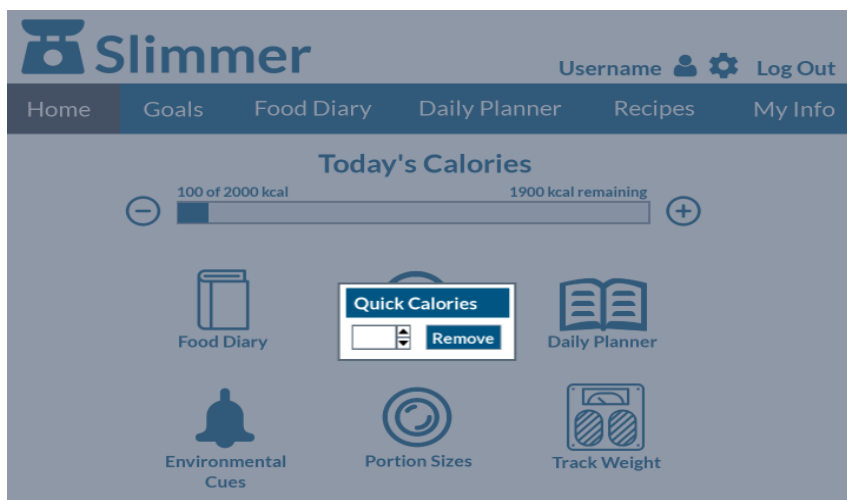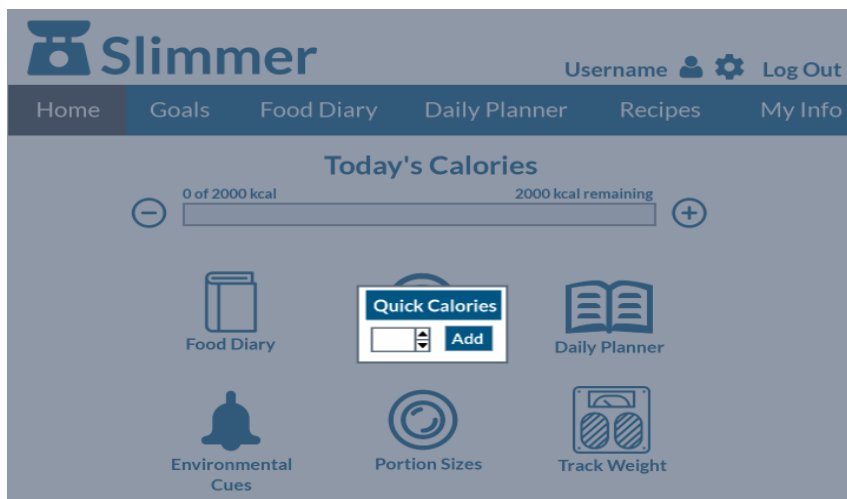
Feature: Weight Tracker

Description: The Weight Tracker allows users to track their weight. Users can use it to update their current weight and it will display their progress towards reaching their target weight.

Requirements: FR3

Use Cases: UC11

Screenshots:
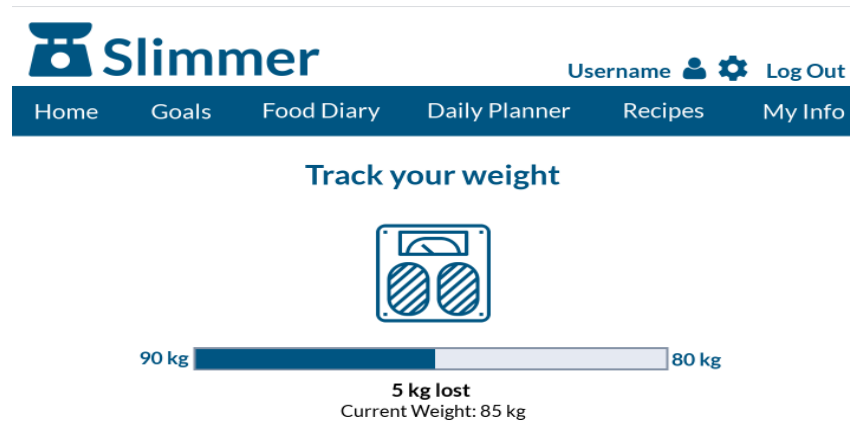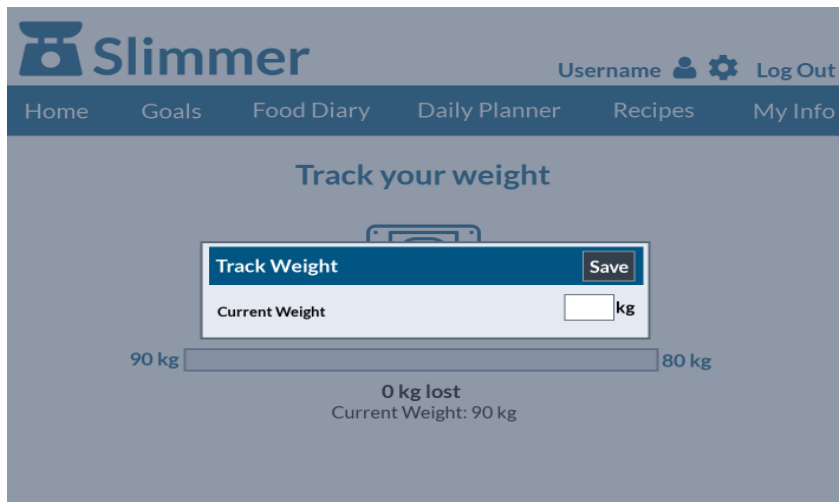
Feature: Food Diary

Description: Users can keep track of what they eat in their Food Diary. This can help users manage their diet and make healthy adjustments. The calories from foods recorded in their Food Diary are added to their Calorie Counter. Users can add foods to their food diary by either searching for foods in the Food Database or by scanning the food item using the Barcode Scanner in order to make food entry faster and more convenient.

Requirements: FR5, FR6, FR7, FR9

Use Cases: UC4, UC5

Screenshots:

Feature: Goals

Description: This feature allows users to set and manage their goals, such as target weight and target date. Users are also provided to the opportunity to agree to their goals and to indicate their intention to strive to achieve their goals to the best of their ability by ticking the goal agreement box.

Requirements: FR8, FR12

Use Cases: UC6

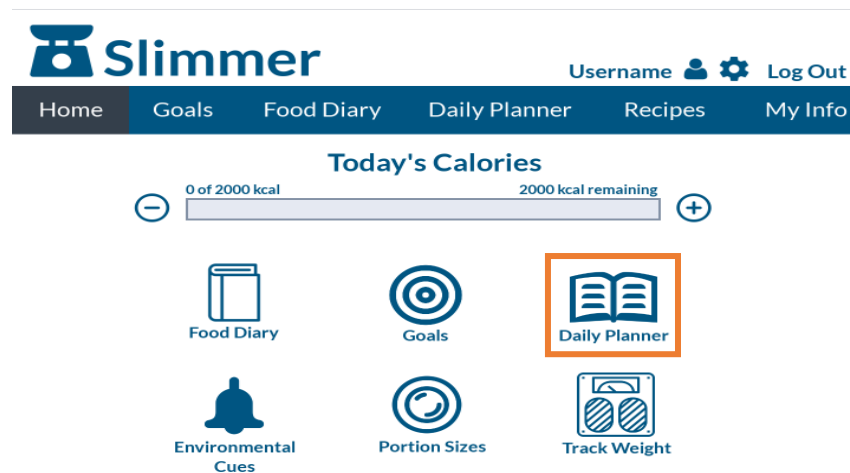**Screenshots:**

Feature: Daily Planner

Description: The Daily Planner provides a tool for users to organise their daily tasks and goals. Daily goals differ from the goals in the Goals feature as they are micro-goals that are set on a day-by-day

basis rather than an overall goal to be achieved over a longer period of time, such as reaching a target weight. At the end of the day, users can update the progress of their daily goals to specify whether had or had not achieved their goals. If the user failed a goal, the feature prompts the user to think about why they had failed and how they can avoid this happening again. The system saves the users response so that when the user next plans that goal, the system reminds the user of why they had failed in the past and how they can avoid failing again.

Requirements: FR10

Use Cases: UC7, UC8

Screenshots:

Feature: Environmental Cues

Description: The Environmental Cues feature is designed to make users think about how they can use environmental cues as reminders. Environmental cues can act as useful reminders for performing activities and behaviours that will help users achieve their goals. The feature presents the user with a number of environmental cues that they might encounter day-to-day. Users must then think of beneficial activities and behaviours which the environmental cue could act as a reminder for. Once the user has entered a number of activities and behaviours for a variety of environmental cues, the user must recall which activities they entered for which environmental cues in a quiz. This is in order to engrain the cue-activity association in users so that when they encounter the environmental cue in real life, they are reminded to perform the beneficial activity or behaviour.

Requirements: FR11

Use Cases: UC9

Screenshots:

Slimmer

| Home | Goals | Food Diary | Daily Planner | Recipes | My Info |

Today's Calories

0 of 2000 kcal   2000 kcal remaining

⊖ [_____] ⊕

📘 **Food Diary**   ◎ **Goals**   📖 **Daily Planner**

🔔 **Environmental Cues**   ◎ **Portion Sizes**   📋 **Track Weight**

Slimmer

Username 👤 ⚙ Log Out

| Home | Goals | Food Diary | Daily Planner | Recipes | My Info |

Environmental Cues

Environmental cues can act as useful reminders to perform certain activities and behaviours.

You will be presented with a number of environmental cues which you might encounter day-to-day. Think about the actvities and behaviours you associate with these cues and how they could act as a reminder for those activities and behaviours.

Your first cue is:

Eating Breakfast

Now think of an activity or behaviour that this cue could be used as a reminder for:

[_____]

Enter

Slimmer

Username 👤 ⚙ Log Out

| Home | Goals | Food Diary | Daily Planner | Recipes | My Info |

Environmental Cues

Your first cue is:

Eating Breakfast

Record my breakfast in my food diary.

Perform my morning stretches.

Is there another activity or behaviour that this cue could be used as a reminder for?:

[_____]

Enter

Next Cue   Finish

Feature: Portion Sizes

Description: The Portion Sizes feature provide the opportunity for users to practice choosing healthy portion sizes so that when they portion out food in real life, they are better equipped to make healthy choices. User are presented with a series of plates with varying portion sizes and ratios of food groups. User must pick the plate that they think is the healthiest option. Users are then provided feedback on their choice. They are told whether it was a good choice or if there was a healthier option, and they are shown what a healthy plate looks like so they can recognize one in the future.

Requirements: FR13

Use Cases: UC10

Screenshots:

Slimmer

| Home | Goals | Food Diary | Daily Planner | Recipes | My Info |

Today's Calories

0 of 2000 kcal   2000 kcal remaining

⊖ [_____] ⊕

Food Diary   **Goals**   **Daily Planner**

Environmental Cues   **Portion Sizes**   **Track Weight**

Slimmer

Username 👤 ⚙ Log Out

| Home | Goals | Food Diary | Daily Planner | Recipes | My Info |

Practice choosing your portion sizes!

Pick the plate below which you think is the healthiest option.

| Home | Goals | Food Diary | Daily Planner | Recipes | My Info |
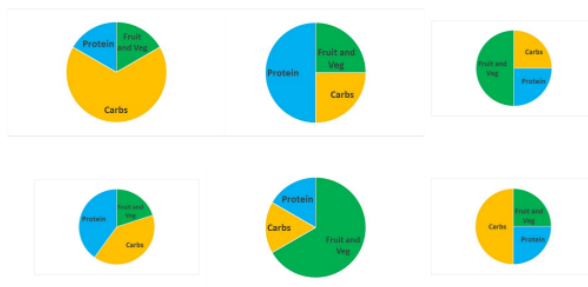
Your plate:

You could have picked a healthier option! There's a lot of carbs on your plate and not much frut and veg.

You also could have picked a smaller plate size. A good tip for restricting calories is to use smaller plates as it means you eat smaller portions.

A better choice would have been:

This is ideally how your plate should look.

Half of the plate is filled will fruit and veg, a quarter is filled with protein and the other quarter is filled with carbs. This is a healthy, balanced ratio.

The smaller plate size also means you can't overload your plate.

Choose Again

Feature: Share Achievement

Description: When a user makes a certain amount of progress toward their goals, such as reaching halfway to their target weight, they are presented with the opportunity to share their achievement with their friends and set an example. When doing do, they are reminded that they are a role model.

Requirements: FR14

Use Cases: UC12

Screenshots:

46
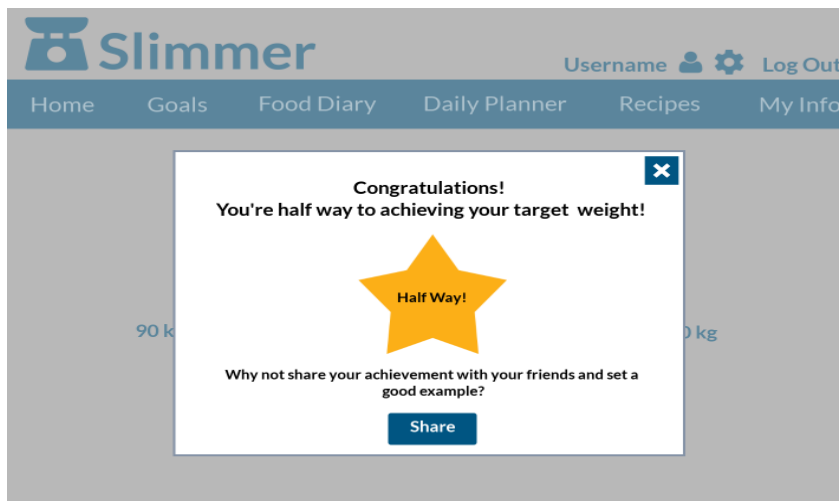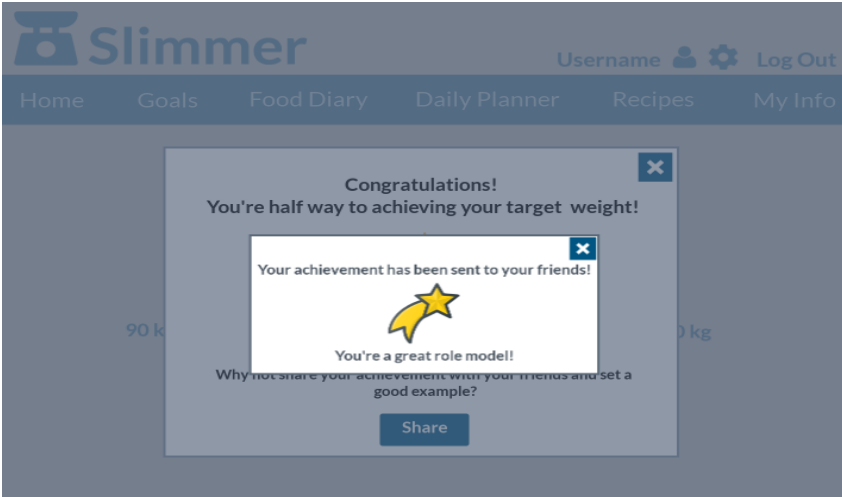
7.0 User Tests

User tests were conducted where users were assigned a series of tasks which they had to complete using the initial version of the prototype. The tests were designed to gain an understanding of how users interact with the app and how they feel about the app's design. The feedback provided by users helped identify improvements and provided a user's perspective which would be used to increase the app's user friendliness. Three test participants were selected from the survey as they had indicated they were interested in prototype testing. Users were provided with a consent form and a briefing sheet prior to the start of the study so that they were made aware of their rights as a research participant and what to expect during the test. They were then provided with a link to the prototype and a tasks sheet detailing the tasks they had to complete. The tests took place via Microsoft Teams with each user completing the tasks individually in separate sessions. Users shared their screen with the test facilitator so that they could observe the users' actions as they completed the tasks. Users were also asked to verbally express their thoughts and feelings as they completed the tasks and engaged with the app so that their thought process and opinion on the apps' design could be understood. After each task, users were questioned on their thoughts of the features they had just used, what they liked and disliked about them, how easy or difficult they were to use and if there was anything they would change. Once all the tasks were completed, users were asked some final questions about their overall experience with the app. The users' screens and voices were recorded throughout the tests so that the sessions could be reflected on and analysed at a later date.

Each test consisted of 8 tasks which were designed to have the user interact with specific features. This allowed the facilitator to observe the user using each feature and so that the user friendliness and suitability of each feature could be assessed. Users expressed their thoughts whilst using the app and were also prompted to express their thoughts on the features they had just used at the end of each task. Once the tests were completed, each session was reflected on and examined task-by-task, analysing the actions of the user, their thought and feelings, feedback and any improvements they may have suggested. The results of the user tests can be viewed below:

Task 1: Create a user account using the following details:

- Name: Tester
- Age: 30
- Height: 6"0
- Current Weight: 90 kg
- Target Weight: 80kg
- Target Date: 01/09/2020

Then, log in using your log in credentials.

Task Intention: Have the user use the Sign Up form to create a user account and log into the system.

Observations and Feedback: All users found and completed the Sign Up form easily. The form was described as standard, professional, and intuitive. It included everything the users would expect. All users signed in with ease. User 3 said that he liked the toggle buttons for the units of measurement, the colour scheme used and that everything was centre aligned. All users logged in with ease. The overall sign up and log in experience was reported as standard and easy to navigate. No users reported any difficulties. User 1 and User 2 both said that they wouldn't change anything. User 3 suggested using a slider for entering height and weight.

Outcomes and Improvements: There was a very positive reaction to the sign up and log in system with no complaints. Users used the system as intend with no difficulty. User 3 suggested using a slider for entering height and weight but since User 1 and User 2 were both happy with text input this will not be implemented. As there was a wholly positive reaction, no changes will be made.

Task 2: Add 100 calories to your calorie counter then remove 100 calories from your calorie counter.

Task Intention: Have the user use the calorie counter for tracking simple calories without having to record an entire meal.

Observations and Feedback: All users completed this task with ease. User 1 said that it was straight forward and easy to do. He said that it was really obvious where to add calories and that the progress bar was a good visual indicator. He also said that it dominates the screen but that this is a good thing because it is important to know how many calories have been consumed that day. User 2 said that the calorie counter was similar to those in other apps and that the design was a good UI choice. User 3 said that users can't go wrong and that it was a really nice feature. He liked how the background was dimmed after opening the quick calories modal boxes as it draws attention to the modals straight away. He said he loved the spinner buttons. User 1 used the text box only to input the calorie number whereas User 2 and User 3 used both the text box and spinner buttons. When questioned on their choice and whether they think there is value to having both methods, User 1 said that entering the number directly in the text box is quicker than repeatedly hitting the spinner buttons and incrementing the number gradually. However, he thought that there was value in having the spinner buttons as had he been using a touch device then he would have used the spinner buttons as he would not have to open the keyboard and there would be less key strokes. User 2 said that the text box is easier as it allows you to enter a specific number and is more precise but thought that there was value in having both methods available. User 3 said that he would use whichever method fell closest to his mouse and that he liked having both available. None of the users would change anything.

Outcomes and Improvements: All users reacted very positively to this feature and they wouldn't change anything. It is easy to find and intuitive to use. Both methods of input (text box and spinner buttons) will be kept as all users liked having both methods available. No changes will be made.

Task 3: Update your food diary with the following meals:

Breakfast – 2 medium bananas.

Lunch – 1 ham sandwich.

Search the food database to input your breakfast and use the barcode scanner to input your lunch.

Finally, remove the ham sandwich from your food diary.

Task Intention: Have the users use the food diary to record and delete various meals whilst also testing the search bar and barcode scanner as varying methods of inputting food data.

