

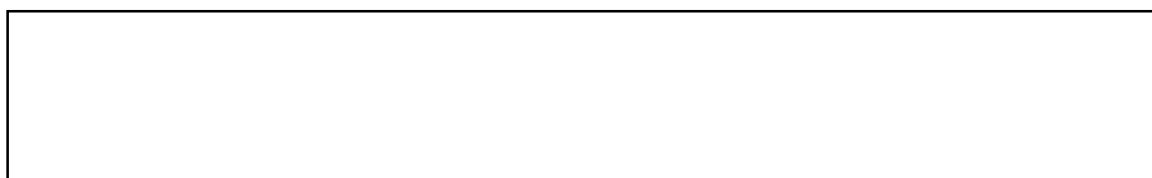


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## PREventive Care Infrastructure based on Ubiquitous Sensing

Instrument: Collaborative Project

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### **Abstract**

The present document represents the final motivational service design document of the PRECIOUS system and its implementation. It specifies the functionality of user-facing content in each app, and it presents related mockups and applications included in PRECIOUS system. It also summarizes and includes applied examples of main concepts and principles on relevant motivational, behaviour change and gamification theories and techniques, which are applied within PRECIOUS system. This document will put forward the PRECIOUS service design concept evolution that will build and sustain mid-to-long term users' motivation towards healthy behaviours.

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## List of Acronyms

API	Application Programming Interface
APP	Application
BIT	Behavioral Intervention Technologies
BMI	Body Mass Index
CVD	Cardiovascular Disease
EEG	Electroencephalogram
EMI	Exercise Motivations Inventory
EU	European Union
GPS	Global Positioning System
MET	Metabolic Equivalent of Task
mHealth	Mobile Health
MI	Motivational Interviewing
SDD	Service Design Document
SDT	Self-Determination Theory
T2D	Type 2 Diabetes
VIM	Virtual Individual Model
WHO	World Health Organization
WP	Work Package

## Executive Summary

The PRECIOUS system aims to promote healthy lifestyles, based on three main components: 1) transparent sensors for monitoring user context parameters and health indicators such as food intake, sleep, stress and physical activity 2) the development of a virtual individual model (VIM) representing users' variables and different parameters collected (both directly from the user and with sensors) for inferring health risks and desired behavior changes, and 3) application of a motivational service design framework combined with gamification principles to trigger, monitor and sustain mid-to-long term behavior change.

This deliverable presents the Service Design Document (SDD) [SDD1], which summarizes the deliverable products of tasks 3.1 and 3.2 (WP 3) of the PRECIOUS project, and provides a detailed description of how the various components of the PRECIOUS service will function (see tasks' descriptions below). The objectives of these tasks are to define and design elements and mock-ups for practical sub-applications and interfaces to foster users' preventive health care-related motivation:

### *Task 3.1 Behavioral representation of the individual*

*The PRECIOUS system is a model-driven personal guidance system (enabling formulation of motivational feedback) that relies on the Virtual Individual Model (VIM). The VIM is constantly updated by the individual's behavior data and related actions. This task focuses on the parameterization of the user's behavior and development of a combined VIM that takes into account all the considered risky behaviors (e.g. physical inactivity) and produces a reliable risk profile for the individual. This task is especially divided into modelling effects of:*

- *Task 3.1 a Stress*
- *Task 3.1 b Sleep*
- *Task 3.1 c Physical activity*
- *Task 3.1 d Food intake*

### *Task 3.2 Building motivation for behavioral change*

*This task will analyze and optimize ways for users to build up the motivation to change their behavior when it is identified that they are under health risks by themselves or by health officials. This task will benefit from the partners experience in gamification, human computer interaction and service concept / user interface design. The main outcome of this task will be a list of requirements that should be considered in order to design and build the motivational system, which will encourage the user to implement the proposed actions, to reduce the expected health risks. The respective requirements are further divided to:*

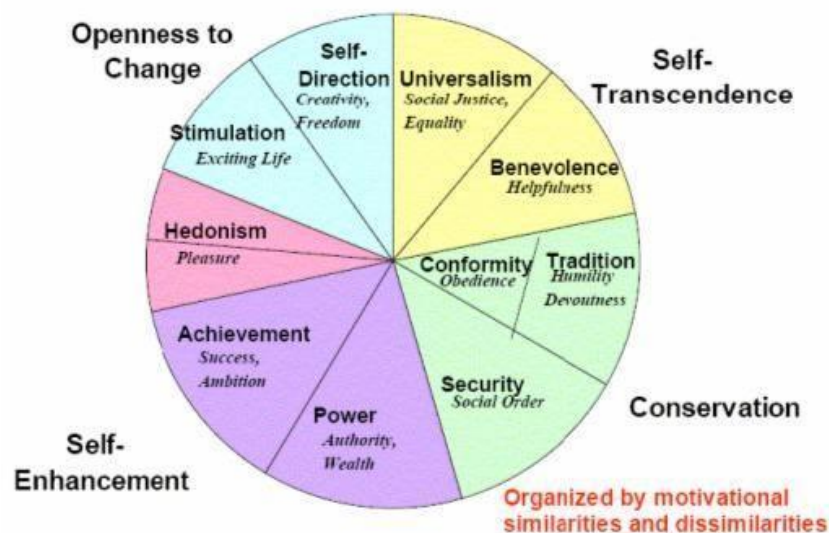
- *Task 3.2 a Identification of the need for preventive care intervention*
- *Task 3.2 b Requirements for the motivational service design*
- *Task 3.2 c Building motivation - motivational interviewing (MI) techniques*
- *Task 3.2 d Design features and motivation*