Observations and Feedback: All users found and used the food diary with ease. User 1 said that it was straight forward to use. He explained how he had used the spinner buttons this time to input the number of bananas because he knew he was only going from 1 to 2. User 2 said that it was similar to food diaries he has encountered in other apps. He commented on how he liked the images next to each food item and that this was something he hadn't seen in other apps. He suggested displaying the

macro-nutrient information as well as the calories in the food diary once they've been added. User 3 said that he liked the design and that the table looked clean and tidy. He liked that the red delete button made it obvious how to remove items directly form the diary rather than having to click into each item. He liked how the nutritional information was displayed when you searched for a food. He also said that it was easy to navigate and that it was difficult to go wrong. He suggested allowing users to customise the meal slot names as names for meals (e.g. lunch and dinner) vary from region to region. He also said that the scan button was quite close to the search bar and at first he thought they were all one feature. All users commented on how the food diary was separated into Breakfast, Lunch, Dinner and Snack. They all responded positively to this saying it provided a good structure and made it obvious where to add meals. Both User 1 and User 2 initially added the ham sandwich by searching for the food rather than scanning it. Once this had been pointed out to User 1, he deleted the food and added it again using the barcode scanner. User 2 noticed this on his own accord and then proceeded to add the food again using the barcode scanner. When asked whether they didn't use the barcode scanner in the first place was because the button wasn't obvious, User 1 said that, despite the fact that he had not used it, he actually thought it really stood out and that he would use that feature in the future. He suggested labelling the button with the word 'Scan' to make it more obvious. User 2 said that the button was obvious but that he would usually only use that feature for very specific foods whereas ham sandwich is quite a generic food that he would usually just search for. All users said that the barcode scanner was very easy to use.

Outcomes and Improvements: All users responded positively to the layout and design of the feature. Following user feedback, the barcode scanner button will be moved further away from the search bar and will be labelled with the word 'Scan'. User 2 said that he would like to see the macro-nutrient information in the food diary. Therefore, the macro-nutrient information will be displayed alongside the calories in the food diary. The default meal slot names will remain as Breakfast, Lunch, Dinner and Snack but will be customisable so that the users can change them according to their preference.

Task 4: Update your weight to reflect the following information:

You've lost 5 kg.

Then share your weight loss achievement with your friends.

Task Intention: Have users use the Track Weight feature to update their current weight and then test the Share Achievement feature to share the progress.

Observations and Feedback: User 1 went straight to the Weight Tracker to complete this task. User 2 and User 3, however, both went to the Goals page initially and tried updating their weight under Weight Goals. Once they had realised that this was not correct, they soon returned to the home page and found the Weight Tracker. Both User 2 and User 3 said that having a Weight Tracker tab on the navigation bar would have made it easier to find. User 3 also commented that Weight Tracker is one of the most important features and that it's icon on the homepage should be in a more obvious position among the feature icons, rather than in the bottom right corner. User 1 and User 3 both said that it was not obvious that you needed to click on the scales to input your weight and that the feature wouldn't benefit from a prompt to make this more explicit. User 3, however, liked the idea of pressing on the scales to input your weight. All users liked the ability to share the achievement, with User 1 saying that it was really easy to share the achievement but equally that he could have just as easily close the share box had he decided not to share it. User 2 and User 3 also said that they liked the positive messaging when they received the achievement.

Outcomes and Improvements: The Track Weight feature should be made easier to find and given a more significant position as it is one of the most important features. Its icon will be moved to the top row of icons on the homepage and a Track Weight tab will be added to the navigation bar. A label will be added to the scales in the Track Weight page so that it is more obvious that users need to click on the scales to enter their weight. The Share Achievement feature will remain as it is following the positive feedback it received.

Task 5: Practice using environmental cues as reminders.

Activities you should remember when 'Eating Breakfast' include:

- Record your breakfast in your food diary.
- Perform your morning stretches.

Complete the quiz.

Task Intention: Have users use the Environmental Cues feature to practice using environmental cues as reminders and then complete the quiz to recall the reminders identified for the cues.

Observations and Feedback: All users found the Environmental Cues feature straight away. After a minute of interacting with the feature they soon grasped the purpose and intention of the feature. User 1 wasn't sure whether to press 'Enter' or 'Next Cue' once he had entered an activity. He also wasn't sure on the difference between 'Next Cue' and 'Finish'. However, after further interaction with the feature he realised that 'Next Cue' would move onto another environmental cue such as 'Eating Lunch'. He suggested making the 'Enter' button bigger and moving the 'Next Cue' and 'Finish' buttons further apart to reduce confusion. He thought that the feature was a good idea and that using environmental cues was important. User 2 grasped the purpose of the feature very quickly and thought that it was a good idea. He said that he had never seen a feature like this in any other apps and that it was a nice feature. User 3 also said that this was a new feature to him but, again, grasped the idea fairly quickly. He entered the activities easily but his biggest concern was that the quiz would become repetitive and would stop being used after a while. He, therefore, said that the quiz should be kept highly interactive and varied. All users completed the quiz easily and without difficulty.

Outcomes and Improvements: Users reacted positively to the feature and thought that it was a good idea. Following User 1's suggestions, the 'Enter' button will be made bigger and the 'Next Cue' and 'Finish' buttons will be moved further apart to reduce confusion. To account for the possibility that the feature will stop being use after a while, as suggested by User 3, general reminders will be added to the app where users will intermittently receive reminders from the system where they are reminded of what activities they said they should remember when they encounter each cue.

Task 6: Practice using portion sizes until you have chosen the healthies option.

Task Intention: Have users use the Portion Sizes feature to identify healthy portion sizes.

Observations and Feedback: All users found and used the portion sizes feature with ease. User 1 said that it was a good feature and that it was fairly obvious what he was being asked to do. User 2 said that it was an interesting feature and was good for teaching you how to structure your meals. User 3 also said that it was an interesting feature and that it was easy to use. User 3 pointed out, however, that the healthiest portion size available was for a general case and that this might change depending on the individual and the activities they have completed or are planning to complete.

Outcomes and Improvements: All users reacted positively to the feature. They thought it was interesting and easy to use. No users offered any suggestions for improvement. However, based on User 3's comments, a possible future improvement to this feature would be to tailor the healthiest portion size to the individual user based on their personal information, goals and the activities they have logged in their planner.

Task 7: Update your goals as follows:

- Target Weight: 75 kg
- Target Date: 25/07/2020

Agree to the goals.

Task Intention: Have the user use the Goals feature to update their Weight Goals and user the Goal Agreement feature to agree to strive towards their goals.

Observations and Feedback: All users found and used the Goals feature easily. They had no problems updating their goals. User 2 liked that he could reach Goals from the navigation bar as it made it easier to reach. He also liked the Goal Agreement feature as he felt that it showed the app cared about users trying hard to reach their goals and that it added greater significance to the goals. He said that this was different from other apps. He warned that having the feature appear too often would become annoying but that the balance was good and that it's a good feature. User 3 also liked the Goal Agreement feature and thought that it was motivational. After ticking the agree box, User 1 wasn't sure if the agreement had been confirmed and was looking for a save button.

Outcomes and Improvements: All users found the Goals feature easy to use and reacted very positively to the Goal Agreement feature. So that it is more obvious that a user's agreement has been confirmed, the agreement box will turn green when ticked.

Task 8: Add the following goal to your daily planner: on Monday 1, eat 1800 kcals or less.

Update the progress of the goal to reflect the following information:

- You failed the goal.
- You failed because you did not take lunch with you to work which meant you had to buy lunch from the canteen but they did not have any healthy options, causing you to consume too many calories.
- You could avoid this happening again by preparing healthy lunches at the start of the week or the day before so that you have healthy lunches to take with you.

Finally, add the same goal to Tuesday 2.

Task Intention: Have the user use the Daily Planner function to set a daily goal and then use the Barrier Identification feature to update the progress of the goal with reasons for failure.

Observations and Feedback: User 1 initially went to the Goals page and tried editing Daily Nutrition Goals to set a daily goal, rather than go to the Daily Planner page. Similarly, User 3 wasn't sure whether to go to Daily Planner or the Goals page but decided to go to the Daily Planner. Both User 1 and User 3 said that the reason they thought Daily Goals might be in the Goals page was because of the word 'goal'. User 3 suggested that this ambiguity could be removed by changing 'Daily Goals' to 'Daily

Objectives'. User 2 went to Daily Planner immediately. All users initially tried adding a daily goal to the tasks areas but soon found the area for daily goals after realising this was incorrect. User 1 mentioned that he would expect Daily Goals to come above the task planner as it shows your overall goals for the day. He also mentioned that he first tried adding the goal to the task planner as the add button was at the top of the screen so this was where his eyes first fell. User 1 said that it required some thought to work out how to update the progress of the goal but soon worked it out and said that once users got used to the system it would be easy to use again. User 2 also wasn't sure on how to update the progress of the daily goal and first tried going to the food diary to record more than 1800 kcals as he thought this would cause him to fail the goal. He suggested having a prompt to inform users of how to update the goal progress. User 3 liked that the goal turned red once it had been failed. All users responded very positively to the Barrier Limitation feature. User 1 said that the reminder of previous performance of the goal was useful and a good prompt. He suggested having a feature that would allow you to add the method for avoiding failure in the future to your daily planner. For instance, if the method to avoid failure was, "Prepare healthy lunches in advance", then he would like a button that would add this activity to his Daily Planner. User 2 said that it was one of his favourite features of the system. He said that it's good that it makes you think about why you failed and that it makes you think of constructive criticism for yourself rather than just logging your failure. He liked how it reminded him of how he failed and the steps he could take to avoid this happening again. He mentioned how he had never seen this in any other app. Both User 2 and User 3 specified how they liked that it quoted them directly. User 3 said that he would like a list of previously saved goals which he could use to quickly add repeat goals.

Outcomes and Improvements: Users reacted very positively to the Barrier Identification feature with User 2 citing it as his favourite feature of the system. User 1 and User 3 encountered some confusion as to where to enter the daily goal. To avoid this confusion and remove the ambiguity, 'Daily Goals' will be renamed 'Daily Objectives'. User 2 wasn't sure how to update the progress of the daily goal. To make this more explicit to first time users, a prompt will be displayed to indicate how to update the progress of the daily goals. User 1 said that he would expect the Daily Goals section to come above the task planner as this makes more sense as they are the overall goals for the day. Therefore, Daily Goals will be moved above the tasks section. Following his further suggestions, a feature will be added that will allow users to add the methods identified for avoiding failure in future directly to the daily planner. Following User 3's suggestion, a goal history will be added which will allow users to quickly and easily add repeat goals.

Once all of the tasks had been completed, users were asked a number of final questions regarding their overall experience with the app. Firstly, they were asked to compare two different colour schemes applied to the home page in order to gauge which colour scheme users prefer. All users said that they preferred Colour Scheme A. User 2 said that Colour Scheme A felt familiar because it was similar to MyFitnessPal and that he had come to associate blue with health and fitness. He suggested adding a feature to allow users to toggle between a dark and light mode. User 3 said that, without a doubt, he preferred Colour Scheme A as Colour Scheme B was too intense. Following the user feedback, Colour Scheme A will be used.

Users were then asked the following questions:

What did you think of the layout of the content?

All users thought that the layout was good. User 1 said he wasn't overwhelmed by what was on screen. User 2 said that the layout looked tidy and that the thought it was very professional. He said that he could imagine himself using it. User 3 said that he liked how everything was centre aligned and that it looked modern. He said that the best word to describe the layout was neat. Following this positive feedback, the layout of the app will remain largely the same.

How easy or difficult was it to navigate?

All users said that they found the app easy to navigate, for the most part. User 1 said that most of the icons on the home page were good and accurate representations of their features, although a more appropriate icon for Environmental Cues could be used. He suggested a lightbulb. User 2 said that most parts of the app were easy to navigate although he encountered some initial difficulty finding the Track Weight feature and finding where to update the progress of a daily goal. As previously mentioned, these issues will be resolved by adding Track Weight to the navigation bar and by adding a prompt to indicate how to update daily goals. User 3 said that the app was very easy to navigate. He did encounter some confusion when updating daily goals as he wasn't sure whether to look in the Goals Page or the Daily Planner. He attributed this to the shared use of the word 'goal'. Therefore, Daily Goals will be change to Daily Objectives.

Were there any features or aspects of the prototype that you particularly liked?

User 1 said that he liked how the app was straight forward to use. He said that now he had gone through it once, he would have no difficulty using it again. He liked having the visual representation of consumed calories on screen. User 2 said that he liked the design and look of the app. He mentioned that the Barrier Identification feature was he favourite aspect of the app. User 3 also mentioned that he liked the design of the calorie counter as it was clear and obvious. He also said that he thought the Environmental Cues feature was a good idea.

Were there any features or aspects of the app that you disliked or would change?

User 1 said that he would introduce another colour into the colour scheme. He also said that it would be good to link the app to additional apps and devices such as Fitbit and to be able to track calories burnt. These are features for future work. User 2 said that he would resolve the navigational issues he previously mentioned but, other than that, there was nothing he would change. User 3 said that he felt the Environmental Cues quiz wouldn't be used after a number of uses so he would change it to encourage continued use. This will be resolved by adding reminders based on the answers provided by users in the Environmental Cues feature.

What, if anything, surprised you about the experience?

User 1 said that, after reading the briefing and task sheets, he thought it sounded too easy and was going to be harder but he was surprised that the app was a straight forward to use as it appeared. User 2 was surprised by the Barrier Identification, Environmental Cues and Portion Sizes features as they were all novel features that he had not seen in any other apps. This corroborates the findings from the BCT analysis. User 3 was also surprised by the Environmental Cues feature, as well as the Goal Agreement feature. He said that they showed the app was focused on changing the user's mental attitude rather than just their diet and calorie consumption.

What, if anything, caused you frustration?

User 1 said that nothing caused him frustration. User 2 mentioned the small navigation issues he experienced but said that everything else worked as expected. User 3 said that he only experienced some frustration when he couldn't find something he was looking for such as updating his current weight.

How would you describe your overall experience with the product?

User 1 said that his overall experience was very good. User 2 described his experience as very positive. He said that it was an exciting app which he thought would help people stick to their goals. User 3 described his experience as easy and straight forward.

Are there any other comments you wish to make?

User 1 wished to add that he thought the app had really good potential. He said that it is something that could grow over time by adding new features but that it was a really good starting point and has everything you need for day one. User 2 wished to add that he thought the app looked really good and that he liked the features that kept users honest with their goals. User 3 said that he really liked it and that it was really easy and intuitive to use.

The user tests were a large success and provided some extremely valuable feedback. They set out to gain an understanding of a user's perception of the app which would allow developers to improve the app and make it more user friendly. The user tests offered a great opportunity to connect with users and observe them using the initial prototype. They helped uncover some navigational and usability issues that otherwise would have gone unnoticed by developers. Users also provided some insightful suggestions which will be implemented to produce a second, improved iteration of the prototype.

8.0 Prototype Version 2

Following the feedback from the user testing, a second iteration of the prototype was developed by implementing the improvements suggested by the users. This was done in order to make the design of the app more user friendly and appealing to users. The improvements made to the prototype are described below:

Feature: Food Diary

A suggested by the users, the scanner button has been moved further away from the search box and a 'Scan' label has been added so that the scanner button more clear and obvious. The macro-nutrient information of the foods are no displayed in the food diary so that this information is readily available. The meal name slots are now customisable by click on the meal name to rename it.
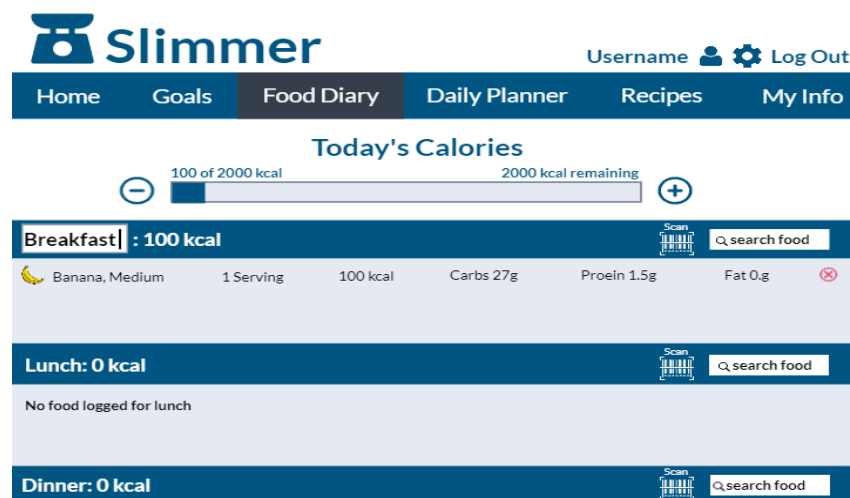
**Feature: Track Weight**

In order to address some of the navigational issues experienced by users, the Track Weight icon has been moved to the top row of icons and has also been given a tab on the navigation bar so that it is easier to find. A label has also been added to indicate that users need to click on the scales button to input their weight as a few users mentioned that this was not obvious to do.

Step on the scales!

90 kg ▭ 80 kg

0 kg lost
Current Weight: 90 kg
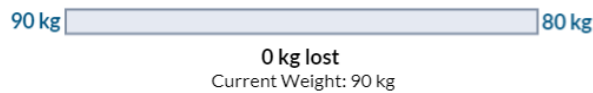
Feature: Environmental Cues

So that the buttons used to navigate the Environmental Cues are clearer, the size of the 'Enter' button has been increased and the 'Next Cue' and 'Finish' buttons have been moved further apart. Reminders have also been added so that the user is intermittently reminded to look out for environmental cues and which activities they should remember to do when they encounter a cue. The Environmental Cues icon has also been changed to a lightbulb as a user suggested that this would be more appropriate than a bell.

Environmental Cues

Your first cue is:

Eating Breakfast

Record my breakfast in my food diary.

Is there another activity or behaviour that this cue could be used as a reminder for?:

Enter

Next Cue   Finish

Feature: Goals

So that the user knows their agreement to their goals has been confirmed, the agreement box wil now turn green when it is ticked.

Feature: Daily Planner

There was a level of confusion experienced by users when trying to set a daily goal. Users found it difficult to locate the Daily Goals section as they were looking on the Goals page. This caused by the shared use of the word 'goals'. Therefore, to remove, this ambiguity, the Daily Goals section has been rename Daily Objectives. The Daily Objectives section has been moved above the Daily Tasks section at the suggestion of the users as it was mentioned that this is where their eye line falls first so it will be easier to find and Daily Objectives should come above Daily Tasks because they show your overall objectives for the day. A prompt has been added which will indicate to first time users how to update the progress of Daily Objective as this was not clear to users at first. A feature has been added which will allow user to directly add tasks to the task planner from the Daily Objectives section that they identify as a way to avoid failure. As suggested, a history of previous objectives will be made available so that it is easier to add repeat objectives.

Could you add this as a task to your Daily Planner?   **Skip**

Date: [   ]   Time: [   ]

Task:

[   ]

Add Task

← **Daily Planner**

Add your daily objective: **Add**

[   ]

⊟ Objective History

Eat 1800 kcals or less

Walk 10000 steps

9.0 Implementation

Unfortunately, due to time restrictions of the project, only a small amount of the app's designs were implemented. The work that has been completed will be detailed in this section. Whilst it is disappointing that a greater amount of the app's designs couldn't be realised during the course of this project, the work that has been completed serves as a good starting point for this project to be continued at a later date. The sections of the prototype that have been implemented include the Sign Up and Log In systems. How these were implemented will be described in this section.

In order to develop the app, a number of standard web technologies were utilised. The frontend was built using HTML5, CSS3, Bootstrap and JavaScript. HTML5 and CSS3 are the most common and widely used web languages and were used to implement the structure and style of the frontend. Bootstrap is a frontend framework which makes the design of the interface faster and easier as it provides a number of HTML and CSS templates. It was chosen as its grid system provides greater control over the layout of the page content and it offers off-the-shelf design elements which can be used to make the interface more aesthetically pleasing with minimal effort. JavaScript was used as a frontend scripting language in order to make the app more interactive and dynamic. JS scripts were used to embed functions into the HTML pages in order to respond to actions by the user. The backend was implemented using PHP as the main scripting language to handle all backend operations and MySQL was used to host and manage the database. PHP was chosen because it is the most widely used scripting language in web development and has a large community for user support. It also works very well with MySQL. MySQL was chosen because it is very reliable and a relational data model is well suited for handling the type of data used by this system.

As previously mentioned, the main areas that were implemented were the Sign Up an Log In systems. These two systems go hand-in-hand and a high level description of how they operate will be provided. First, however, a number of smaller constituent elements must be explained to give context to the wider function of these systems.

The Database

MySQL was used as the database management system. As only the Log In and Registration systems were implemented, only one database table was created. The 'users' table hosts the data that makes up the users' accounts. Fields include, 'id', 'username', 'password', 'age', 'height', 'current_weight', 'target_weight', and 'target_date'. When a user completes the Sign Up form, the data they enter is stored in this table. When user logs in, the user table is queried for the username and password that the user provides. If an entry is returned, the user entered a valid username and password combination and they are granted access to the system.

	#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action			
☐	1	id 🔑	int(11)			No	None		AUTO_INCREMENT	✏ Change	⊖ Drop	▾ More
☐	2	username	varchar(15)	utf8mb4_general_ci		No	None			✏ Change	⊖ Drop	▾ More
☐	3	password	varchar(32)	utf8mb4_general_ci		No	None			✏ Change	⊖ Drop	▾ More
☐	4	age	int(3)			No	None			✏ Change	⊖ Drop	▾ More
☐	5	height	varchar(7)	utf8mb4_general_ci		No	None			✏ Change	⊖ Drop	▾ More
☐	6	current_weight	varchar(7)	utf8mb4_general_ci		No	None			✏ Change	⊖ Drop	▾ More
☐	7	target_weight	varchar(7)	utf8mb4_general_ci		No	None			✏ Change	⊖ Drop	▾ More
☐	8	target_date	date			No	None			✏ Change	⊖ Drop	▾ More

connection.php

This fie is a PHP script which creates a connection to the database and allows other files to access the database In order to store and retrieve data. A connection is created using the host name, user name, password and database name. Whenever a file wishes to connect to the database, it must 'require' the connection.php script so that it can use the connection created within. By using connection.php in this way, it reduces the amount of code needed as instead of creating a connection in every file that needs database access, the files just reuse the connection in connection.php.

```php
<?php

$mysql_host = 'localhost';
$mysql_user = 'root';
$mysql_pass = '';
$mysql_db = 'slimmer';

$con = mysqli_connect($mysql_host, $mysql_user, $mysql_pass, $mysql_db);

if (mysqli_connect_errno()) {
  echo "Failed to connect to MySQL: " . mysqli_connect_error();
  exit();
}


?>
```

core.php

The core.php file is simple file whose main purpose is to store a session flag so that the system knows if a user is logged in and which user it is. This file is required by every other file so that the session can be tracked. It also stores a reference to the current page and the previous page.

index.php

The index page acts as the root for the whole system. Rather than loading the pages directly into the browser, the index page is loaded in which other pages are 'included'. Therefore, it is actually the index.php page that is loaded into the browser, but the index page processes whichever page is desired and it is the content of this page which is returned on screen. Loading pages in this way helps to keep the system more organised.

```php
<?php

require 'core.inc.php';
require 'connect.inc.php';

if (loggedin()) {
    include 'home.inc.php';
} else {
    include 'landing.inc.php';
}

?>
```

Now that these smaller elements have been explained, a high level description of the Sign Up and Log In system can be described.

When a user first navigates to the application, they arrive on the index page (index.php). The first thing that index.php does is it checks if the session flag in the core.inc.php file is set. It is able to access this flag because it requires the core.inc.php file. If it is set, then this means that the user must already be logged in. In that case, the index.php file includes the home page. The browser remains on the index page but it is the content from the home page that is rendered on screen. From here, the user can use the system as they wish. However, if the session is not set then the user is not logged in. In this case, it is the start page (landing.inc.php) that is loaded on screen instead. From here, the user can either Sign Up or Log In.

Sign Up

If the user doesn't have an account, they can create one by using the Sign Up button. This will take them to the Sign Up page, sign_up.php. Here they are presented with the sign up form. They complete the fields accordingly and then click Sign Up. The values they entered are posted to the php script embedded in the page which first checks that all fields have been completed and that they're not empty. The database is then queried to check that the username is unique. If the username is found, the user Is warned that the username has already been taken and they must choose again. Once they have entered a unique username, a new entry is created in the database using the values that were entered. A session is created using the id of the users account and the browser is directed back to the index page. However, as soon as the index page is loaded, it checks the session flag and finds that a user is logged in. The home page is then included and presented to the user where they can continue to use the app.

Log In

If the user already has a user account, then instead of clicking on the Sign Up button, they can enter their username and password into the log in box directly on the start page. The start page posts the username and password values to itself before querying the database to check if they are a valid combination. If a row is returned, there must be an entry in the database with that combination of values so it is therefore a valid account. The session flag is then set and, just as before, the index page is loaded. However, since the user was technically already on the index page which was including the start page, this acts as a refresh. This is so that the index page checks the session flag again where it now finds that the flag has been set and the user is logged in. The home page is then included by the index page and the user is granted access to the system.

Log Out

When the user wishes to log out, they simply click the Log Out button. Doing so calls a script called logout.php which kills the session. The index page is then loaded which checks the session flag and finds that it is empty. The index page then includes the start page from where the user can log in.

This is as far as the implementation process has reached. There are still further features that need to be added to the registration system such as the calculation of the user's calorie allowance, but the core functionality of these two systems has been implemented. However, there is still a great deal of work to be completed. Please see the future results and future work sections for a greater discussion on the next steps to be take. In its current state, a testable system has not been implemented and, therefore, no further testing will be conducted in the course of this project.

10.0 Results and Evaluation

Determining the success of the project is not entirely straight forward. There are many strengths to the project, such as the investigations into existing weight loss apps, the design of features that would improve these apps, the development of a high fidelity prototype, and then user testing which derived further improvements and increased the design's user friendliness. Regrettably, however, the project was unable to capitalise on these early successes due to time restrictions and fell short of implementing a fully functional system. In order to evaluate the success of the project, each project objective must be examined more closely.

Objective 1 – Research previous studies into the effectiveness of weight management apps in order to gain an understanding of the existing work that has occurred in this subject area.

As can be seen in the Background section of this report, a range of research was conducted which looked in-depth into the previous studies that have investigated the suitability and effectiveness of weight loss apps and their incorporation of theory-based content. This research was paramount for gaining an understanding of the work that has already been conducted in this area so that this project could approach its aims from an informed position and to continue the work from where these studies left off. It was through this research that the significance of behavioural change techniques and their deficit in existing weight loss apps was realised. This helped formulate the BCT analysis which is arguably one of the greatest strengths of this project.

Objective 2 – Conduct a series of assessments of the most popular weight management apps in order to assess them for their suitability in providing weight management solutions. This includes:

- A feature review to gain an understanding of how the existing apps operate, the features they provide, and users' opinions of the apps.
- An analysis of the behaviour change techniques (BCTs) that the apps incorporate.

Comprehensive assessments of the most popular weight loss apps were conducted. The feature review and the BCT analysis extended the body of work that has already been carried out in this area and, in the case of the BCT analysis, directly answered the call from previous studies to investigate the inclusion of BCTs in nutrition-focused weight loss applications. The findings from the feature review were crucial for gaining an understanding of how the existing apps operate, what features they provide, how users feel about these apps and which features and qualities users most value. Most importantly, it provided the platform from which to begin identifying and suggesting improvements for these apps. The BCT analysis delivered some of the most pertinent and useful findings from this project. One strength of the BCT analysis is that it used an established instrument in the form of the 26 BCT Taxonomy that has been widely used in a range of similar studies to systematically identify the inclusion of BCTs. The results of the BCT analysis corroborated the findings of previous studies that investigated the inclusion of BCTs in weight loss apps, such as Chen et al's 2014 study [20], determining that there is limited BCT inclusion. It was recommended that app developers should resolve to incorporate more BCTs in order to facilitate greater effectiveness. The assessments provided an update to this body of work by reviewing the most up to date apps. Moreover, a survey was conducted that further identified how users feels about weight loss apps and was able to directly quantify which features in existing apps are most important to users. This data indicated which features developers should priorities if they wish to satisfy users by delivering features of the greatest value.

Objective 3 – Provide recommendations, based on the findings of the assessments, for how these apps could improve and conceptualise features that may implement these improvements.

By analysing user reviews of existing apps, the features and traits that users value were identified. The praise and complaints of users provided an insight into their thoughts and feelings about the services provided by weight loss apps which was then used to determine which features users value. These were identified when the user expressed delight when a feature was present and when they became indignant when a feature was absent. A series of recommendations were then made to developers, highlighting which features they should be sure to include, but also which traits are most important to users, such as intuitiveness, convenience, accuracy and consistency. Furthermore, the BCT analysis identified the least implemented BCTs across weight loss apps. Features were then conceived that would implement these BCTs, showcasing to developers how these BCTs could be incorporated into their apps. Developers can use the findings and recommendations of these studies in their future projects to produce more effective, user friendly apps which deliver greater benefit to their users.

Objective 4 – Develop a prototype weight management app that improves upon the existing apps and provides a more suitable solution, informed by the findings of the app assessments.

The success of this objective is a bit more ambiguous. A high-fidelity prototype was developed using Marvel app which realised the design of features with a degree of functionality that permitted usability testing. These features were designed to implement a series of system requirements which were each derived from the results of the previous assessments. As the results of these assessments were recommendations on how apps can be improved, informed by users and theory-based content, by meeting the system requirements the app would be improving on existing solutions and would provide a more suitable solution. However, the ultimate aim of this objective was to develop a fully functional, testable system. Due to time restrictions of the project, this was not possible and the project ultimately failed in achieving this objective. This could have been avoided through better time management as a great deal of time was spent on the earlier stages of the project which took longer to complete than anticipated. For example, the feature review and BCT analysis could have been done in parallel rather than in series. The feature review was conducted first and the BCT analysis was conducted at a later date. This meant that the apps had to be re-downloaded and the researchers had to re-familiarise themselves with each app before proceeding with the analysis. A more efficient use of time would have been to review an app for its features and then analyse it for its inclusion of BCTs immediately whilst the researcher was still familiar with the app.

Objective 5 – Conduct iterative user-testing to increase the user friendliness of the app's design.

Again, the success of this objective is ambiguous. A first iteration of user testing was conducted where a number of user tests were successfully completed. The results of these tests were extremely beneficial in identifying improvements that would make the design more user friendly. Indeed, these improvements were subsequently implemented. The tests were also useful in identifying strengths of the design, with users responding were positively to the app, particularly the novel features that incorporated the least implemented BCTs. However, only one iteration of user testing was completed whereas it was intended that multiple iterations would be conducted. A further iteration of the high-fidelity prototype should have been performed and then, once the designs had been implemented in code, a subsequent series of user testing would have been conducted on the coded system. Therefore, this objective was achieved to an extent as a successful first round of user testing was completed, however, as the intention was to conduct multiple rounds of testing this objective cannot be deemed fully achieved.

Overall, this project has been a success as it has managed to achieve the majority of its objectives. Despite not implementing a fully functional system, the findings from this project can be used as a springboard for developers to design more effective weight loss solutions and it lays a solid

foundation for this project to be carried forward to full implementation. As previously mentioned, a testable system could not be implemented as a large amount of time was spent on the earlier stages of the project. Although this could have been managed better, spending this time was important and necessary as it lead to useful and reliable findings in the form of user-centred recommendations and theory-based feature designs which can now be used to produce effective weight management solutions. Moreover, these findings were using to design and develop an early prototype which has been further enhanced through users testing. This project is primed to be carried forward by building on the groundwork that has already been laid by implementing the designs of the early prototype into a fully functional system. By following these designs, which are based on user perspectives and theory-based content, a more effective, suitable and user friendly weight loss solution will be produced.

11.0 Project Limitations and Improvements

This section highlights a number of limitations of the project and suggests improvements that could be made. Firstly, it has to be acknowledged that a major limitation of the project is that a fully, functional system was not implemented for reasons previously discussed. This could have been avoided through more efficient time management, such as conducting the feature review and BCT analysis in parallel. However, the designs of the app have been developed with a strong justification and are ready to be implemented in future work.

There were also a number of limitations of the feature review and BCT analysis. For one, apps were only selected from the Google Play Store and not the Apple App Store. The project would have been improved if it had selected apps from both app stores as this would allow greater confidence in a comprehensive and complete selection of the most popular weight loss apps. However, as the Google Play Store is the largest app store, it is unlikely that there was an app on the App Store and not on the Google Play Store that would have met the inclusion criteria, and the Google Play Store still produced an adequate selection. Also, apps were only assessed on an Android device. The assessments would have been more comprehensive had they been conducted on both Android and iOS platforms.

Furthermore, the BCT analysis was only conducted with one researcher. As the inclusion of BCTs is open to interpretation based on the BCT definitions, the findings of the BCT analysis reflect the opinion of one individual. Another individual may have deemed an app to incorporate a BCT where the researcher had not. Therefore, the project would have benefitted from having multiple researchers assess the apps for BCTs individually who then come together to discuss their findings. This would have ensured a more accurate assessment of BCT inclusion. It should also be mentioned that the findings of the BCT analysis only apply to the study sample. Although these are the most popular apps and are therefore perhaps the most pertinent, less popular apps that incorporate more BCTs may exist.

Finally, this project would have benefitted from having a nutritional or behavioural expert on hand to consult and to have an expert opinion inform design decisions. A collaboration of health and behaviour experts in the development of weight loss app is a consideration for future work.

12.0 Future Work

As previously discussed, a solid foundation has been built on which the project can be carried forward. The most obvious place to pick up from this project would to be implement a coded version of the initial prototype that provides full functionality. A number of iterative user tests should then be conducted on the coded prototype, as was intended, in order to fine tune the apps functionality and increase its user friendliness. A number of final tests should then be conducted, such as unit testing and heuristic evaluations, before the minimum viable product is deployed and released for use by the public. That would take this project as far as it ever intended to go, but there is still a great deal of work that could be done that goes beyond this point. As with all apps of this nature, there are always improvements to be made and more functionality that can be implemented. To start with, more BCTs should be incorporated into the app. For the purposes of this project, only five BCTs were selected for implementation. However, as this project has championed the use of BCTs in providing effective weight loss solutions, features that incorporate more BCTs should be implemented into the app. As the BCT analysis found, the weight loss app that had included the greatest number of BCTs had included 16 BCTs. Therefore, a good target would be to either match or exceed this number of BCTs. It is also recommended that Table 4, which rates features on their level of importance according to users, be used to select more features for implementation. This project aimed to implement the top five most important features from this list. Therefore, the next five most important features would be a logical starting point to prioritise the next features for implementation. This ensures that the app incorporates features that users value and have most use for. So far, the app has only focused on the nutritional aspect of weight loss. However, fitness is also a very important consideration. Therefore, in the future, more fitness oriented elements such as an exercise tracker and workout guides should be incorporated into the app. Finally, as has been stated, this project would have benefitted from having a nutrition or behaviour expert involved in the development of the app in order to provide an expert opinion with which to cross-reference content and to inform design decisions. A future collaboration between app developers, health and behaviour experts would be beneficial for the continued advancement of this project, ensuring the inclusion of evidence-based, expert led content.

13.0 Conclusion

Obesity is a major public health crisis. In the technological age in which we live, more and more people are turning to weight loss apps in an attempt to combat their weight issues. However, a number of studies have brought into question the effectiveness of these apps and have shown that they lack a variety of theory-based, behavioural change content. In response to this, this project set out to investigate the effectiveness and suitability of the most popular weight loss apps currently available in order to identify ways in which these apps can be improved and to develop a more suitable solution. A feature review was conducted which explored the services that these apps have to offer and examined how users feel about these apps. These finding were used to derive a series of recommendations to app developers which would help improve the effectiveness and user friendliness of weight loss apps. Apps were then analysed for their inclusion of behavioural change techniques which have been shown to be an important factor in an apps ability to facilitate behavioural change yet which have been found to be lacking in popular weight loss apps. The findings of the BCT analysis corroborated this previous observation and features were designed which would implement some of the least incorporated BCTs. Furthermore, a survey was carried out which was able to quantify the importance of the features identified across the most popular weight loss apps which was then used to determine which features are most important to users. All of these findings were used to develop a set of system requirement which, if implemented, would ensure that the system incorporated a balance of features and traits most valued by users and features which implement a variety of BCTs. Based on these requirements, a high-fidelity prototype was developed which helped realise how these feature might look and function in a system and which laid the blueprint for a future weight loss app. User testing was conducted using the porotype in order to derive further improvements that, once implemented, made the apps design more user friendly. Unfortunately, due to time restraints of the project, the app designs were not implemented into a fully functional system as planned. However, the work that has been carried out provides a strong starting point from which the project can be carried forward by developers in future work. In order to progress the project, the system design should be implemented into a coded prototype with which further user testing can be performed. After a series of iterations and some final system testing, the app will be ready for deployment as usable product. This will not be the final design, however, as there are many further improvements and features that can be added to continually expand the app. Overall, the project has been a success as it has achieved the majority of its original objectives and, although a finished product has not been produced, a set of designs based on user perspectives and theory-based content have been developed which, if implemented, will provide a good starting point for a more effective and suitable solution for weight loss.

14.0 Reflection

Completing this project feels like a monumental achievement. It is unquestionably the largest individual project I have ever undertaken and it has been a invaluable learning experience. Although on a personal level I was disappointed to have not capitalised on the successes of the early stages of the project by completing more of the implementation, I am still proud of what I have achieved. The research I conducted the start of the project is the largest body of research I have completed for a single project and my research skills have been enhanced immensely as a result. It was a fascinating experience to learn how the field of Computer Science crosses over into other disciplines, such as behavioural psychology, and to observe how the two can collaborate to produce effective solutions for the problems of everyday people. This will, no doubt, be a huge benefit going into my future career. It is a privilege to consider how I may have contributed to this body of work. Of course, a great deal of soft skills have been improved through the course of this project, least of all my communication skills. I have never conducted user testing before, having the chance to do so through this project was a great learning experience. I believe that the user tests are one of the strengths of this project as they yielded some insightful feedback which was directly used to make improvements to the design of the prototype. User testing is therefore, definitely a new skill that I have acquired as a result of this project. Furthermore, the designing of the prototype itself was a new skill that I got to put into practice during this project. I had never used Marvel app before and had very limited experience using such tools to design a prototype. However, once I had got to grips with Marvel, it was highly enjoyable and I was impressed with the degree of perceived functionality that it offered, despite it being only a frontend development tool. The frames could be designed in such a way that it gave the effect of functionality to a high enough level that it facilitated user testing. This was a great revelation and I anticipate that the skills developed from this experience will be instrumental in the future. As previously mentioned, I attribute not completing the implementation simply to running out of time. This was due to spending too much time on the earlier sections of the project. Whereas I do feel that spending this time was necessary as it was important to build a strong foundation for the project and some of the strongest work from this project came out of these early stages, the time could have been used more efficiently. Therefore, time management is a skill that has been highlighted for improvement. Finally, to reflect on the fact that I have now completed a project of this magnitude gives me great confidence. It was been a challenging experience but one that has helped me grow both as a computer scientist and as an individual. The skills I have developed through this project will help me to no end in my future career and I will be able to look back on this project with pride and satisfaction.

15.0 Appendix A

15. 1 Review of Popular Weight Loss Apps

A review of the most popular nutrition and weight loss apps was conducted in order to gain an overview of the products currently available on the market and to identify areas where they could be improved.

An open source search engine called KPlaySearch was used to find the most popular nutrition and weight loss apps available on the Google Play Store. The Google Play Store could not be used directly as it does not allow results to be sorted by number of installs, making it impractical to find the most popular apps. An alternative android app market place called AppBrain was first considered as it allows for apps to be sorted based on 'All-time downloads'. However, when used with the search query only 18 results were returned and only 4 of those met the inclusion criteria for minimum number of installs. This sample was deemed inadequate to provide an accurate overview of the most popular weight loss apps currently available.