## 1. Background and objectives

A multitude of mobile health (mHealth) apps have been developed in recent years to support effective self-management of general population and patients with different health conditions. This rapid proliferation of apps has not always been accompanied by a solid framework guiding their design. A growing number of investigators have commented on the lack of models to inform the design of such behavioral intervention technologies, to support users in changing behaviors and cognitions related to health, mental health, and wellness. An interesting review of mHealth service design pitfalls is given for instance by Bridge Design Inc. [Bridge1]. Consequently, several problems related to long-term motivation, adherence to interventions and sustained behavior changes arise.

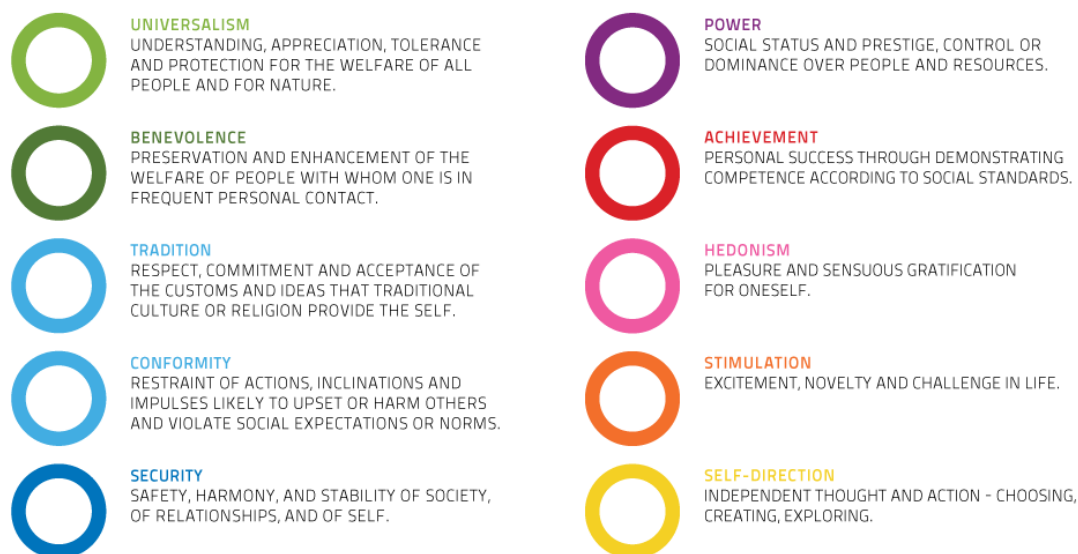
In PRECIOUS we have therefore based the service on latest evidence and built the service features firmly on behaviour change theories. The design is an interaction of objective sensor based data with motivational and gamified elements. The theoretical background, consisting of a wide review of theories on motivation, behaviour change, and gamification, has been described in PRECIOUS project deliverables [D3 3 Interim motivational service design document-1.0](#) and [D3 1 Interim report on behavioral representation and Virtual Individual Modeling 1 0](#). In this deliverable, we present how the theoretical information has been integrated for practical solutions.

While developing the PRECIOUS service, we have acknowledged different values that guide individual users. For instance, a widely recognised model of values is the Schwartz's values model (Schwartz, 1992); (Fig. 1 and Fig. 2). It represents so called universal values that have been identified in numerous cultures across the world. The figure below also displays the relationship of different values to each other. Values on opposing sides of the circle are most distant from each other and values side-to-side are more closely tied.



**Figure 1** - Schwartz's values model





**Figure 2** - List of values and their definitions [VF15]

For PRECIOUS, we have evaluated, which values (outcome goals) are the most relevant for health behaviours and which can be achieved by physical activity, diet, stress management of sleep hygiene. These have been operationalized in research investigating individuals' motives for exercise and healthy diet (Markland & Hardy, 1993; Satia, Kristal, Curry & Trudeau, 2001), and further refined and elaborated on in focus groups with individuals at an increased risk of cardiovascular disease during a previous project titled *Movement as Medicine for CVD Prevention* (Avery et al., In preparation). The list of values and outcome goals established in this earlier research will populate users choices in the "Outcome goal setting" component of PRECIOUS and set the context for user interactions with the system.