The following search query was used in KPlaySearch: *weight loss, nutrition, diet, lose weight, calorie counter, food diary, healthy eating.* This returned 120 apps which were then sorted by number of installs. To reduce the list for practicality and to ensure that only the most popular apps were reviewed, all apps with less than 5 million installs were excluded. This reduced the list to 13 apps which was then further reduced by applying the following inclusion criteria to ensure the relevance and appropriateness of the apps for review:

- Must use the English language.
- Must be available in the UK.
- Must be free to download and provide a free basic service.
- Must have a rating greater than 3.
- Core functionality must not be dependent on any additional devices (eg. wearables such as FitBit)
- Must provide functionality for recording meals in order to ensure there is a nutritional focus.

4 of the 13 apps selected from the initial round of refinement were excluded from the review. Weight Watchers Reimagined (WW) was excluded as, although the app is free to download, a paid subscription is required in order to access its services. Lose Weight in 30 Days (LW), BodyFast Intermittent Fasting: Coach, Diet Tracker (BF), and Weight Loss Tracker & BMI – aktiBMI (WLT) were all excluded as they do not provide functionality for logging meals or tracking calorie intake and were, therefore, deemed to not have a nutritional focus.

The remaining 9 apps were downloaded onto an Android phone and explored individually. Each feature identified was recorded and a sample of positive and negative reviews for each app were randomly selected from the Google Play Store. Positive reviews were those that awarded greater than 3 stars and negative reviews were those that awarded less than 3

stars. 5 of each type of review were taken for each app. Screenshots of each app's features and interface were also taken.

| | = Included |
| | = Excluded |

App Name	Abbreviation	Installs	Rating (0 – 5)
Lose Weight in 30 Days	LW	50,000,000+	4.8
Calorie Counter-MyFitnessPal	MFP	50,000,000+	4.5
8fit Workouts & Meal Planner	8F	10,000,000+	4.5
WW (Weight Watchers Reimagined	WW	10,000,000+	4.5
Noom: Health & Weight	NHW	10,000,000+	4.1
HealthifyMe: Calorie Counter, Weight Loss Diet Plan	HM	10,000,000+	4.6
Calorie Counter by FatSecret	CC	10,000,000+	4.7
YAZIO Calorie Counter, Nutrition Diary & Diet Plan	YZO	10,000,000+	4.3
Lifesum – Diet Plan, Macro Calculator & Food Diary	LS	10,000,000+	4.3
My Diet Coach - Weight Loss Motivation & Tracker	MDC	10,000,000+	4.5
Calorie Counter by Lose It! for Diet and Weight Loss	LI	10,000,000+	4.6
Weight Loss Tracker & BMI – aktiBMI	WLT	5,000,000+	4.6

BodyFast Intermittent Fasting: Coach, Diet Tracker	BF	5,000,000+	4.6

Table 1. Apps with more than 5 million installs that have been included or excluded from the review.

Calorie Counter - MyFitnessPal

Rating: 4.5

Downloads: 50,000,000+

No. reviews: 2,000,000+

Free Features:
- Barcode scanner
- Blogs and articles
- Calorie counter
- Challenges and rewards
- Connectivity to additional devices
- Connectivity to other apps
- Create exercises
- Create foods
- Create meals
- Create recipes
- Exercise tracker
- Food database
- Food Diary
- Goal setting
- Macro nutrient tracker
- Notes
- Recipe finder
- Reminders
- Social community
- Social network connectivity
- Water tracker
- Weight tracker

Paid Features:
- Diet insights
- Diet plans
- Workout plans

Positive Reviews:
- "I loved a downloaded version of this years ago. This has now improved so much it's phenomenal. You can always find the nutritional elements of the exact food you're eating. You can log all food and exercise accurately and get tremendous positive feedback and encouragement with all of the graphs and charts anyone could desire to monitor your progress. I can't believe they let you do all of
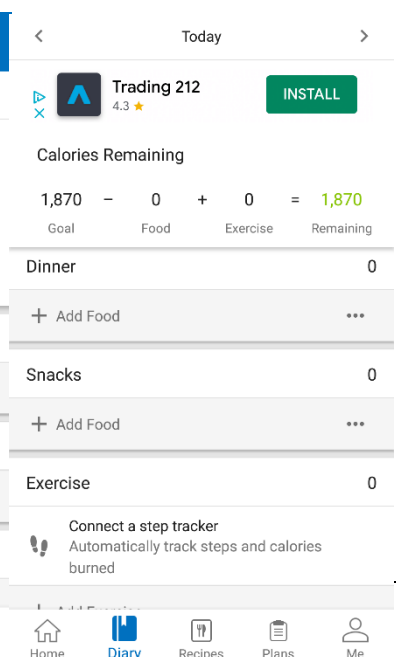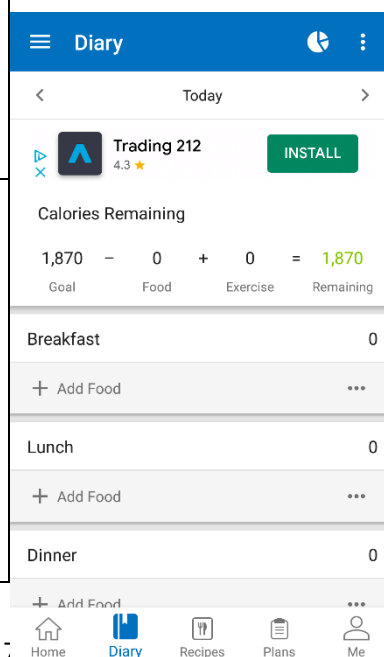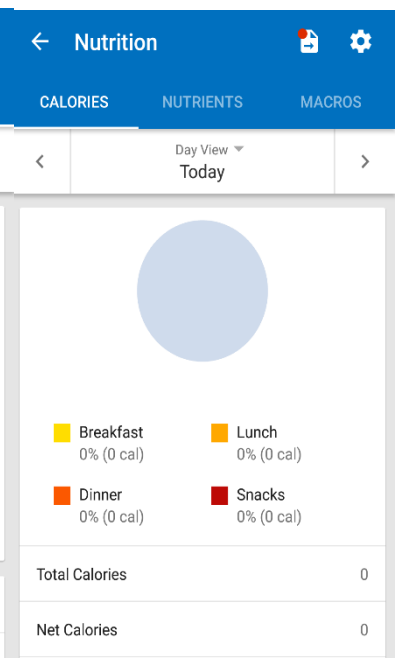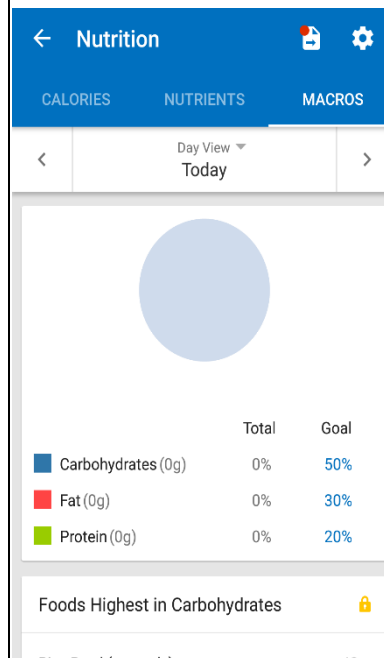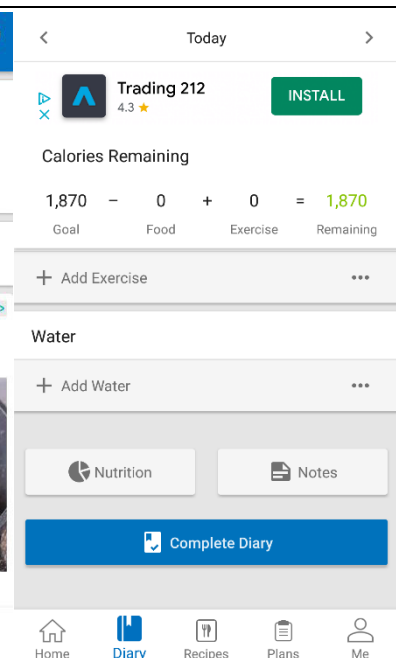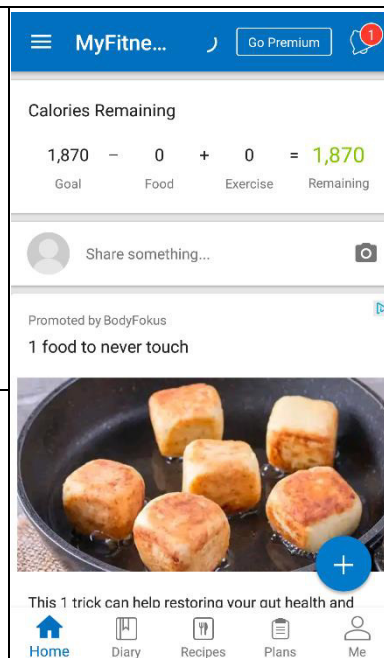
this for free. It used to be very expensive. I've paid the nominal amount for the extras because they deserve it."

- "The option to create your own recipes and meals, for later use, has saved me lots of time and made my calorie micromanagement much more precise. Also barcode scanner - awesome! The ads and articles only appear on the home page and to be fair they are relevant. I do learn lots of nutritional facts there. The Fitbit integration is so great, the number of calories i burn through exercise are taken into account so i know exactly how much more i can eat in a very active day, without starving myself."

- "I had used the Lose It app RELIGIOUSLY before this, and was frustrated that you weren't able to edit homemade recipes that you entered (say, if you made it with beef one time, and maybe just had chicken on hand for the next time you made it). It sounds like a little detail, but for someone who cooks a lot, it was a real pain. So glad you can do that and more with this app!"

- "I like the free version, gives plenty of information about calories, fats, ect of anything you eat! I like that it has knowledge of brand name, home made, and organic products and foods to better gauge your intake! That, and adding in exercise to add to your intake, is really helpful! I like the way it tells you if you maintain the regimen, how fast you can lose weight! Thank you, this is terrific!"

- "Good... To track weight, water intake. The free version doesn't track calories well from strength training but seems ok with cardio. The number of food items that you can track is pretty good.. but I'd like some more descriptive options. Like buttered toast seems way more calorie dense than you'd expect. Is that because of the amount of butter used - that detail would be good to know. Otherwise thank you for making this. Makes trying to lose weight a bit easier. In fact it's an essential for it"
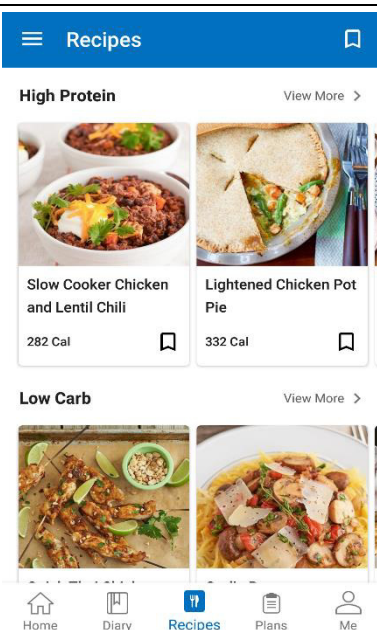
Negative Reviews:

- "The app just keeps advertising and insistently reminding you to subscribe to premium. There's no simple way to just add calories, like Garmin Connect deals with water ingestion. You can't just estimate, like, "today I have consumed xxxx calories. Too much meals, too much receipts, lots of unnecessary food data. And again, the advertising is so annoying. P.S.: I'm really surprised Garmin have to deal with such unnecessary app, instead of having their own feature inside Connect Garmin app."

- "Great concept but terrible software. Freezes up since a recent update. Double adds items. Just generally not as easy to use as it was 4 or so years ago when I started using it. For the app to be effective, it needs to be quick and easy to use. Please address the performance issues and return the app to what it use to be like."

- "I loved this app, but it's not adding food correctly anymore. I'll find what I need and add it, but it won't show up. Then hours later it will have logged the same food multiple times. Its useless if I can't log my food properly."

- "Used this app for years. After the February 2020 update the ad banners are so big I can only see one ingredient entry in my diary at a time. The convenience of the app no longer exists die to this design. Deleting this one and moving on to more user friendly design app that allows me to list and look at lists of food instead of just one item at a time."

- "The app used to be fantastic. The best around. But over the last 2-3 weeks it's become unusable. Slow loading times, and now just constant crashing where it 'stops working' and asks if you want to send feedback. Can't do anything with it in its current state. Needs a fix so that people can use it again."

8fit Workouts & Meal Planner

	Rating: 4.5 **Downloads:** 10,000,000+ **No. reviews:** 138,000+

Free Features:	Paid Features:
• Blogs and articles • Exercise tracker • Goal setting • Tips and advice • Weight tracker • Workout guides • Workout plans	• Diet plans • Food diary • Motivational messages • Pedometer • Recipe finder • Shopping lists • Sleep meditation

Positive Reviews:

- "I love the workouts, I always feel great afterward and you can move up difficulties at your own pace! They have delicious meals, and a lot of diet options compared to other apps. I the reason it's four stars and not five is because I tried to vegan meal plan for a while, and the portions were huge. One serving was way more than I could eat on my own, for almost all meals. But I will say, I haven't been vegan for a while, so this might have changed."

- "I've been using it a week and I already feel the difference, the workouts are simple and you can do them at home it takes 10-15 minutes to finish a workout in the beginner stage, you can replace workouts and modify it too suit your need's, they also show you how too do the workouts with a video, you can plan your meals and it'll notify you when you gotta workout! Overall the best fitness app I've ever used!"

- "Great app. Great exercises from beginners to advanced. Recipes are great as well based on your preferences on food. It's not like any other app I've tried. I have lower back pain and exercises are modified to fit my needs, throughout the workouts you have exercise videos to teach you the proper way of doing
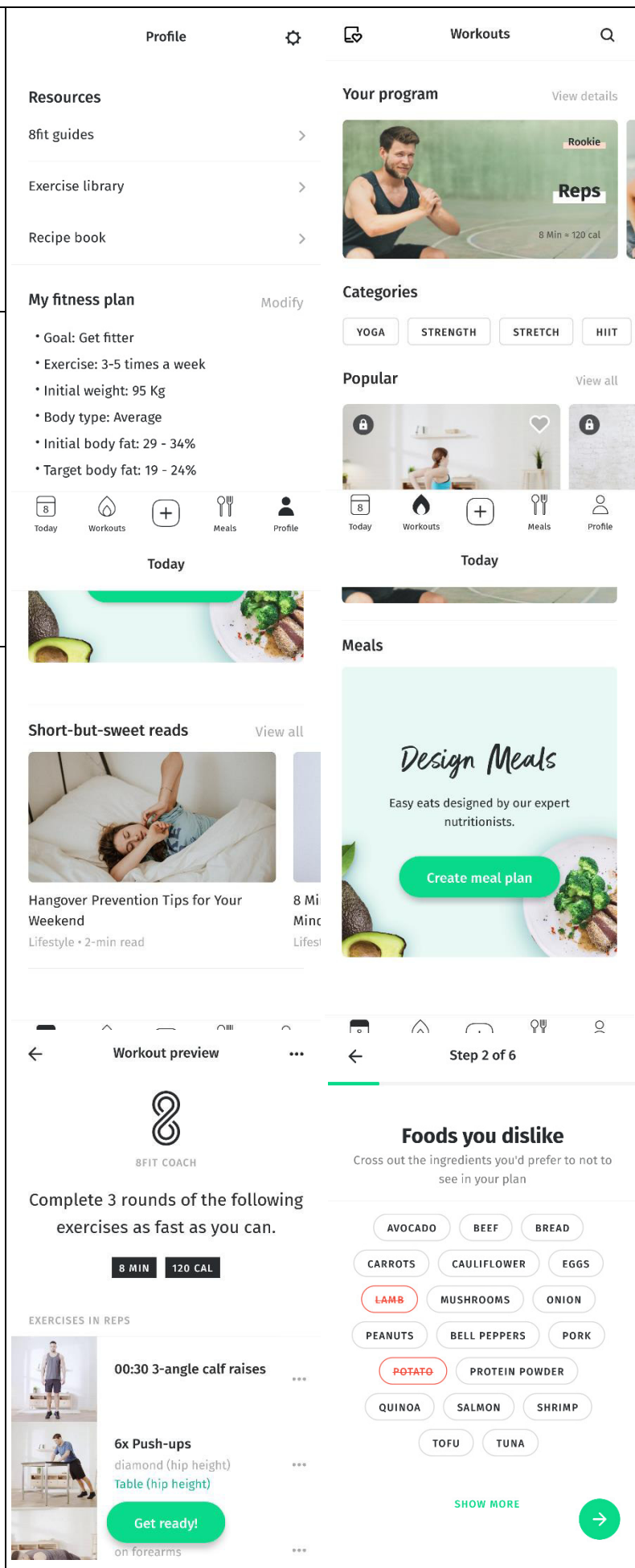
them. This app is the best so far! Thank you 8fit"

- "This is my first time using it and on my first two workouts I lost 3 pounds. And I loveee how they give u Q's on ur health to set a perfect workout just for u I love this app."

- "I like how they don't start the workout strongly in the beginning. They also shows how many calories you burn already so that's great!"
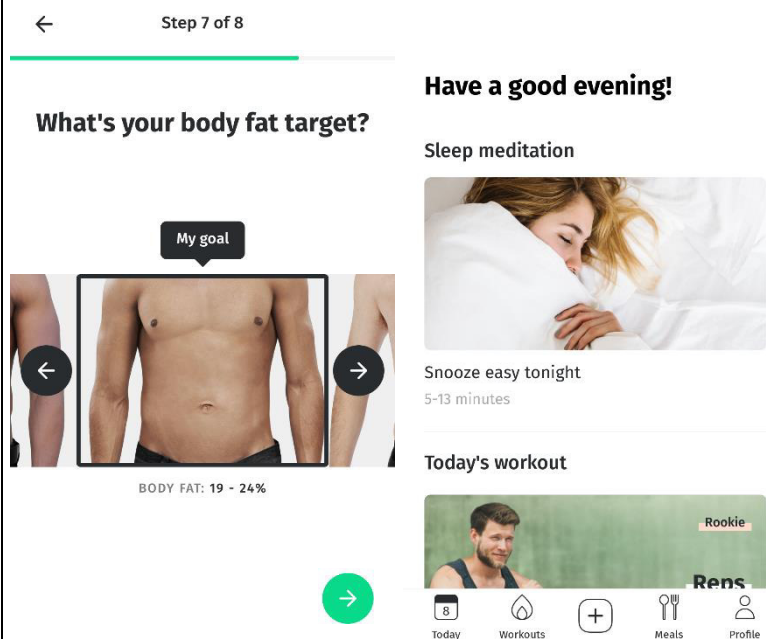
Negative Reviews:

- "After updated this app, i continue my workout for the next level and the app stop working when my workout ended. So my progress isnt save. And have to start from beginning again!"

- "I'd love to be able to try the app, but once I pick everything and then go to "choose your plan" page, it just loads forever. It happened when getting the workout plan, but restarting the app seemed to completely skip that page so I'm not sure what happened. But now It happens when getting the meal plan after picking every detail, it just loads forever and doesn't show me my meal plan. No amount of restarting is working."

- "The meal planner doesnt work at all!! It keeps loading but nothing happens. And I was so excited to try this app!"

← Step 7 of 8

What's your body fat target?

My goal

← →

BODY FAT: 19 - 24%

→

Have a good evening!

Sleep meditation

Snooze easy tonight
5-13 minutes

Today's workout

Rookie

Reps

Today   Workouts   +   Meals   Profile

• "You basically have to pay if you want this app. What is the point in downloading this app for free when you need to pay to access the basics? Either you pay or get literally nothing." • "so far, everytime I choose, "choose plan" for meal prepping it loads for hours. I never get to the next screen and its frustrating because that is the reason I downloaded the app. rating will stay the same unless bug is fixed. thanks Urbanite Inc, I went ahead and emailed you"	

Noom: Health & Weight

Rating: 4.1

Downloads: 10,000,000+

No. reviews: 100,000+

Free Features:
- Barcode scanner
- Blood glucose tracking
- Blood pressure tracking
- Calorie counter
- Connectivity to additional devices
- Connectivity to other apps
- Diet insights
- Exercise tracker
- Food database
- Food Diary
- Goal setting
- Pedometer
- Weight tracker

Paid Features:
- Blogs and articles
- Diet plans
- Recipe finder
- Social community
- Workout plans

Positive Reviews:
- "Love it! I have lost over 10 pounds in 6 weeks and that's including probably more cheat meals than I should have done 😬. I love how the foods are broken up into categories with how much of each category you should have in a day. Before I logged food and did alright but how they break them down in this program has really made the difference. I haven't really exercised much either, this has all just been in changing how I eat. I can't wait to keep going!"

- "Perfect way to lose weight! Fun and informative. Gently follows you throughout your day with guidance and feedback. Built in pedometer works well and in the "do more" section you can add in specific physical activity
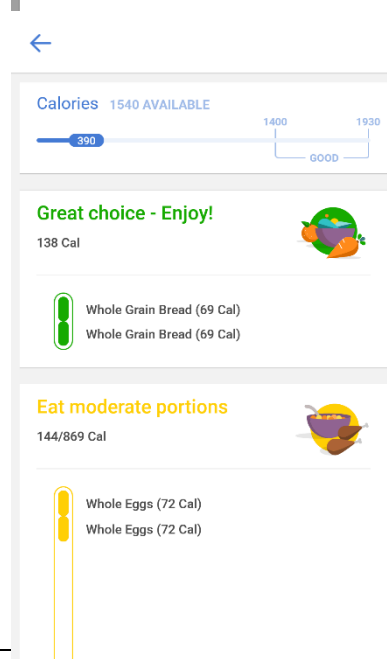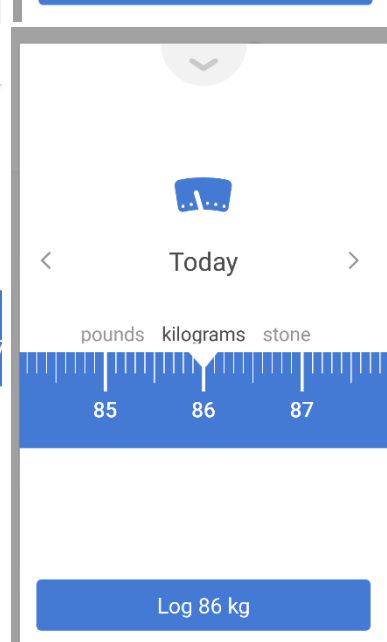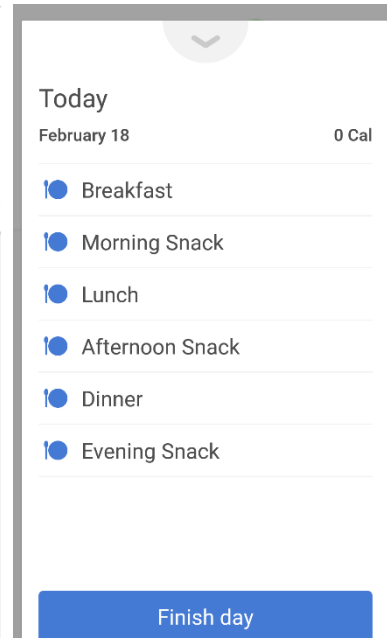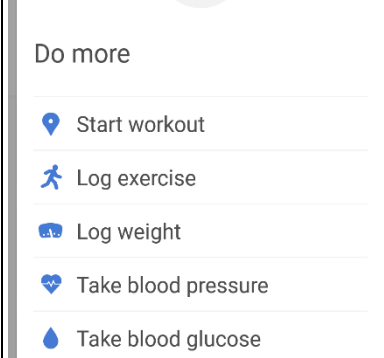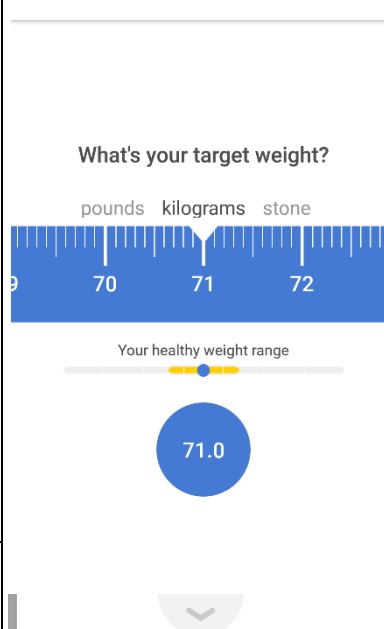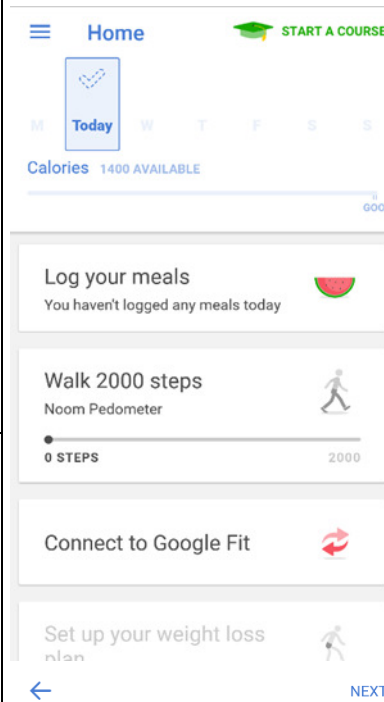
that measures your calorie expenditure and returns half of those calories for you to use for food that day if you wish. This app manages to be lighthearted while in imparts serious information. You also get 1:1 support as well as group support, on your own schedule! Working for me!"

- "Noom: health and wellness app is fantastic. It helps you to identify triggers or causes that may hinder you from losing weight and achieving your lose goal. This app tracks your weight ins, blood pressure, if you have diabetes , your sugar level, your exercise routine. It touches on your emotions and why we sabotage our weight lose goals. Its an excellent app or tool to use to achieve your weight lose goal and to become the new health you."

- "This is an awesome program. I like the helpful articles with a refreshing sense of humor mixed in. And the daily tests are fun. They make it easy to log in foods and at the same time show you what foods should be consumed sparingly. I haven't even started the exercise program yet, and in one week have lost a pound a day--yep, that's 7 pounds!!"

- "I really like it. It's a bit kitschy, but it's fun, and I feel like I'm learning a lot. While I think I came in knowing how to lose weight (good tools) I definitely had negative associations with healthy habits, having failed so many times before. Noom is giving me good tools for overcoming self defeating behavior. One thing I'd like to see is addition of a "Notebook" feature, where you can take notes regarding lessons right there."
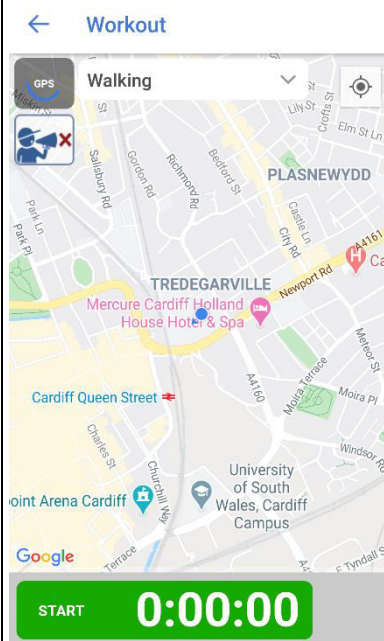
Negative Reviews:

- "The score is purely based on the function of the app. The app is poorly done. The data bases are lacking extremely. Logging food is complicated, the measurements are not ideal AT ALL. It makes it extremely hard when logging a home made meal and I only have .15 servings of something in a full serving of the meal. The exercises are also lacking significantly. Finding the food analysis for the day is more difficult than it should be. Dont get me wrong, the service is amazing. Not the app."

- "You might as well buy yourself a notebook and write down everything you are doing instead of paying for this app. It is nothing more than a logbook. It tries to help you establish a few goals, but then it doesn't save those goals anywhere, which means you are unable to go back and view or review your goals and refer back to them or change them. There is also no function that allows you to establish a correlation between calorie intake, your excercise and your weight loss/gain. Waste of money."

- "They really shouldn't be advertising this "awesome life changing app " all over TV and social media if it doesnt even work properly. Problems you need to fix in your app : your step tracker is off by 6000 a day :you food library doesnt have accurate nutrition values or if you search nothing even pops up ? :your online coaches are just automated messages ? That repeat the same thing :you have to pay extra for a meal plan on top of your subscription : price is ridiculous."

- "I have followed this program for a month with results. However this program, atleast the way it comes across for me, is for people that need accountability every day. The coaches are only there for accountability. When you ask a direct question you only get and question back. If you are trying to stay

organic and limit processed foods the recipes will not help you. This program is not for people who have already committed to loosing the weight and working out.”	
• “App is very glitchy. Pedometer doesn't work; reported the issue twice. No change with the update/fix. Sometimes the articles they want you to read are doubled up, listed twice. Quite annoying. The writing is corny, and "cutesy" and the coaches say they "hear your struggles" but offer little advice you can actually use. I basically use the app to track calorie intake.”	

HealthifyMe: Calorie Counter, Weight Loss Diet Plan

	Rating: 4.6 **Downloads:** 10,000,000+ **No. reviews:** 100,000+

☰ Today ⌄ ⏰

✕ 86 of 2200 Cal Eaten ⊕

🥤 0 of 12 glasses consumed 🔒

👣 Connect to track daily steps 🔒

⚡ 0 of 435 Cal Burnt 🔒

⚖ 0.0 of 26.0 kg Lost ⊕

📷 Snap^BETA

Discover   FILTER

Ⓗ HealthifyMe

Change happens one step at a time. Take your first step towards healthy living today with Premium.

🏠 Home   📋 Plans   👤 Me

☰ 30 Dec, 19 ⌄ ⏰

✕ 0 of 2200 Cal   NEW ⊕

🥤 0 of 12 glasses consumed 🔒

👣 Connect to track daily steps 🔒

⚡ 0 of 435 Cal Burnt 🔒

Which meal would you like to track?

Breakfast	0 of 580 Cal	+
Morning Snack	0 of 217 Cal	+
Lunch	0 of 580 Cal	+
Evening Snack	0 of 217 Cal	+
Dinner	0 of 580 Cal	+

VIEW ANALYSIS ⊕

Based on your weight loss goal of

26 kg in about 12.5 months

Your Daily Calorie Budget is

2200 Cal

Tracking increases chances of meeting your goals by 3x.

Start now!

⊕

← Insights

All Meals ⌄   ⤴

Nutrient	Quantity		
Protein	0.0 g		0%
Fats	0.0 g		0%
Carbs	0.0 g		0%
Fiber	0.0 g		0%

VIEW TOP CONTRIBUTORS

Other Nutrients

Track your food to get more

← Insights

Breakfast ⌄   ⤴

Nutrient	Quantity		
Protein	6.6 g		23%
Fats	6.6 g		34%
Carbs	1.0 g		1%
Fiber	0.0 g		0%

VIEW TOP CONTRIBUTORS

Other Nutrients

Well Done!   ✅
Cholesterol

Can do better   ⚠
Calcium, Iron, Zinc, Magnesium

← Weight Summary

Your BMI: 28.7   Ideal weight range
Overweight   **62-76 kg**

Set Target Weight

⊖   69   kg   ⊕

How quickly do you want to lose 26.0 kg?

Medium ⌄

You will reach your goal before 12 months 15 days

I COMMIT TO MY GOAL

Free Features:	Paid Features:	
• Blogs and articles • Body measurements tracking • Calorie counter • Challenges and rewards • Connectivity to additional devices • Connectivity to other apps • Connectivity to other apps • Create meals • Daily reports • Diet insights • Exercise tracker • Food database • Food diary • Goal setting • Macro nutrient tracker • Photo food logging • Points and leader board • Recipe finder • Reminders • Social community • Water tracker • Weight tracker	• Connectivity to health professionals • Daily reports • Diet plans • Sleep tracker • Workout plans	

Positive Reviews:

- "I am using the free app, since I'm not that regular in tracking my food. The app does exactly what it claims to do. It has a user-friendly interface. The features work correctly. My favorite feature is that it also considers weight gain diseases like thyroid and diabetes while calculating recommended calories. It's a carefully created app. Kudos to the designers and developers."

- "Great app, the list of food with macro list is very extensive and very helpul in planning a meal as per calorie required for the day."

- "My first app towards my fitness goals. It can sync with Google Fit as well. I've been using for quite some years, and it is a very refined app. Besides covering all of Indian cuisine, has all of the others as well. Lovely calorie tracker and overall fitness app. Almost the first and a very refined app. I've not paid for the app as I can't afford it, yet doesn't pester as much like other apps for paying the key functions. I've already recommended to more than 50 people, and almost all use it now."

- "Using the app from past 6 months and my experience about the app is that i lost 8 kg of weight and i want to say that it help me to track my calories intake so i am using it free of cost. I didn't even spend any money on this app. You can also do this by entering correct amount of food in the calories section so you can see how much you eat in the whole freakin day My experience about the app is awesome🖐️✋👍. Loved it"

- "This app is good as it helps me to calculate the calories I consumed and burnt , Insights helps me to manage the consumption of balanced nutrients , we can also add the excercises which we have done for the day it automatically calculates the burnt calories , the app is commencing by setting a goal through which its fixing the consumption of
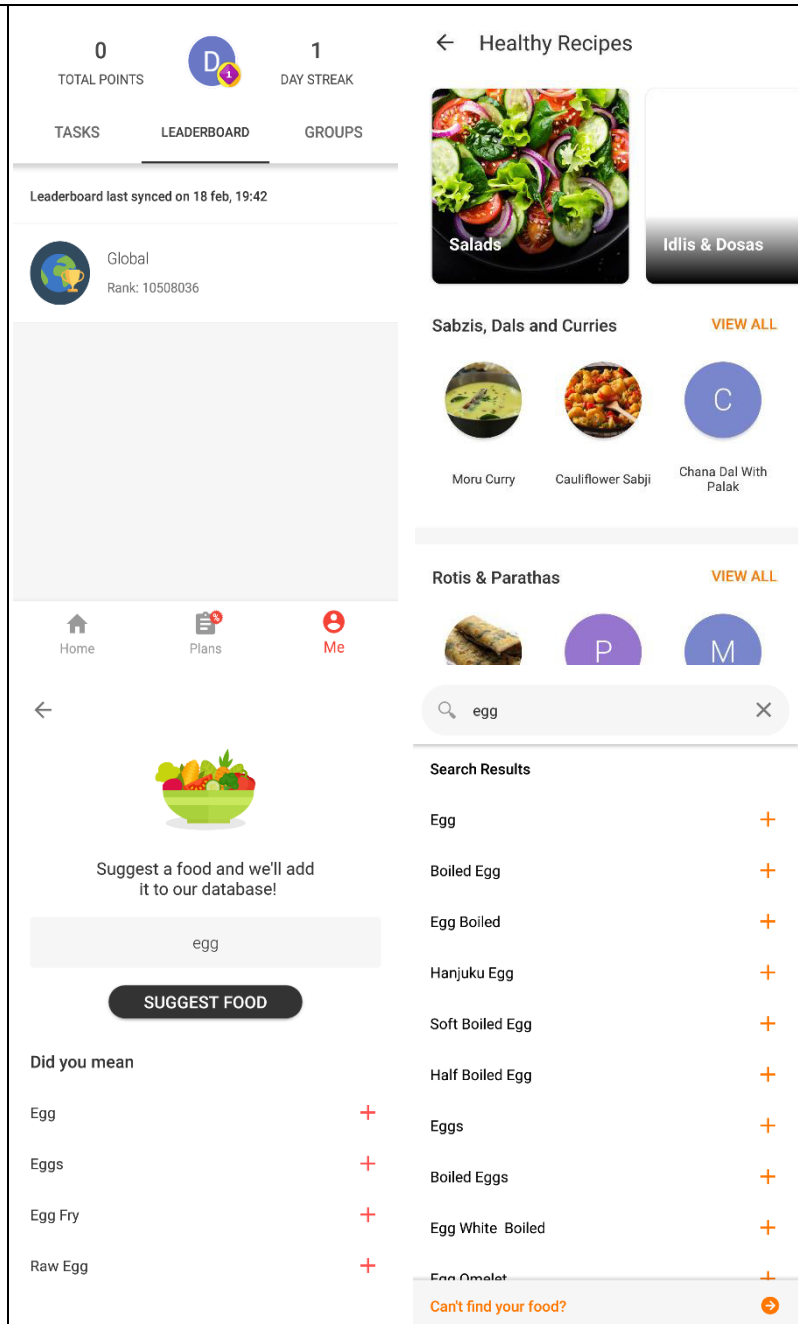
calories per day that'll differ from person to person (Ive not updated to premium yet ..actually I dont want to becoz this is enough for me I guess)"

Negative Reviews:

- "I wanted to give a try to this app, but after installing, the app was flooded with notifications. There were so many notifications, that I could not click buttons to move forward. Therefore I felt this app is useless to me as it cant let me do anything. When I went to delete my account then guess what, this app ask you to enter ur mobile number to delete your account. That's some serious violation of someone's privacy. In conclusion, this app does not deserve even a single star."

- "Totally confusing app!!! I don't know what the app is trying to be. I'm using it as a fitness tracker to count the calories i consume. But it acts like it's a app to feed you about health news. No option to turn off all the usless things. And most of time it is spamming the interface with some pop up like talk with executive, do this plan, do that. I have purchased their premium membership for a month still they are trying to hard sell everything useless."

- "Previous version was better than this beacuase that version could track exercise activity live like running, walink with time and how much calories burned but this feature didn't find in this version."

- "App is ok to log diet & count calories. But do not pay for premium plans. The coaches are a

joke. They don't provide customised diet plans as per your age, weight, goals.They just keep pedalling the general diet plan to everyone, with complete disregard for foods you are allergic to or past history. When you see the reality, and ask for refund, the support personnel never revert & put you in an endless loop of writing emails/calling. This is a scam at best. Save your health and money, stay away!" • "I don't know why but water drinking tracking and calorie intake tracking are not consistent. I have noticed many times that the app doesn't save the information entered. I have, on numerous occasions, input a food item and then close the app. And when the next time I open it, the entered food item is gone. Same is for water tracking. It's just so annoying. Please fix it. This is one of the best apps I have used in my life but just this one annoying thing makes me want to delete it."	