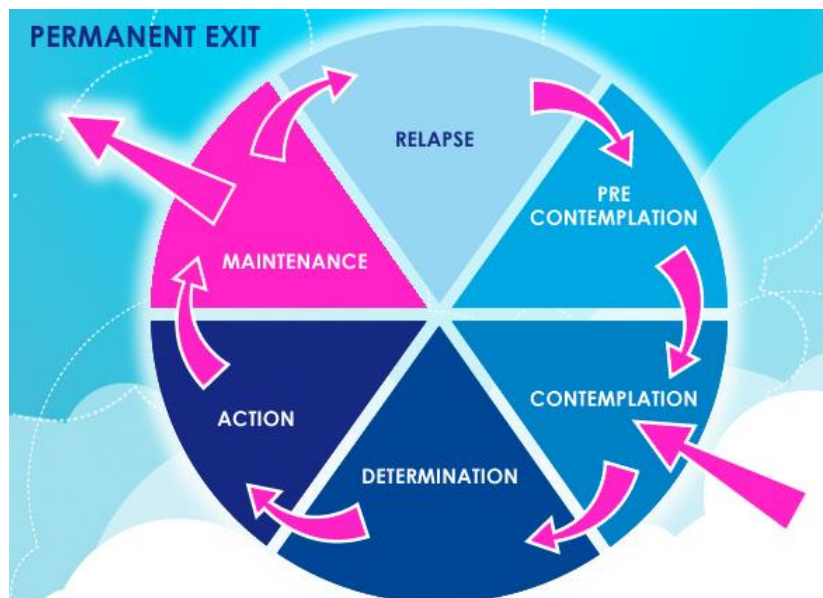
### 1.1 The Service Design Document

This SDD aims to briefly integrate both the conceptual and technological architecture of the PRECIOUS system. Conceptually, the PRECIOUS lifestyle monitoring and app suggestion tool is conceived based on the Behavioural Intervention Technologies (BIT) model and it should answer the questions why, what way, how (conceptual and technical), and when our targeted PRECIOUS-health app would be applied. While the general goal of the system is to promote healthy behaviors to foster health and wellbeing, this goal generally consist of smaller intervention aims (the "why"), such as promotion or reduction of specific behaviors, and behavior change strategies combined with motivational interviewing (MI) and gamification principles (the conceptual "how"), such as education, goal setting, tailored feedback and monitoring. Behavior change strategies are realized by some specific intervention components (the "what"). The characteristics of intervention elements may be further defined or modified (the technical "how"), to meet the user's' needs, capabilities, desires and preferences.

Generally, process of lifestyle change follows some general pattern as depicted in Fig. 3. However, we must keep in mind that the whole service needs to be conceptualized from a user-centred perspective to create truly functional, long-term personalized health solutions. Specifications related to workflow that defines when an intervention component will be delivered are also presented in this deliverable. This implementation may be either predefined

or include adaptive systems that can tailor the intervention based on data from the user and the user's environment.

In brief, this SDD provides a step towards formalizing the translation of developer aims into specific intervention components and methods that support research and communication between investigators on how to design, develop, and deploy such mHealth applications for preventive purposes.



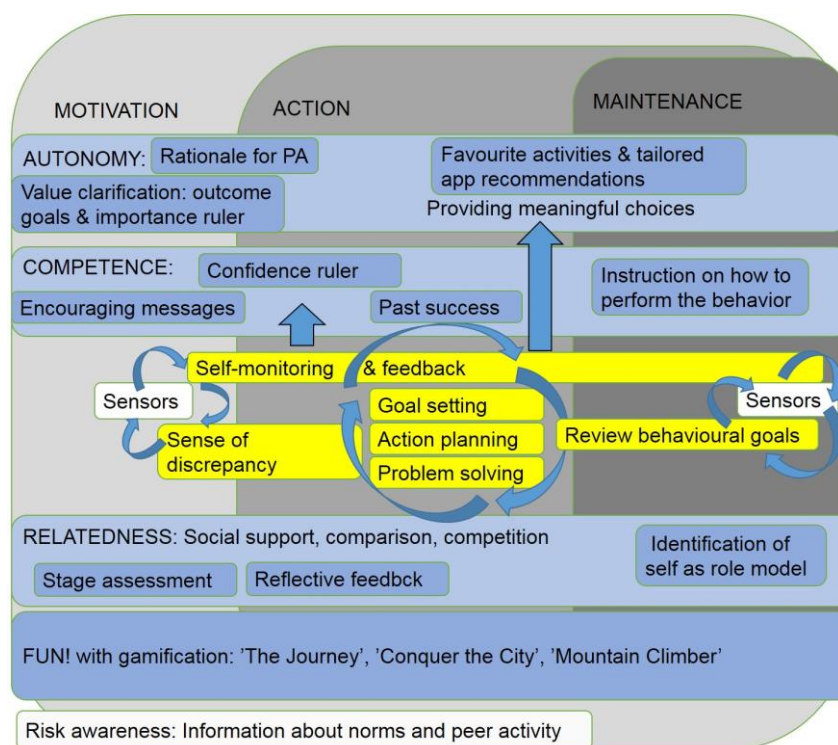
**Figure 3** - A visual depiction of the process of lifestyle change [WA05]

## 2. Service design of general motivational structures: towards a motivational framework

The PRECIOUS system will provide a motivational framework tailored to the individual and their lifestyle on a variety of different levels (Johnston & Johnston, 2013). This section will first briefly explain the guiding principles of the design, and then present the individual apps in detail, describing their functionality and how they meet the psychological principles. The specific technical working mechanisms for each app are fully described in deliverable 3.2 *Final report on behavioral representation and virtual individual modeling*.

The general approach in PRECIOUS is a user-centred, personalised health and positive reinforcement. The conceptual framework of the system is intended to facilitate sustained motivation and internalisation of healthier behaviours over time. The pillars of this motivational framework are: 1) **Understanding** of user motivation, preferences, values and interests; 2) **Behaviour change** and motivational status; 3) **Autonomy** and **choice**; 4) **Gamification**. For these purposes, PRECIOUS motivational framework is principally based on the theoretical insights and practical applications of Self-Determination Theory (SDT) and motivational interviewing. In order to develop a more autonomous motivation towards behavior change in an individual, SDT explains that the social environment surrounding the individual in a healthy context must support three basic psychological needs: a) Autonomy, b) Competence and c) Relatedness. Thus, SDT represents a coherent framework for understanding the process underpinning the development of autonomous motivations, but it does not provide detailed guidelines that can be used by health professionals to create SDT-

based interventions. It is mainly for this reason that motivational interviewing can complement SDT; while conversely, this model provides a great practical framework based on more than 20 years of research that could provide an SDT needs-supportive environment necessary for autonomous motivation development (Markland, Ryan, Tobin & Rollnick, 2005; Miller & Rollnick, 2013). Although SDT and motivational interviewing were developed independently of one another, several scholars claim that SDT can offer a theoretical framework for deepening our understanding of the efficacy of MI. More precisely, it is argued that the specific strategies in MI fulfill the individual's' basic psychological needs for competence (e.g. by using strategies to explore and build confidence), autonomy (e.g. by allowing individuals to discover their own reasons for change), and relatedness (e.g. by being compassionate) (Markland et al., 2005; Patrick & Williams, 2012). Fig. 4 below presents how the techniques from MI and socio-cognitive models are designed to support the basic psychological needs of autonomy, competence, and relatedness in the PRECIOUS service. The grey background fields indicate which stage of behaviour change is specifically targeted. We base the model on earlier research within PRECIOUS project, which has indicated that autonomous forms of motivation may translate into physical activity via self-regulatory techniques such as self-monitoring and problem solving (Nurmi, Hagger, Haukkala, Araújo-Soares & Hankonen, 2015; Nurmi, Hagger, Haukkala, Araújo-Soares & Hankonen, under review). The gamified elements of the service are designed to target all the phases of behaviour change from initial motivation to sustained habit formation.



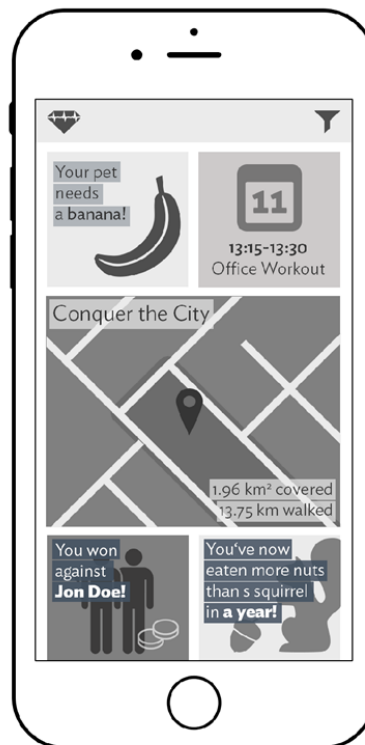
**Figure 4 - Mapping of PRECIOUS behavior change components onto the key variables in self-determination theory**

## 2.1. General layout, functions and “suggested apps” structure

For the main screen of the PRECIOUS system, users will be faced with the tiled sandbox layout pictured in Figure 5, which will be built for availability across both Android and iOS versions of PRECIOUS. Each sub-app (i.e. those detailed in sections 3 and 4 of this

document) will have its own tile, which may display a static image, rolling text, reminders or information about behavior or cognitive status related to the sub-app in question. It may also display links to other 3rd party apps if the appropriate APIs are developed and integrated.

The tiled sandbox display will be dynamic, in that variables related to user characteristics, behavior and previous engagement with the system captured by the virtual individual model (VIM) will alter the order of the tiles. At all times, the “suggested” app or apps (i.e. those which might most benefit the user at a given point in time) will float to the top of the display. The current VIM rules which govern which apps are suggested at any given time are specified in section 4 of deliverable 3.2 *Final Report on Behavioral Representation and Virtual Individual Modeling*. This list will continue to grow and be adapted as more users interact with the system, thus enhancing the effectiveness of tailoring within PRECIOUS.