Calorie Counter by FatSecret

	Rating: 4.7 **Downloads:** 10,000,000+ **No. reviews:** 300,000+

Free Features:	**Paid Features:**
• App tour • Barcode scanner • Calorie Counter • Connectivity to health professionals • Connectivity to other apps • Create meals • Create recipes • Daily Reports • Diet insights • Exercise tracker • Food database • Food Diary • Goal Setting • Macro nutrient tracker • Photo food logging • Recipe Finder • Sleep tracker • Social community • Weight tracker	• Diet plans • Water tracker
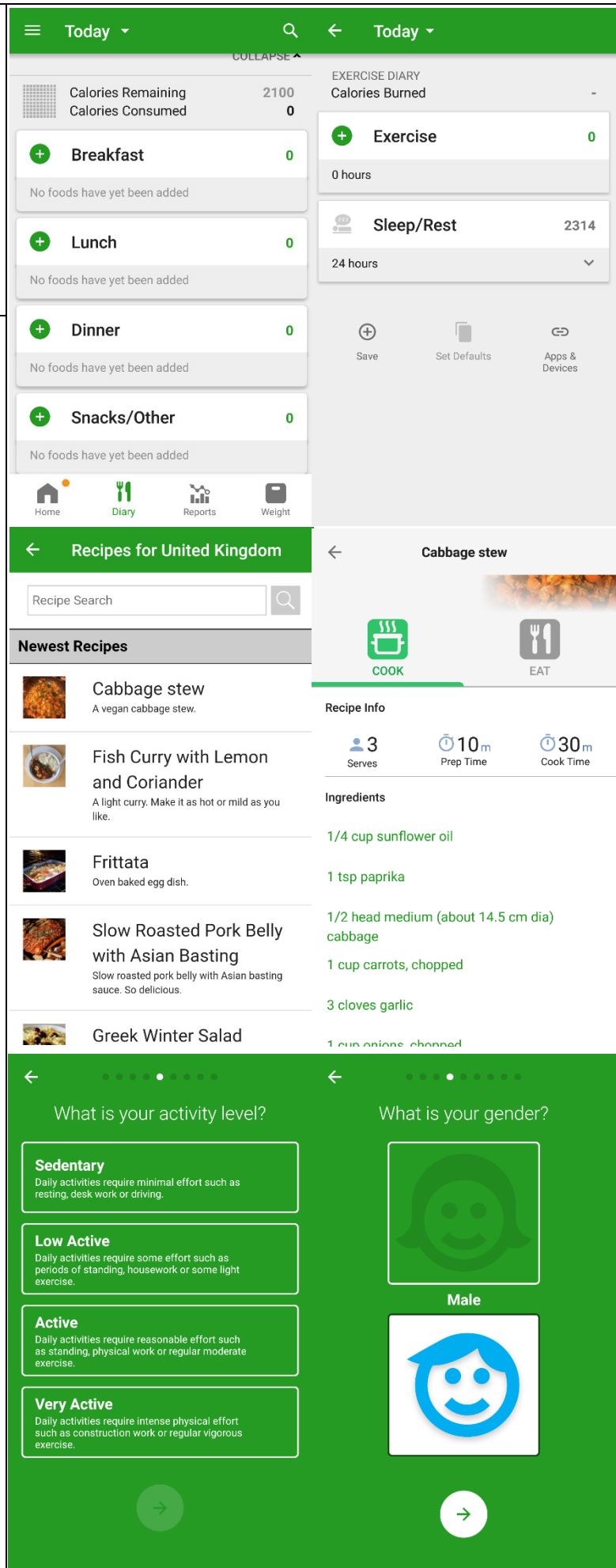
Positive Reviews:

- " I switched from MFP because it aggravated my anxiety and disordered eating. So far, this has been a much less judgmental and anxiety-inducing experience. Very robust in features, even without the Pro version. My only complaint is that if you want to add a custom meal, you need to pay monthly, which I cannot afford to do. MFP offers that feature for free, and I miss it. Would happily pay a one-time fee for it, but not a sub. Still, despite this relatively minor complaint, I recommend the app."

- " Extremely helpful! I have lost 5 pounds this month by cutting back on my calories. I doubt I would have been able to do that on my own. I was amazed at how many calories I was actually consuming each day before starting on this weight loss journey. Calories for almost all of the food I ate are listed in an easy to search for format. Plus, you have a community page that you can display pictures and get inspiration from others. No complaints."

- " I have been using this app for a long time every time when I needed to drop a few vanity pounds. It has proven to be very helpful - without it one has no idea how much one really consumes. This app has been relatively bug free, their new improvements actually improve your experience, and it has the most user friendly, easy to use UI I have seen in such apps. Very happy with it."

- "I only use this to record what I eat and my weight, but it's really good. The only niggle I have is that your limited to the number of meals you can have on the tracker, as the plan I am currently on I eat 5 to 6 small meals a day. So I have to merge them together when tracking but for the average 3 meals a day person it's fine. I like the reminders for if you haven't input a meal yet after it's due time. It can be synced with the Google fit app so it record your steps and calories burned."
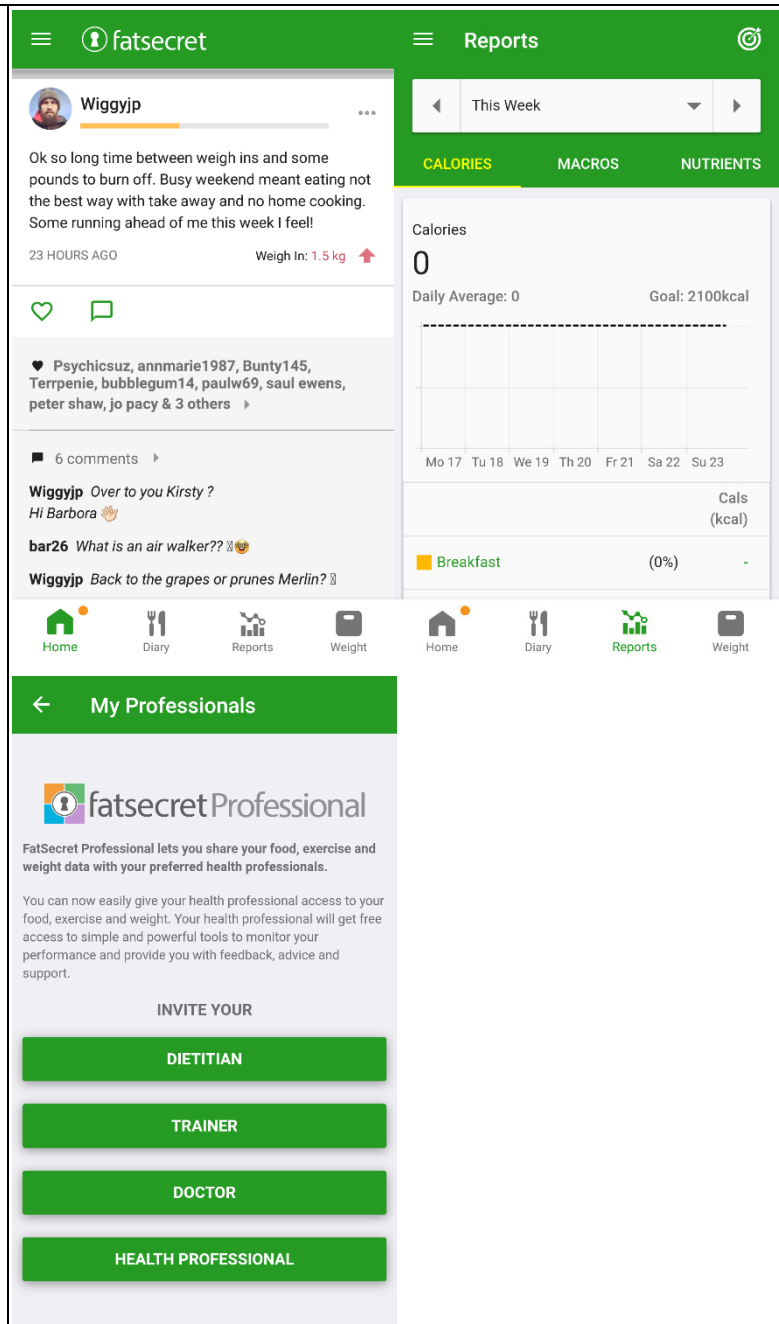
- "I'm really loving this app! I've never tried counting calories or tracking macros, but this app makes it so much easier than I imagine it would be! I can start typing in an entire meal and it breaks everything down for me. It's amazing! I've only had it a couple of weeks but I've lost 6 pounds already. I didn't even know I was overeating. Life-changing!"

Negative Reviews:

- "Bad UI. Lack of features. Poor integrations with other services."

- "It is not accurate. I ate asparagus and broth and it said I had 32 GM's of protein."

- "Google fit "integration" is to much of a one-way street. In a day and age of connected scales that automatically sends your weight to Google fit, it's beyond me that this app can't pull that data off Google fit, but relies on manual entry - that it then sends to Google fit."

- "Garbage UI and terrible search. I added a new food that wasn't appearing in search and it dissappeared. No where to be found. I searched the exact name I entered for it and it isn't appearing."

- "Would be nice to have configurable number of meals and not be restricted just to breakfast, lunch, dinner and snacks. What about second breakfast and third lunch? Edit: Why am I forced to the language of the phone? I'd prefer to have it configurable. Region settings are useless. Widget is not working anymore."

YAZIO Calorie Counter, Nutrition Diary & Diet Plan

Rating: 4.3

Downloads: 10,000,000+

No. reviews: 200,000+

Free Features:
- Barcode scanner
- Before/after photos
- Calorie Counter
- Challenges and rewards
- Connectivity to additional devices
- Connectivity to other apps
- Create foods
- Create meals
- Create recipes
- Exercise tracker
- Food database
- Food diary
- Goal Setting
- Macro nutrient tracker
- Photo food logging
- Social network connectivity
- Water tracker
- Weight tracker

Paid Features:
- Blood glucose tracking
- Blood pressure tracking
- Body measurements tracking
- Daily reports
- Diet insights
- Diet plans
- Fasting tracker
- Mood and feelings tracker
- Recipe finder
- Shopping lists

Positive Reviews:
- " This app helps me so incredibly much and has amazing features to it without necessarily having to purchase the premium membership. Unlike many other apps they aren't forcing the membership onto you (for example by constant ads). This is actually an app I'd be willing to pay the developers for, because it's more quality than just cash grabbing. Really REALLY happy and satisfied with this app."

- " good interface, calories seem accurate, easy to add the things you used before"

- "Easy to use once you get the hang of it! When you start, check out the options (like copying items from one meal to another - very useful!), it will save you time. One downside (at least of the free version) is that it's more difficult to include other portions than the standard ones."

- "This app has been very helpful and has some great features, but I've found some difficulties. One: adding own meals / recipes is complicated, as others mentioned, and you cannot search your own entires (or I haven't found out how). The other is the message "the calories and the other data don't match" when I'm copying from the food's label. I'm trying to enter what's written there, what am I supposed to do?"

- "Love your app! Bought year subscription and realized that there are some features I'm lucking, please add option while cooking recipies to remove or add some ingredients and calculate its total calories. Also while it is meal plan add option to remove some recipes at all. And the last one add icon with calories that are needed to be burned daily to achieve my goals. And again love love love your app!"

Negative Reviews:

- "This year has to have the worst design so far. It takes so long to do anything, having to click multiple times to do a single thing. As well as the lag is frustrating in it self, which never happened in the old design. On top of it, now it is not connecting with other apps so you have to waste more time typing the same information multiple times. Please have a option so we can choose the old or new version. I can't even be bothered to use the new one anymore, it's frustrating"

- "I wany to love this app but pleaseeeeee when creating a new food let me add the serving size in grams instead of just ounce/fluid oz!!! It's so much easier for me and most nutrition

labels use grams per serving. Same struggle happens when scanning a barcode, let it scan the serving size and not a different one. I've spent so much time creating foods with the correct servings and having to google oz to grams in google just to make it accurate on the app."

- " I Used to love this app and lost 20 kg with it. Sadly the new Update ruined the UI so badly that it is not a real help anymore. The Old UI was just so much more efficient with helpful color-coding and all necessary details on the front page. I loved to see my Activites as a Yellow Part of the Bar this way i could actually learn the relationship between sport I did and the food I ate."

- "The new design feels confusing, loveless and unfinished to me. It uses the language set on the phone only. Changing the language is not possible. Was a great app before."

- "I purchased the app for the main reason that it is very easy to use. Now, your UX DEVS literally ruin the whole experience! Bring back the old UI and you'll get 5 stars!"

Lifesum – Diet Plan, Macro Calculator & Food Diary

Rating: 4.3

Downloads:
10,000,000+

No. reviews: 200,000+

Free Features:
- Barcode scanner
- Calorie counter
- Connectivity to additional apps
- Create exercises
- Create foods
- Create meals
- Create recipes
- Exercise tracker
- Food database
- Food Diary
- Goal setting
- Life Score™
- Macro nutrient tracker
- Water tracker
- Weight tracker

Paid Features:
- Body measurements tracker
- Daily reports
- Diet plans
- Lifestyle change recommendations
- Recipe finder
- Diet insights

Positive Reviews:
- " This is the best food diary, health tracker I have used! Easy to use scan a barcode for ingredients works out the calorie intake and track your weight loss, lots of other great ideas like linking to your fitness app such as samsung health! There are options for meal plans and more on premium subscription, have not tried this yet! Great app"

- " Recipe ideas for each meal is an amazing tool, although it would be great if food options with similar ingredients could be grouped to make shopping easier. Entering food that isnt the recipes could use some improvement to make the process easier, overall a great app to help you on your way!"

- "Generally really like it. Especially like the design. Some points to improve on: Could add
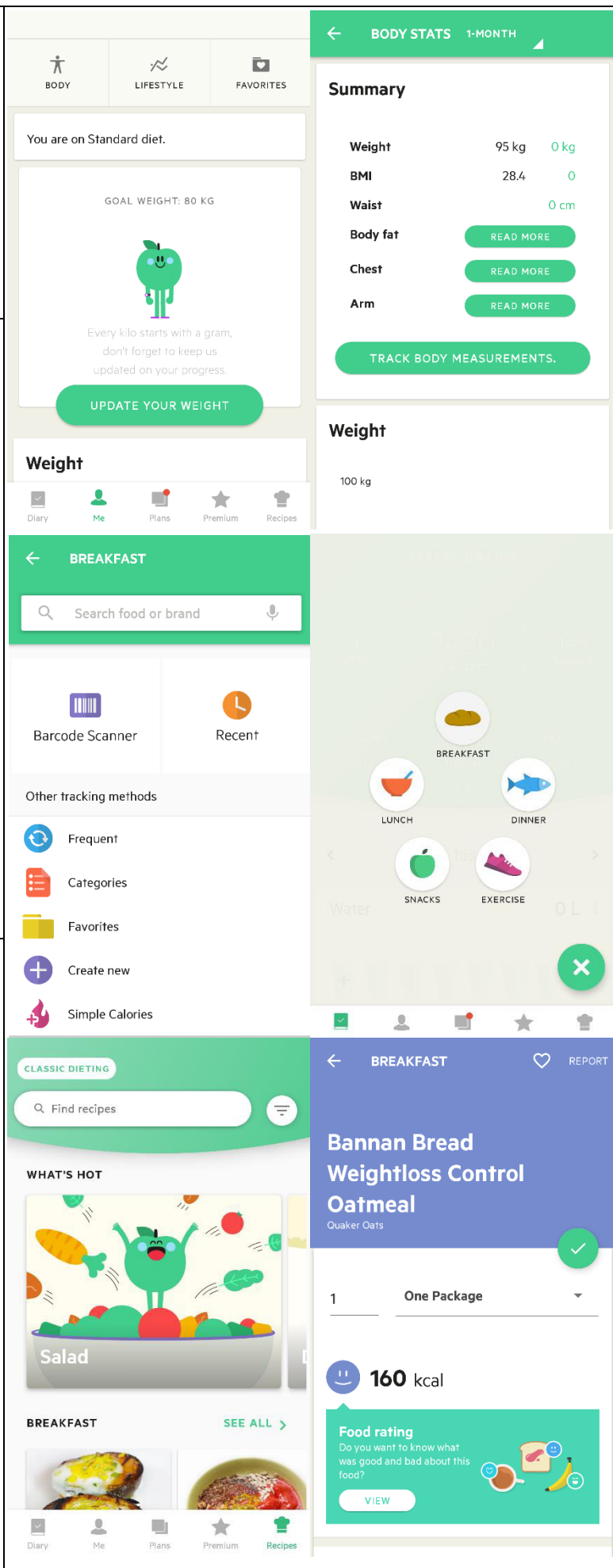
foods to favourites from everywhere e.g. when you open a food from your log • Show more nutrients e.g. iron and calcium •Able to show more than just calories at a time for each meal e.g. calories and protein Larger range of recipes and more than just the plans e.g. budget recipes."

- "I enjoy the app for the most part. It has quite the list of foods in it's meal log, and ability to create custom meals out of ingredients. The weight tracker is a little buggy. I went from 285 - 271, went back up to 273. Once I got back below 271 it added an extra 2lbs to the total weight lost so fa..."

- "This app makes much easier to succeed at dieting. There are items that are misrepresented but by far most are accurate. The only issue I've had after a few weeks was one verified item wasn't correct, and I could not adjust the calorie value. Search stopped working for a while. If that continues it's down to 1 star."
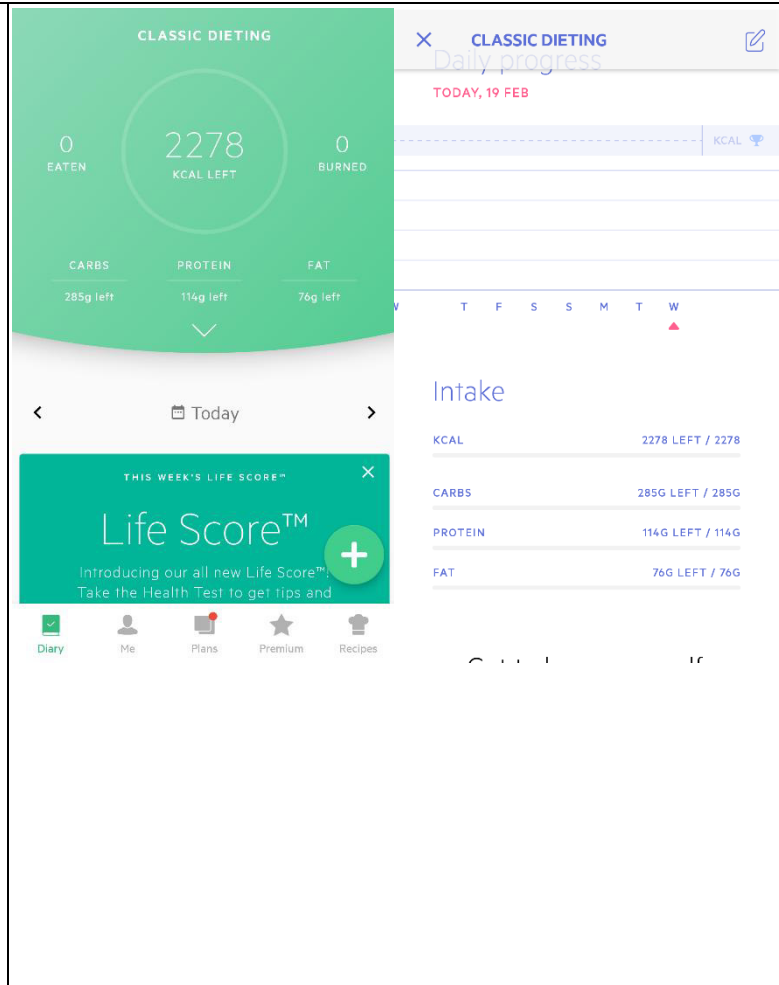
Negative Reviews:

- " Premium user here. Calorie/macros are incorrect on food you look up in the app a majority of the time. Even with food you use the barcode for. Calories are almost always under reported (show less than actual), so be careful. Also no easy way to quickly input custom cal/macros you just ate (which I often have to do because the input is wrong)."

- " Even when you use the barcode scanner the nutrition facts are incorrect. I would like a refund, since I paid for a year and only used it 2 weeks. Tried to give a chance, it's just inaccurate, plain and simple but frustrating and not worth it."

- " This is a terrible app. Very empty. I paid for premium expecting more plans and just more and there's no real difference. So bad. Needs more recipes, meal plans, workout, etc. Might as well be using a free calorie counter. I bought premium for a year by accident and you cant get a refund for unused time. TERRIBLE APP. JUST USE A FREE CALOROE COUNTER."

- "The Free version of this app is VERY limited and not really worth it, especially since there are other apps out there that allow you to do and customize way more. The nutritional information on many of the foods are incorrect and the system for correcting them is ineffective. The barcode scanner will sometimes scan a barcode and present a completely different product than the one I'm holding in my hand. There needs to be some major improvements to the food/nutrition database."