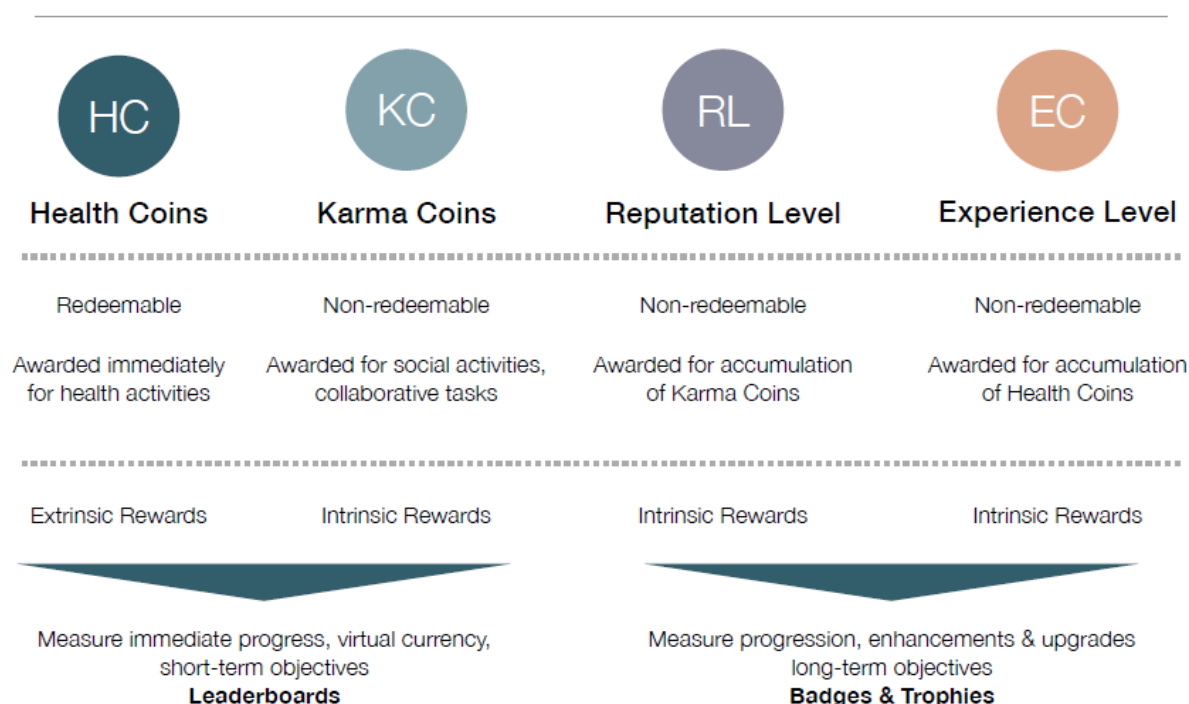
**Figure 5** - Draft visualization of the tiled sandbox layout

Although PRECIOUS will always have an app suggestion ready for users to try, they are not forced to follow the suggestion. This avoids the tunnelling present in many existing behavior change apps, and makes the service consistent with the principles of self-determination theory (highlighting the user’s autonomy and free choice) and motivational interviewing (offering users a menu options on how to proceed). The “suggested app” structure we have envisioned is novel within existing behavior change interventions, and when coupled with the dynamic tiled sandbox layout, should provide a rich user experience which is intuitive and supports user autonomy, consistent with theory.

## **2.2. Gamification and rewards**

Generally, motivation can be divided into intrinsic and extrinsic motivation. The first one is internal and more effective but the latter one is more easy to support by various external rewards resulting from obtaining the intended behavior change goals. Magnitude of intrinsic motivation can also be increased by self-realization of internal goals but recognizing, understanding and utilizing of these internal goals for behavior change is more challenging.

One way how we try to address intrinsic motivation is by gamified serve design elements that will be discussed later (see Fig. 6).



**Figure 6** - General rewarding system in PRECIOUS

In terms of extrinsic motivation build up, PRECIOUS will implement a standardised global reward system across all applications (Fig. 6). Each achievement will get a contingent reinforcement based on preferred feedback (visual, audio, text messages). Also, some intermediate steps towards specific goals will be rewarded to praise the process and promote mid-long term intrinsic motivation. These intermediate rewarded steps will follow a variable interval schedule. This reward system will serve to make achievements and progresses comparable among apps and individuals, where tangible and contingent rewards will be kept to a minimum and primarily serve as an extrinsically motivating tool during the onboarding process, and also while using the service, thus trying foster motivation and to incrementally show the value of the system to the user. Furthermore, the reward system is not pattern-bound - that is to say, not linear and unique - but included dynamically to achieve a single gameful experience even though the user is dealing with a number of different applications, potentially from different developers. In the future, these rewards can then also potentially be used to purchase additional services offered by the PRECIOUS platform.

In general, the rewarding system implemented in PRECIOUS will be comprised of the following features:

- **App-activity coins** are the primary metric measuring micro-goals within the system. They are non-redeemable. They are immediately awarded (contingent and fixed interval) for different kinds of health activities and thus serve as a feedback tool. In this sense, they give a compressed overview of the individual's health status in order to measure self-progress. Optimally, the user should learn to associate certain levels of app-activity coins with actual and experienced lifestyle changes. Different applications will have different subtypes of activity coins. These coins can also be lost absent of active use of the system.

- **App-activity levels** are awarded for accumulation of app-activity coins and thus measure medium to long-term progress. Given that app-activity coins do not expire over time, app-activity levels should typically increase with system usage over time. The system will differentiate between different activity levels in terms of reachability. Thus, while during the initial phase it is easier to progress to advanced levels, it will get increasingly harder to achieve higher levels. Certain activity levels can also be used for developers in order to unlock objectives, upgrades, quests and tasks and furthermore can be used as a quick health indicator in order to determine the intensity levels of the individual's usage of the system.
- **Health status** can be improved in forms of medals, which can be bronze, silver or gold. For instance, depending on how many activity coins users managed to collect within a certain period of time, the user's health status can either get better from bronze to silver status or decrease from silver to bronze status, for instance. Another possibility is a traffic light like system, or a rating based system where users additionally can have an outlook on their status (indicated for instance in a similar way to credit ratings, e.g. AAA+). Thus, the user always has an overview of her or his current status in a simple, quantified form.
- **Leaderboards** can be created automatically from PRECIOUS system by capturing the different points, coins and levels from all users. Generally, no-disincentive leaderboards will be used, where the user's status is only compared to a peer group with similar health values gathered from the VIM. Nevertheless, the option will be given to switch to infinite leaderboards. Furthermore, leaderboards will also be available for given friends & family members, as well as specified by geographical distance in order to be able to potentially contact intensive health users of the PRECIOUS system to achieve common goals.
- **Badges and trophies** will be awarded when the user reaches certain levels of activity, reputation or experience (transformation of activities into gamification points/levels). Each app can include own badges and trophies here and can make in-game progress dependent on these elements.
- **Aesthetic** settings for in-app modification of content.
- A standard way to access **settings of friends, family or other users** and create **collaborative tasks**.

As mentioned in deliverable 2.4 *Ethical and privacy guidelines for PRECIOUS system implementation*, in section 2.2.2., all the above mentioned measures will continuously be tracked for obsessive usage of the system (e.g. unnatural and unhealthy fast progress in terms of coins or levels in order to prevent both misuse and obsessive usage). Excessive collection of coins is notified to the user by tailored warnings and potentially also by coin devaluations such that it would hamper motivation build up and maintenance as little as possible.

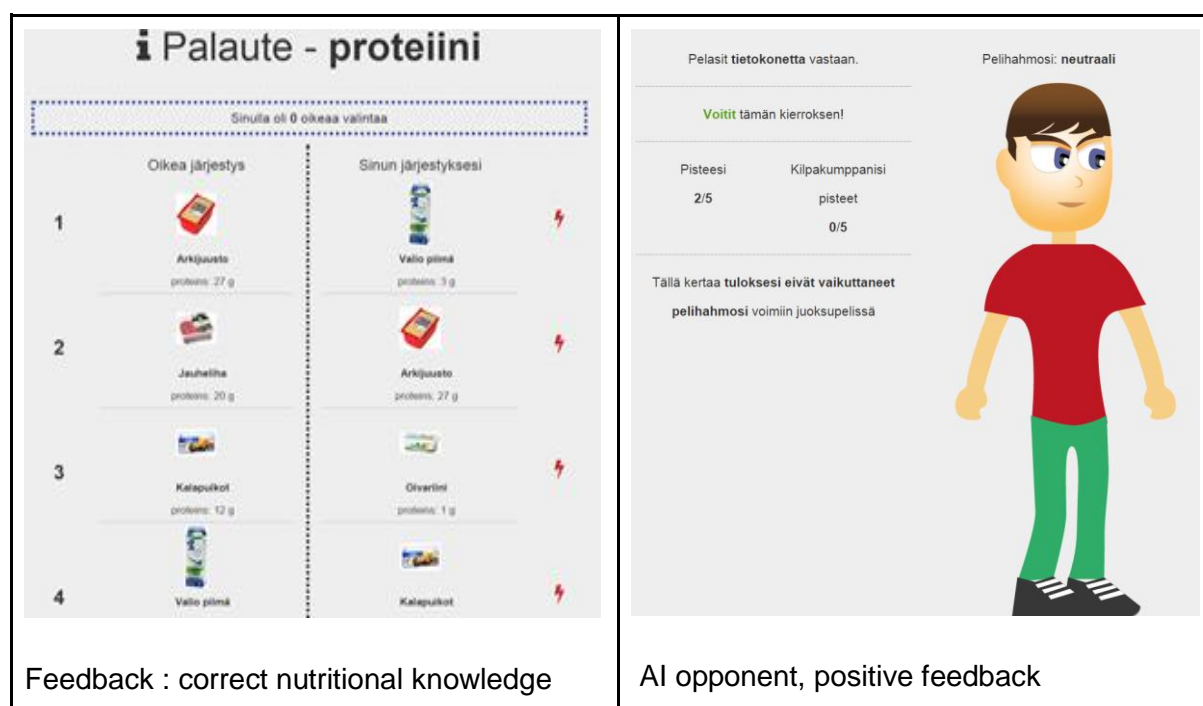
### **2.2.1. Lessons learned from lab studies: Gamification elements applied to diet**

As part of feasibility studies for PRECIOUS service, a serious game was developed with the following aims: a) to teach healthy food choices (e.g., correct nutritional knowledge information), and b) to increase the player approach motivation toward a more healthy diet (see Fig. 7).