- "Don't use this app for keto. It cannot calculate net carbs properly, so it's useless for tracking them. This has apparently been a longstanding issue that they've refused to fix for some reason. Personally, I subscribed to premium for the meal plans, which was also a mistake because there really aren't that many recipes. It might be fine if you want to experiment with
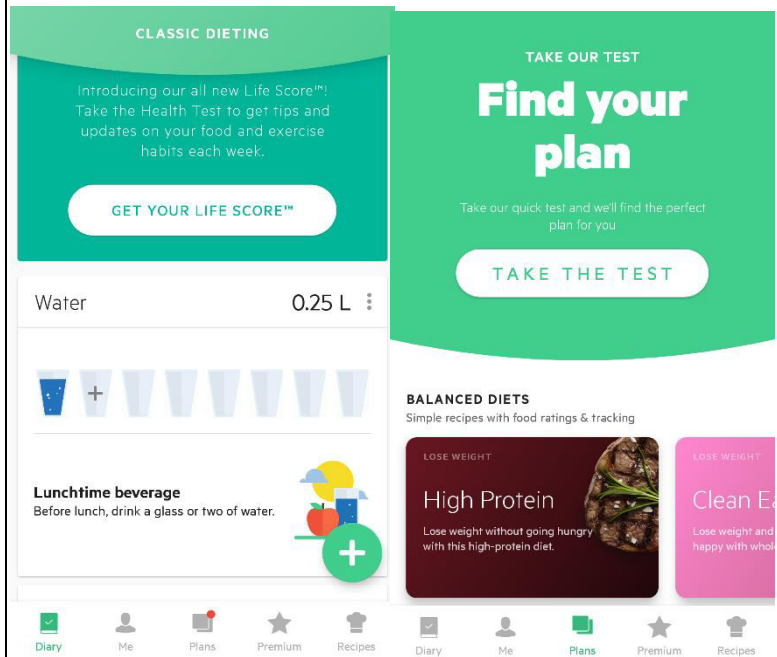
diets, but otherwise it's not remotely worth the price, especially when you aren't paying monthly." • "Every time I go to correct the information of the food I scanned... It's keeps saying to take a look at the information again... I'm only going by what the package of the food it shows. I'm a premium member, but the support is horrible slow and most importantly, when you report a bug or wrongs of the app, they don't follow through with it or at least give a response back. I wouldn't recommend 100% on the of the information provided by this app or its developers... 👎👎👎"	

My Diet Coach - Weight Loss Motivation & Tracker

Rating: 4.5

Downloads: 10,000,000+

No. reviews: 100,000+

Free Features:
- App tour
- Avatars
- Before/after photos
- Calorie counter
- Exercise tracker
- Food database
- Food diary
- Goal setting
- Motivational messages
- Reminders
- Tips and advice
- Weight tracker

Paid Features:
- Challenges and Rewards
- Cravings panic button
- Create exercises
- Create meals
- Notes
- Photo food logging
- Water tracker

Positive Reviews:
- "I've loved this app since the first day I used it. Perfect for me and it makes my weight loss/maintenance much more enjoyable. There's a lot of functions I find useful. Especially the panic button! That's saved me from ruining my day so many times... Thank you! Very wonderful app. So many features I never want to go without... Which is why I even opted for the paid version haha. I never do that, but tjis app is worth it. Seriously."

- "This app is simple, exactly what I need in order to track my weight loss. I love that there are virtual rewards, before & after pics, and a panic button if I get stuck (which reminds me that I don't really want that piece of cake). The avatars are fun and a great visual reminder too."

- "I really love this app...I sprung for the paid version after a couple of days, as I wanted to be able to use the other functions available. This is not my first rodeo, and I have used pretty much
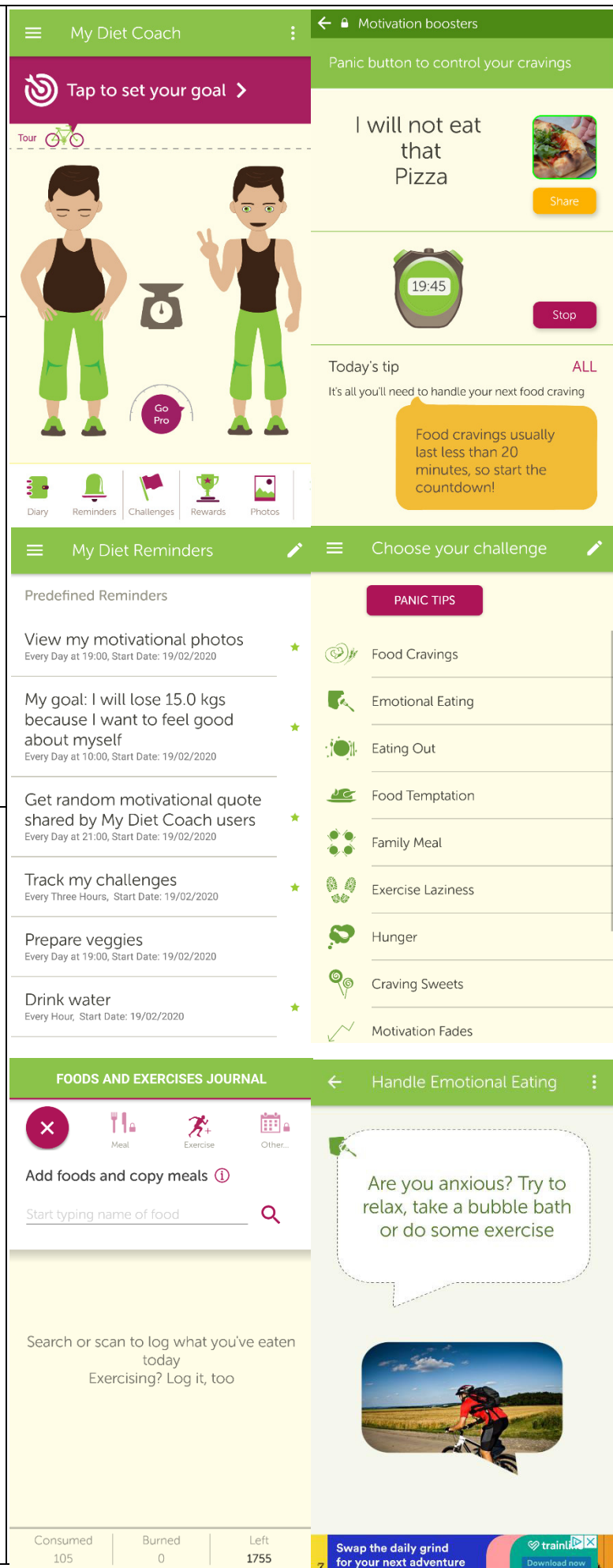
all of the major tracking apps out there. But I tend to gravitate back to this one because of the unique ability to have an avatar and collect fashion items. The new ability to watch your avatar slim down is great and really helps with motivation. Keep up the great work, developers"

- "This app is not as fancy as others, it doesn't track protein or carbs when you make your food diary entries. But it definitely gets the job done. Honestly I would recommend this calorie counter app to anyone because it's so easy to navigate. And has features like the panic button, before and after pics that you can upload. if there is a food item that's not listed in their log you can type it in and also login the calories and amount that you consume and it will save. So far I have lost weight."

- "I had this app on my old phone and lost over 20lbs. I stopped using it and gained it all back. Now I'm using it again and lost 8lbs already. This app is a fun and very helpful tool for food addicts like me. It makes me be accountable for what I'm eating and how much I'm exercising. I just wish you didn't have to start the app over, including $, when you switch phones. Overall a terrific app!"

Negative Reviews:
- "Do not download this app, you will definitely get frustrated and angry for sure. It's a cheating. They dont do any upgrades after they took amount from your account. You can't contact anyone to solve this.i have wasted 2 full days in it. Though it looks like a pretty good app non of the functionalities is complete. Worst app ever. Premium upgrade is a cheating. Beware."

- "This app has quotes that promote anorexia. For example "Think thin, it's only food, nothing important. " And "Is food really worth it? " This could cause young people to get an eating disorder, or if they already have one, relapse."

• "Unable to scan barcodes. Link to Google play barcode scanner app says item not found. I would still like to have grey/white hair as an option, just like iOS version offers. Clothing options don't always appear on the Avatar as they do in the fashion board." • "It looks like a decent app, I was excited when I saw that you could customize an avatar, unfortunately all of the clothing items are very gender binary, as someone who's non binary, it was rather upsetting. Even if there was a variety of styles that you can choose from (within the free outfits). My other issue was that, the notifications you can choose to have, that the app says you can delete the notifications that you don't want, the swipe to delete function isn't working." • "Started off well but went down the drain pretty quickly - paid the £5 one off charge for extra features that I didn't get full access to. I've been trying to contact the development team since October about this,without any reply. Prior to paying, I contacted them to ask if the £5 charge was a one off payment and they replied straight away..The app is missing so much in terms of foods, exercises, and there is so much content that you can't access without paying - uninstalled now for a better app"	

Calorie Counter by Lose It! for Diet and Weight Loss

Rating: 4.6

Downloads: 10,000,000+

No. reviews: 90,000+

Free Features:
- App tour
- Barcode scanner
- Calorie counter
- Challenges and rewards
- Create exercises
- Create foods
- Create recipes
- Exercise tracker
- Food database
- Food diary
- Goal setting
- Macro nutrient tracker
- Pedometer
- Photo food logging
- Reminders
- Social community
- Weight tracker

Paid Features:
- Blood glucose tracking
- Connectivity to additional devices
- Connectivity to other apps
- Diet insights
- Diet plans
- Recipe finder
- Sleep tracker
- Water tracker
- Workout guides

Positive Reviews:
- " Very easy and organized. Daily accountability is a must! Wake up, start putting in your food intake. I like that it tells you where you are in calories and the percentage of fat, carbs & protein so that you can modify your eating habits simply. Also, it's very obvious when you go over your target intake and you can review how you've done over the weeks. Input water, coffee, special foods. Very nice app!"

- " It has been a life saver! So easy to use and love the bar code scanner feature. I can tell I am losing already by being accountable for what I'm eating rather than going at it alone! It's a new lifestyle change for me now... Just upgraded to premium definitely worth the small investment for the awesome extra features and awesome
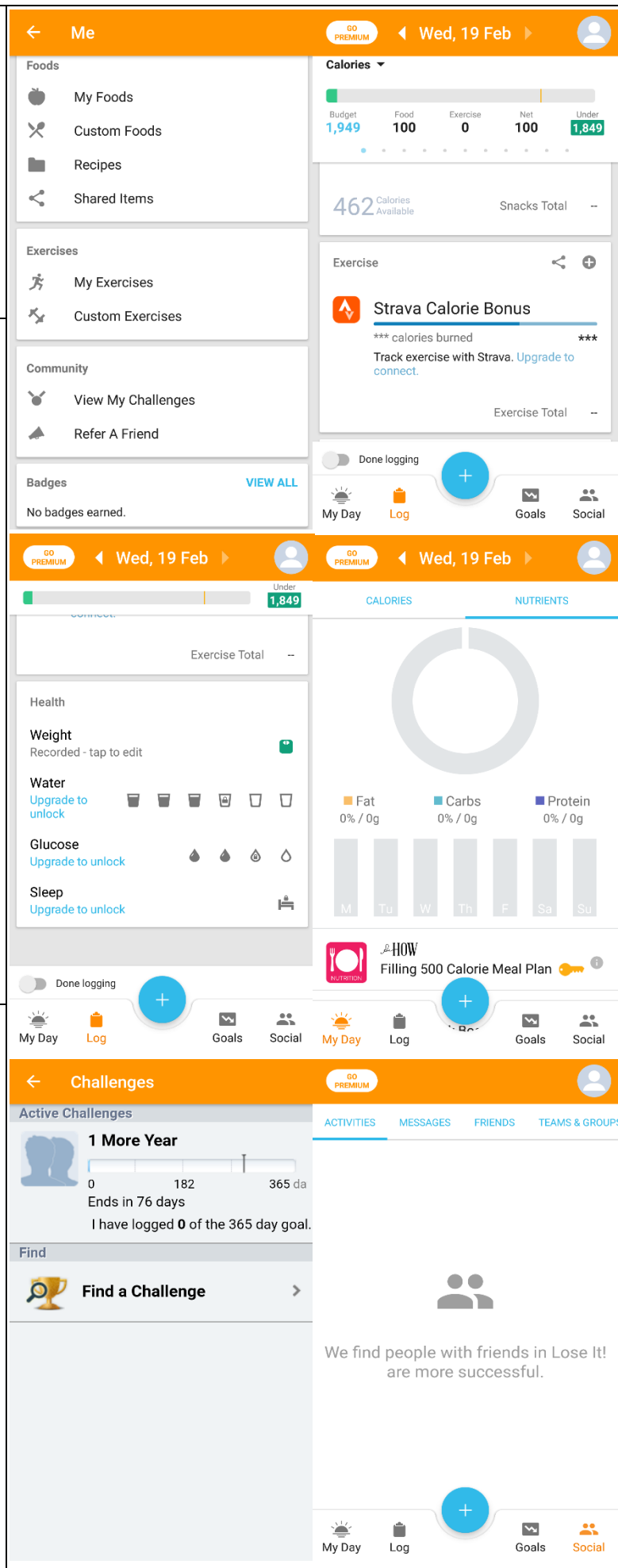
recipe ideas! I cannot say enough GREAT things!!! Thank"

- " I have the free version and have always had no problem. I love that I can scan foods and get accurate calorie readings. I don't get annoying ads. Except the app does want you to upgrade and it reminds you at least once a day, but i just press no thanks, and go on about my calorie intake. It's great!.."

- "This app is very easy to use with little instruction. Just logging my intake for a few days has made me eat a lot less. The free version is good for now but i will probably upgrade soon to get extra benefits because it is very inexpensive. The food search has items listed from specific restaurants, brands, flavors and stores wiith calories and nutrients already stored - what a surprise!"

- "I love it. Easy to keep track of calories, exercise, and even create recipes to keep you on track! I don't find the few pop ups as annoying as others. I'm just glad there's a free app that jeeps me so much. You can pay to be able to log more options, but im happy with the basics"

Negative Reviews:
- " Recent updates have been breaking stuff (literally) right, left and center. Arrow to scroll day left/ right works <10%. Scanning barcode is busted and autofill is an untested disaster. (Prev) App itself is ok but - way too much vertical screen space wasted in white space. - goal graph needs work to allow better expansion - option to export data to CSV to allow proper analysis in a spreadsheet. And constant full page up-sell pop-up on every launch is pretty obnoxious"

- " Shows ability to connect to Samsung health for step tracking in the basic (non-premium) version, but does not show it as an option. Only Google fit and Fitbit. Also no ability to put in a custom calorie amount. And you can't back date weight entries to show weight already lost."

- " My app won't save any of the recipes in your meal guides. Some of them prompt me to save them, some don't. The ones that I save don't show up in my custom foods, in my recipes nor do they revert back to my shared foods."

- "I like most of the app. Workouts are great. It's user friendly. My largest complaint is the food database. ITS A MESS!! Too many people putting in incorrect information. I'm finding myself having to look up the nutrition of everything online which is taking away from its convenience. May not renew if this is not fix."

- "Been a premium user for 4-5 months, although not very regularly. The reason is that this app lacks a lot of popular foods on its list. Most of the time you'd have to enter all ingredients in yourself to measure the macros which is exhausting. Thats why I have been using it less and eventually asked for a refund which I was denied because it is outside the 5 weeks window. Pretty disappointed I gave in early and paid $56 for it before thoroughly using it."

✓ = Free Feature
✓ = Paid Feature

(Green ✓ = Free Feature, Blue ✓ = Paid Feature; below, free = ✓, paid = ✓ᴾ)

Feature/App	MFP	8F	NHW	HM	CC	YZO	LS	MDC	LI
App tour					✓			✓	✓
Avatars								✓	
Barcode Scanner	✓		✓		✓	✓	✓		✓
Before/after photos						✓		✓	
Blood glucose tracking			✓			✓ᴾ			✓ᴾ
Blood pressure tracking			✓			✓ᴾ			
Blogs and articles	✓	✓	✓ᴾ	✓					
Body measurements tracking				✓		✓ᴾ	✓ᴾ		
Calorie counter	✓		✓	✓	✓	✓	✓	✓	✓
Challenges and rewards	✓			✓		✓		✓ᴾ	✓
Connectivity to additional devices	✓		✓	✓		✓	✓		✓ᴾ
Connectivity to health professionals				✓ᴾ	✓				
Connectivity to other apps	✓		✓	✓	✓	✓			✓ᴾ
Cravings panic button								✓ᴾ	
Create exercises	✓						✓	✓ᴾ	✓
Create foods	✓					✓	✓		✓
Create meals	✓			✓	✓	✓	✓	✓ᴾ	
Create recipes	✓				✓	✓	✓		✓

Feature	1	2	3	4	5	6	7	8	9
Daily reports				✓	✓	✓	✓		
Diet insights	✓		✓	✓	✓	✓	✓		✓
Diet plans	✓	✓	✓		✓	✓	✓		✓
Exercise tracker	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fasting tracker						✓			
Food database	✓		✓	✓	✓	✓	✓	✓	✓
Food diary	✓	✓	✓	✓	✓	✓	✓	✓	✓
Goal Setting	✓	✓	✓	✓	✓	✓	✓	✓	✓
Life Score™							✓		
Lifestyle change recommendations							✓		
Macro nutrient tracker	✓			✓	✓	✓	✓		✓
Moods and feelings tracker						✓			
Motivational messages		✓						✓	
Notes	✓							✓	
Pedometer		✓	✓						✓
Photo food logging				✓	✓	✓		✓	✓
Points and leader board				✓					
Recipe finder	✓	✓	✓	✓	✓	✓	✓		✓
Reminders	✓			✓				✓	✓

Feature									
Shopping lists		✓			✓				
Sleep tracker				✓	✓				✓
Sleep meditation		✓							
Social community	✓		✓	✓	✓				✓
Social network connectivity	✓		✓			✓			
Tips and advice		✓						✓	
Water tracker	✓		✓	✓	✓	✓	✓	✓	✓
Weight tracker	✓	✓	✓	✓	✓	✓	✓	✓	✓
Workout guides		✓							✓
Workout plans	✓	✓	✓	✓					
Total Free Features	22	7	15	19	19	18	16	12	17
Total Paid Features	3	7	5	6	2	10	5	7	9

Feature Analysis

Each app was explored in order to identify the features that they provide. Some features were free and available as part of the app's basic package, whereas other features were paid and only available after upgrading to a premium package. It is important to note that some features in the apps may have been missed if they only become visible after upgrading as only the free versions of the apps were reviewed. Paid features were, therefore, only identified if they were visible in the app but locked for use, or through their descriptions in the app store or through in-app advertisements.

A total of 47 features were identified across all apps. YZO provided the greatest number of features with a total of 28 identified features. 8F offered the lowest number of features with a total of 14 identified features. The app with the most free features was MFP which had 22 free features. 8F had the lowest number of free features with a total of 7 free features. The

app with the most paid features was YZO which had 10 paid features. CC had the lowest number of paid features with 2 paid features.

The most common features identified were an exercise tracker, food diary, goal setting and weight tracker which were present in every app. An exercise tracker is a feature that allows the user to record the exercise activities they complete. A food diary is a feature that allows users to record the meals and foods they consume. This feature was expected to be present in every app as it is a requirement of the inclusion criteria. Goal setting is any feature that allows users to set a goal and record their progress towards meeting that goal. A weight tracker is a feature that allows users to record their weight and track changes over time. The exercise tracker, goal setting and weight tracker were free features across all apps, whereas the food diary was a paid feature in 8F. Diet plans is a feature that provides custom weekly diet plans for users. This was the most common paid feature as it was present in 7 apps and was a paid feature in each of those apps. Avatars, cravings panic button, fasting tracker, life score, lifestyle change recommendations, moods and feelings tracker, points and leader board, and sleep meditation were the least common features with each only being present in 1 app. These are all quite novel features, apart from points and leader board which was expected to be more common. Life score is a trademarked feature of LS and was therefore only ever going to be present in that app.