Each participant was presented with 8 trials, which differed for their food criteria (sugar, calories, fibers, salt, fat, and proteins). We examined whether a) winning or losing against an



opponent b) the mere knowledge of the characteristics of the opponent (artificial intelligence vs. human) and c) rewards or punishments as opposed to a control condition affected the user emotional and motivational responses toward a set of healthy and unhealthy food-attitude images, and knowledge outcomes. When compared to losing, participants winning any opponent reported more positive emotional valence ratings and higher arousal responses. In addition, playing with a human opponent elicited a more positive and arousing game experience. When compared to punishments, participants that were rewarded reported increased approach motivational tendencies. Higher self-reported fun rating was associated with better knowledge outcomes.



**Figure 7** – Screenshot from lab-based diet game - gamified avatar

Lack of interest coupled with limited motivation were associated with weaker results in the memory tests and with less behavior change. The results from the study will benefit the design of the PRECIOUS system (see Table 2, section 4.2.6.1).

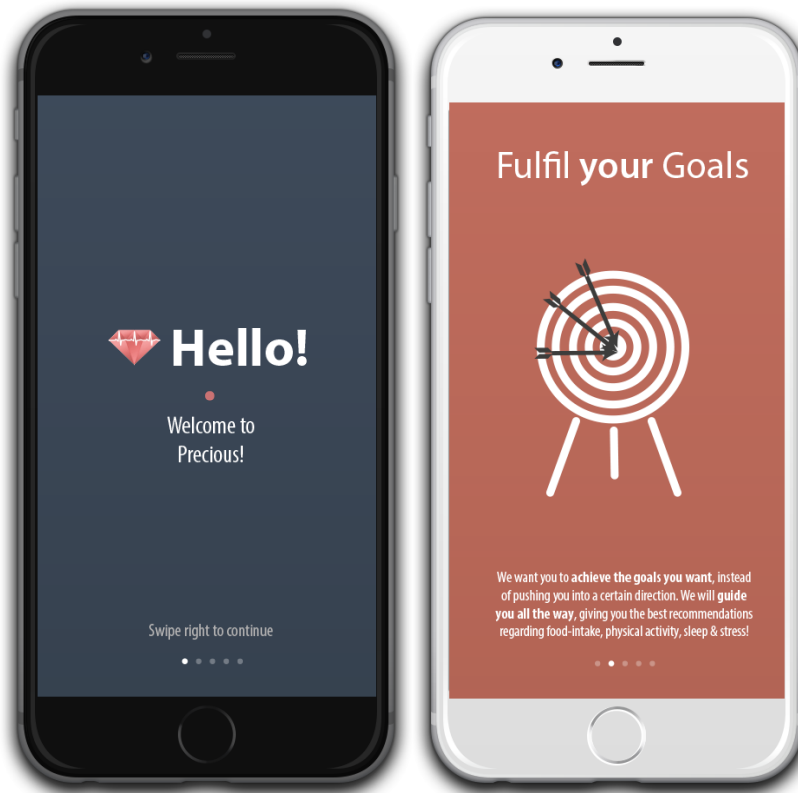
### 3. Theoretical basis and function of general motivation-phase apps

As described in section 5 of deliverable 3.2, many users who interact with the system will have low motivation for behavior change. The PRECIOUS system will first aim to engage these users and build initial motivation for change, before progressing to more action-focused portions of the system.

#### 3.1. Welcome, Minigame and Onboarding

A still non-personalized welcome screen will be shown together with the initial messages conveyed to the user (Fig. 8). This will be the first point of contact with the system, and it is important to immediately clarify in a clear and brief manner the functions of PRECIOUS. This will be accomplished via five animated single page views graphically describing the features and functionalities of the system from abstract point of view.

It is expected that in future versions of PRECIOUS system (once the prototype has been tested and further developed), within “optional tutorials”, a short video describing how PRECIOUS can be used and how it works will be available.



**Figure 8** - Draft version of PRECIOUS welcome screen (a) and initial messages (b)

Next in the onboarding process a small introduction game will be offered. The aims of this minigame are to be quick (<30 seconds), show the interactivity of the service, catch user attention, build trust, provide immediate feedback/reward, and to introduce the ‘my journey’ screen. The mini game will illustrate some basic functions of the system (e.g. accelerometry, reward mechanisms) and reveal components of the system incrementally.

After the mini game, the user will start the personalisation process by creating an account to register, his/her personal settings as well as connections to social platforms and devices already in possession of the user. From the early registration it is important to provide choice and autonomy to user. Several initial choices related to the personalization of the service will be offered. These will be:

- Username / nickname.
- Email and password.
- Gender, age/date of birth, height, weight.

Further functionality of the system will be reachable through the settings view. It is consistently reachable via a swipe right gesture and can be scrolled through by swiping upwards and downwards. A preliminary arrangement of settings has been found to include the following:

- Personalisation (e.g., themes, sounds, colours, etc.).