User Reviews Analysis

The comments left in the user reviews were categorised using affinity diagrams in order to gain an understanding of what aspects of the existing apps users valued and which aspects they disliked. One affinity diagram categorised positive comments and another diagram categorised negative comments. A total of 16 categories were identified from the user reviews. Some of those categories contained exclusively positive comments. The categories identified were:

- Meals and Recipes
- Calorie Tracking
- Messaging and Imagery
- Barcode Scanner
- Reports and Insights
- Information
- Avatars
- Community Support
- User Interface
- User Experience
- Food Logging
- Food Database
- Targets and Goals
- Fitness and Workout Features
- Weight tracking
- Other

Meals and Recipes

This category contains all comments regarding features pertinent to meals and recipes, including customised meals and searching for recipes through the app. A number of users commented on how they liked that they could create and save custom meals and recipes as it made it easier to record those meals in a food diary at a later date. It was important to users that these features were easy to use. Users liked that some apps suggested recipes based on previously used recipes and personal preferences. Where diet plans were offered in the app, users liked that there were lots of options.

There were also a number of negative aspects of meal and recipe related features that users found. Users indicated that they didn't like it when it was too complicated to add custom meals and recipes, indicating simplicity is important to them. Some also found it difficult to change the portion sizes of the meals and recipes they created and they found the portion sizes too big. A number of users expressed a desire for a larger range of recipes, whereas others found there to be too many meals and recipes. Some users also complained that an apps meal planner didn't work properly.

Users suggested a number of additional features and improvements. One suggested grouping recipes with similar ingredients. Another expressed a desire to remove some recipes from the meal plans provided. They would also like the ability to remove some ingredients from recipes and have the total calories recalculated accordingly. Some users suggested new recipe categories such as budget recipes and organic recipes.

Calorie Tracking

This category contains all comments regarding features that allow users to track their calorie intake. It was important to users that it was quick and simple to log calories consumed. Users liked it when a daily calorie allowance was created based on their weight and goals and when the remaing calories they have for the day was displayed to them after recording the calories they have consumed. They also liked it when the exercise burnt through exercise was considered, rather than just the calories they have consumed.

A number of users complained when an app's calorie tracker did not remain consistent. After recording the calories consumed from a meal, they would return to record the calories from their next meal and found that the calorie count had changed. This indicated that consistency and accuracy was important to them. Users expressed a desire to quickly add calories to their calorie count without having to enter an entire meal. They also suggested displaying the number of calories required to burn in order to meet their goal.

Messaging and Imagery

This category contains all comments regarding features pertinent to the messaging and imagery displayed to users in the app. Where avatars were included in the app, users found them to be motivating and found that they acted as a visual reminder. They also found it to motivating when they could upload 'before and after' photos. It was important to users that the messaging used was not judgemental. They also liked it when they received feedback, guidance and encouragement. They also liked to receive reminders to update their food diary and to workout. Users approved when there were no ads in the app.

Users didn't like it when they received too much messaging from the app. They complained when there were too many notifications, adverts and reminders to upgrade. Some users found that there were so many adverts that the interface became unreadable as it was overwhelmed. One users also complained that the messaging promoted anorexia and another felt that some of the in-app rewards were too gender binary.

Barcode Scanner

This category contains all comments regarding the barcode scanner feature. A large number of users indicated that they highly enjoyed this feature when it was included in an app. They found that it saved a lot of time and made it far easier when recording foods in a food diary. It was important to them that it was easy to use. Some users complained that the barcode scanner did not find the correct food, indicating that accuracy was important to them.

Reports and Insights

This category contains all comments regarding features pertinent to reports and insights. These include the analysis of the nutritional content of the foods users consume. Users found that these insights helped manage nutrient consumption. That also found graphs and charts useful for montiroing progress when working towards goals. Where these features were present, it was important to users that the data presented was accurate.

A number of users found it difficult to find their daily food analysis. They also felt that a wider range of nurtients should be analysed. It was suggested that the data from the reports and insights should be exportable to a CSV file.

Information

This category contains all comments regarding the information presented to users in the apps. It was important to users that the information provided was accurate. They enjoyed it when nutritional information and helpful articles were provided. There were no negative comments left by users regarding the information provided.

Avatars

This category contains all comments regarding the avatar feature. Where avatars were present in apps, users thought that they were a fun feature. They found them to be motivational found them to act as a visual reminder. There were no negative comments left by users regarding the avatar feature

Community Support

This category contains all comments regarding any form of community support offered by apps. This includes in-app social networks that allow user to connect and communicate with each other. Where this service was present in apps, users found them to be a good place for sharing inspiration and found the support on offer to be helpful. There were no negative comments left by users regarding the community support provided.

User Interface

This category contains all comments regarding an apps user interface. Many users indicated that they liked it when an interface was organised and easy to use. They also indicated that it was important to them that the interface was intuitive and required little instruction to use.

Further indicating that ease of use, intuitiveness and convenience are the most important attributes of a UI for users, users complained when these properties weren't present. Users complained when it required too many clicks to complete a task. Some users expressed a desire for colour coding in the interface.

User Experience

This category contains all comments regarding the overall user experience. Users indicated that it was important to them that the app as a whole was easy to use. Accountability appeared to be an important aspect of an app as numerous users liked it when an app held them accountable. They also liked it when an app provided tools that helped with breaking bad habits and which helped identify 'triggers'. As with the user interface, it was important that the app as a whole was intuitive and easy to use with little instruction. They also like it when the app was fun and informative.

Similarly to the issues found with some of the user interfaces, users complained when an app was difficult to use, slow, confusing and inconvenient. Some users expressed a desire for more free features and for the ability to change the apps language. Users complained when the support offered for the app as inadequate.

Food Logging

This category contains all comments regarding features that allow users to record the foods they consume such as a food diary. As food logging is frequent activity, it was important to users that logging their foods was quick and easy to use. For this reason, they liked it when they could use a barcode scanner to quickly scan in foods. They also liked it when they received reminders to update their diary.

Many users complained that the weight measurements when logging foods were inconvenient. Users expressed a desire to change the units to grams rather than ounces. In some apps this ability was only available as a premium feature, whereas in other apps this feature wasn't present at all. Some users found the food logging feature to be broken as it wouldn't add foods correctly and the net carbs calculated was inaccurate. Users didn't like it when logging foods were too complicated. One user suggested adding the ability to add foods to their favourites from their food diary for convenience. Many users complained that they were limited to the number of meals they could add a day as they could only record breakfast, lunch, dinner and a snack. They required the ability to add extra meals if they ate more than this.

Food Database

This category contains all comments regarding the food database feature. This is a feature when an app has a database storing foods and their nutritional information which a user can use to quickly search for and enter foods when creating meals and recipes and when recording them in a food database. Users liked it when a food database had an extensive list of foods and it was important to them that it was easy to search for foods.

Some users desired more detailed descriptions for food items, whereas others thought that there was too much unnecessary food data and that some of the nutritional values were inaccurate. Users complained when there were too few food items in the database, indicating that an extensive database was important to them.

Targets and Goals

This category contains all comments regarding features pertinent to target and goal setting. Users liked it when an app set daily allowances of calories and macro-nutrients, and when the app made it obvious that these allowances were exceeded. They also liked it when the app estimated how long it would take to reach certain goals, such as a target weight.

Some users found that their goals weren't being saved and that they were unable to edit their goals. As with the calorie tracking features, users wished for the calories required to burn to reach their goals be displayed to them

<u>Fitness and Workout Features</u>

This category contains all comments regarding fitness and workout features. Users liked it when they could record the exercise they completed. They also liked it when an app provided them with workout plans, along with demonstrations of the exercises and reminders to complete the exercises. Some users stated that they liked the fact they could modify the workouts if there were certain exercises they couldn't perform.

The biggest complaints regarding fitness and workout features centred on the lack of exercises and workouts available to users. User desired a wider range and variety of workouts. Users also complained when there was no way of tracking their exercises and when their workouts progress wasn't saved correctly, indicating that an accurate way of tracking their exercises was important to them.

<u>Weight Tracking</u>

This category contains all comments regarding the weight tracker feature. Users felt that this was an important feature which helped them monitor their weight and kept them accountable whilst working towards their goals. Some users liked it when a weight tracker took into account weight gain diseases. A number of users complained that the weight tracker in one app was 'buggy'.

<u>Other</u>

This category contains all outlying comments which do not fall under any of the categories identified. Some of the additional features that users enjoyed and found useful include a cravings panic button, a pedometer and a water tracker. Users also liked it when an apps offered virtual rewards which they could earn by completing certain activities and achieving goals. Some users also commented that they liked it when they could connect an app with other apps and devices.

Some users found an apps pedometer and water tracker to be inaccurate and inconsistent. They complained that some of the online coaching was unhelpful. Some users also complained that the integration with other services was poor, further indicating that connectivity to additional apps and devices was important to them. One user expressed the desire for a way of establishing a connection between calorie intake, exercise activity and weight change. Another user suggested adding a notebook feature to an app where this feature was not present.

Affinity Diagram 1: Positive Comments

Meals and Recipes

Create custom meals out of ingredients

Copy items from one meal to another

Easy to create recipes

Ability to save recipes and meals

Able to edit saved recipes

Lots of diet plan options

Provides suggested recipes

Can find recipes based on food preferences

Avatars

Avatars are fun

Avatar is a visual reminder

Avatar helps motivation

Community Support

Good community page to post and find inspiration

Access to group support is helpful

Calorie Tracking

Easy to track calories

Daily calorie allowance

Shows you how many calories you have left for the day

Considers calories burnt through exercise

Good calorie tracker

Barcode Scanner

Love ability to scan foods

Barcode scanner easy to use

Barcode scanner saves time

Information

Displays nutritional information

Easy to find nutritional information of food

Helpful articles

Information is accurate

Messaging and Imagery

Avatar is a visual reminder

Avatar helps motivation

Not judgemental

Reminders to update food diary

Helpful articles

Positive feedback and encouragement

Workout reminders are useful

Can upload before and after photos

Provides guidance and feedback

No ads

Reports and Insights

Insights to help manage nutrient consumption

Graphs and charts to monitor progress

Data is accurate

Other

Panic button very useful

In-built pedometer is a nice feature

Can track water intake

Can sync with additional apps (google fit) and devices (fitbit)

Good that the app offers virtual rewards

Fitness and Workout Features

Questions to customise workout plans

Can modify workouts

Workout reminders are useful

Good workout plans

Includes workout demonstrations

Can record exercise

User Interface

Easy to use

Organised UI

Friendly and easy to use UI

Easy to use with little instruction

User friendly interface

Food Logging

Love ability to scan foods

Accurate meal and food logging

Reminders to update food diary

Easy to log foods

Targets and Goals

Makes it obvious when you exceed targets

Sets daily calorie allowance

Sets daily macronutrient allowances

Estimates time to reach goals

User Experience

Easy to use

Makes me accountable for what I do

Good tools to break bad habits

App is fun and informative

Helps identify triggers

Daily accountability

Easy to use with little instruction

Food Database

Extensive list of foods

Easy to search for foods

Weight Tracking

Can track weight

Considers weight gain diseases (thyroid and diabetes)

Affinity Diagram 2: Negative Comments

Messaging and Imagery

Too many reminders to upgrade

Articles are poorly written

Too many notifications

Interface is spammed with messages

App has quotes that promote anorexia

Too many adverts

Can only read one food item at a time as ads are too big

Gender binary cloth items for avatars

User Interface

UI is poorly designed

Design is not convenient

Difficult to find daily food analysis

Interface is spammed with messages

Bad UI

Too many clicks to do one thing

No colour coding

Too much vertical screen space wasted with white space

User Experience

System freezes

Not easy to use

Needs to be quick and easy to use

Design is not convenient

Unusable and slow

Not enough free features

App is confusing

Can't change language

Support is inadequate

Calorie Tracking

Needs to display how many calories needed to burn to reach goal

No simple way to just add calories

Calorie tracking is not consistent

Targets and Goals

Doesn't save your goals

Cannot change goals

Needs to display how many calories needed to burn to reach goal

Fitness and Workout Features

Doesn't save my workout progress

Exercises are lacking

Not enough workouts

No way of tracking exercise

Food Database

Needs more detailed food descriptions

Lots of unnecessary food data

Food database is lacking in items

Food database doesn't have accurate nutrition values

Food database search doesn't return foods

Food database full of incorrect information

Food database missing popular foods

Reports and Insights

Needs to analyse a wider range of nutrients

Difficult to find daily food analysis

Allow data export to CSV

Meals and Recipes

Should group recipes with similar ingredients

Want to remove some recipes from meal plan

Difficult to change portion sizes

Too complicated to add own meals/recipes

Include budget recipes

Portion sizes too big

Needs larger range of recipes

Want to remove ingredients from the recipes and re-calculate calories

Too many meals and recipes

No recipes for organic only food

Meal planner doesn't work

Food Logging

Can only record a limited number of meals

Want to add foods to favourites from food diary

Doesn't add food correctly

Logging food is complicated

Measurements are not ideal

Doesn't calculate net carbs properly

Limited range of measurements – needs grams

Doesn't save food items

Other

Pedometer is inaccurate

Online coaches are unhelpful

Water tracking is not consistent

Poor integration with other services

Barcode scanner does not find the correct food

No function for establishing a connection between calorie intake, exercise and weight change

Needs notebook feature

Weight tracker is buggy
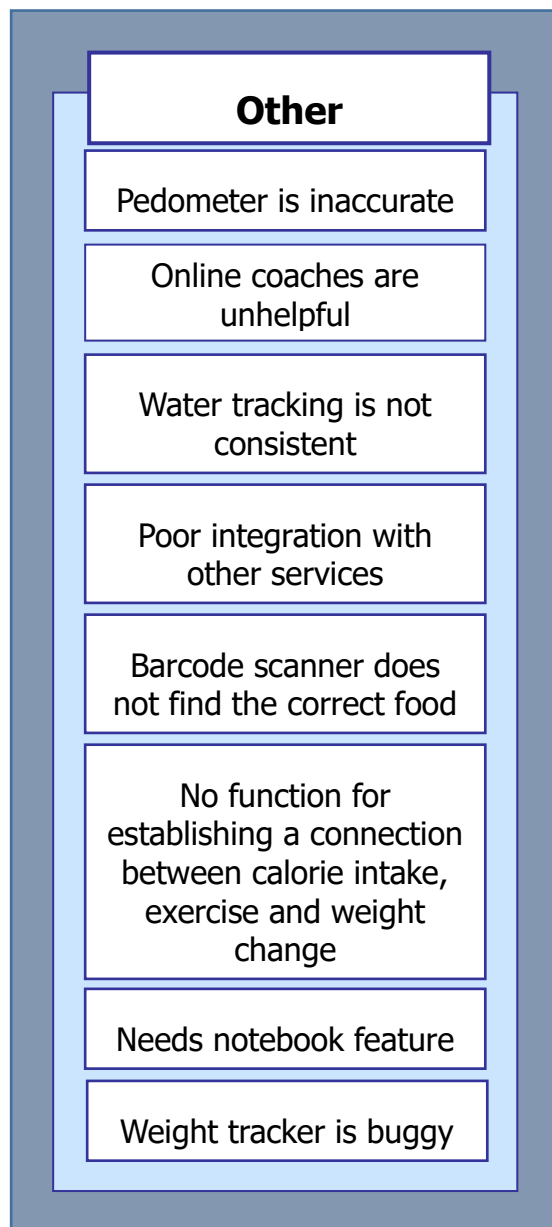
Suggestions for Improvement

The analysis of user reviews has highlighted some of the properties of weight loss apps that are most important to users. Users have expressed delight at the presence and functionality of certain features and have been critical where features are absent or defective. These comments reveal which features and properties users care about which can then be used to inform the development of future apps. Below is a summary of the main points developers should consider when developing features for categories identified above.

The ability to create and save custom meals was very important to users as this made logging future meals far easier. Convenience was the main trait users looked for in these features as they expressed delight when logging their meals was quick and easy but were highly critical when the process was complicated and time consuming. If the process of recording meals is not convenient then users will be discouraged from doing so which will lead to disengagement with that feature. Developers should therefore ensure that logging meals is a quick and simple process by allowing users to save favourite meals and recipes for simple logging at a later date. There were some conflicting comments from users regarding the number of recipes available. Some users were pleased that there were an extensive list of recipes available, whereas others felt overwhelmed as there were too many. My suggestion would be to apply the HCI design pattern of progressive disclosure by only revealing a limited number of recipes at any one time and allowing users to discover more as they see fit.

As with meals and recipes, one of the most important traits of calorie tracking for users is convenience. Calorie tracking is arguably one of the most important considerations when losing weight. Developers should therefore ensure that logging calories is a fast and simple process so that users remain engaged with this activity. One user complained that there was no way of adding calories to their calorie count without recording a whole meal in their food diary. This feature should definitely be included for convenience, especially if users wish to include calories consumed from drinks. Many users expressed how they found it very helpful when an app created and displayed a calorie allowance based on user biometrics and goals, as it helped prevent them from over-consuming calories. I would therefore recommend this feature always be included. Another highly important trait for users regarding calorie counting was consistency. A number of users expressed concern when their calorie count did not remain consistent between meals. Developers should always ensure that this data remains consistent and accurate. Failure to do so could actually be detrimental to a user's progress in working towards their goals.

Most users reacted positively to receiving reminders to record their progress and complete activities as they found it helpful. However, many complained when they felt overwhelmed with notifications and messages and, at times, some even found the app messaging to negatively affect the interface. I would recommend giving users control over the notifications they receive by allowing them to select what they wish to receive notifications and reminders for and by allowing them to turn notifications off where they desire. Users expressed delight when they received non-judgemental, constructive feedback and encouragement. However, there were instances of users finding messaging to promote

anorexia and gender bias. Developers should, therefore, be mindful of this and messaging should be informed by health professionals, nutritionists and/or clinical psychologists.

The barcode scanner was a highly popular feature as it made the process of food logging far more convenient. As already discussed, to maximise engagement this process should be made as convenient as possible so developers should always looks to include this feature. However, they should ensure that data scanned in remains accurate as users indicated accuracy was important to them and there were accounts of this not being the case. Where reports and insight are being created, developers should consider using charts and graphs as users found these to be helpful visual aids. Again, however, accuracy is an important consideration as inaccurate reports will have little value to users who will perceive the feature negatively as a result.

Convenience and intuitiveness were the most valued properties by users of both the user interface and the user experience as a whole. Many were pleased when they found the interface and app easy to use with little instruction but there were vast numbers of complaints when these two properties were absent. I strongly recommend that HCI design principles are used to inform the design of an app and to involve users in the design process to ensure the apps remains user friendly, intuitive and easy to use.

As previously mentioned, food logging is a critical task which should be made as convenient as possible as users are deterred from doing so if the process is tedious. The task can be simplified by storing favourite meals for quick logging and by including a barcode scanner for convenient entry of nutritional data. Some suggestions from users which I further recommend are to allow users to record an unlimited number of meals per day rather than just 4 set meals as in some apps, and to also include a range of weight measurements for foods in recipes such as grams and ounces. Many apps include a food database which users can use to search for foods when recording them in a food diary and when creating meals and recipes. This is a popular feature with users as it is convenient and speeds up the process of data entry. However, some users complained that the food items were too detailed and they were overwhelmed with nutritional information. Progressive disclosure would be an appropriate technique to apply here to rectify this. For example, upon searching for a food item, initially only the calories and macro-nutrients would be displayed with further nutritional information being hidden but discoverable upon request by the user. Accuracy is an important consideration if implementing a food database in an app.

In closing, three properties in particular consistently re-appeared throughout the user reviews and were regarded as highly valued and important traits by users; convenience, accuracy and intuitiveness. An app must be convenient for the user for it to add value to them and to ensure engagement with the app. If an app is not convenient, is too complicated and takes too long to use, then users simply won't use it as it is not worth their time. The accuracy of data and information in an app is vital, otherwise it will be misinforming users and could actually be detrimental to their progress rather than beneficial. Finally, an app must be intuitive to use so that users can easily use it with little training. If an app is too difficult to use, users won't use it. Developers should remember the Zero Overhead Principle; 'no feature may add training costs to the user'. Developers should,

therefore, bear in mind these three properties when developing a weight loss app and look to apply them in both individual tools and throughout the app as a whole in order to be successful.

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