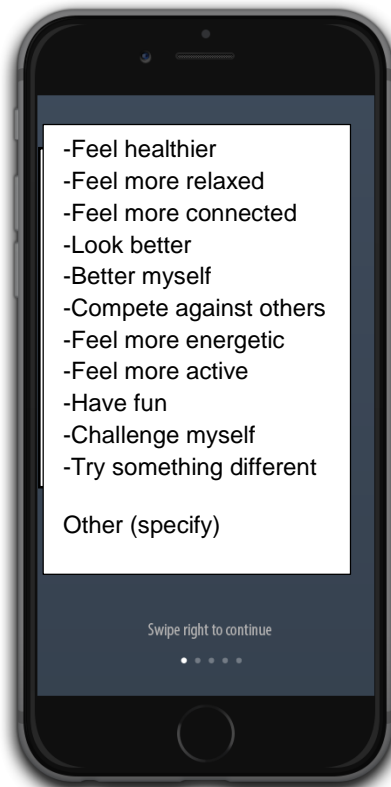
- Privacy (e.g., passcode protection, friends visibility, app access to data, etc.).
- Your goals (e.g., goal guidance system and overview).
- Feedback preferences (e.g. visual, audio, vibration, etc.) and scheduling (daily, weekly, monthly). Feedback preferences can be fully customised, starting from simple phone vibration to the activation of specified actuators at home.
- Settings (e.g., notification types & frequencies, etc.).
- Statistics (e.g., steps taken, etc.).
- Charts (e.g., visually appearing representation of health data).
- Timeline (e.g., of personal activity and of friends and family).
- Coins (e.g., activity coins, etc.).
- Levels (e.g., reputation level, experience level, etc.).
- Leaderboards (e.g., app badges, global, local leaderboards, friends leaderboards).
- Friends & family (e.g., overview of contacts and others' achievements).
- Marketplace (e.g., all apps, reviews, etc.).
- Connections & devices (e.g., Facebook/Twitter, Gmail, Runkeeper, MyFitnessPal, Nike+, BodyMedia, Withings, Runtastic, etc.).

After having finished the basic registration and individualisation process, a personalized welcome message will be displayed (*Welcome NICKNAME!*). Afterwards, the onboarding part of the system will be completed with an optional tour of the features explaining navigation and other aspects, to create a comfortable but enjoying experience to users.

### **3.2. Establishing outcome goals**

After onboarding, users are directed to an app which allows them to identify “what they want out of life”, or in other words, to set an “outcome goal” or “higher order goal” (see Fig. 9). According to several prominent theories (e.g. goal setting theory and self-regulation theory), these outcome goals are powerful motivators of health-related behavior. Additionally, focusing on higher-order goals, as opposed to strictly focusing on behavioral goals, is something novel and different from any other behavior change or prevention app on the market. This personal choice also promotes user autonomy and ownership of the behavior change process.

Within this app, users rate predetermined outcome goals in order of importance, with each framed in terms of increasing a desired outcome (e.g. “I want...” to feel healthier, to have more fun, to feel more relaxed). The outcome goals from which users can choose are from the exercise motivations inventory (EMI); (Markland & Hardy, 1993) and the motivations for healthful dietary change questionnaire (Satia, Kristal, Curry & Trudeau, 2001).



**Figure 9** - Draft version of outcome goals screen

Each outcome goal will be accompanied by the following parameters:

- Health behaviors which can be offered to achieve the outcome goal (e.g. diet, physical activity, relaxation, environment).
- Sub-behaviors which can be used to achieve the outcome goal (e.g. running, cycling).
- Progress bar toward outcome goal.

The system should log the following:

- Top-ranked active outcome goal for priority order, ranking of all other outcome goals.
- The top-ranked outcome goal will be then followed with the following assessment:

Motivational level.

*If on a scale of 0 to 10, 0 is not at all motivated and 10 is 100% motivated, how motivated do you feel to [selected goal] at this moment?*

Depending on the score, a motivational feedback message eliciting change talk will be displayed.

*Why did you choose this number and not [lower number]? [Note: this elicits change talk]*

*What would you need to get from this number to a [higher number]? [Note: this elicits change talk]*

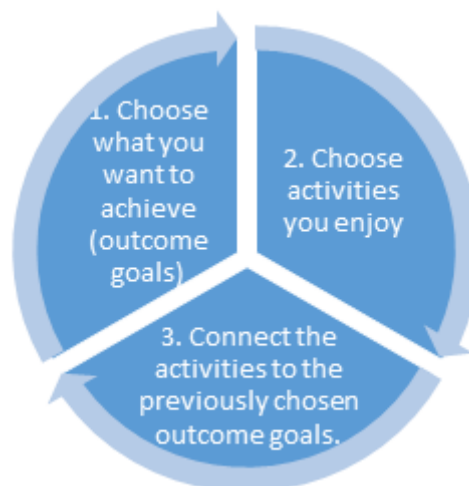
### **3.3. Choosing behaviours to achieve outcome goals**

In previous deliverables ([D3 1 Interim report on behavioral representation and Virtual Individual Modeling 1 0](#)), we have identified several modifiable behavioral risk factors

associated with prevention of Type 2 Diabetes (T2D) and cardiovascular diseases (CVD); namely physical activity level, dietary intake, stress and sleep quality. The aim of this app is for users to identify which of these behavioral targets would most help them to achieve their chosen outcome goal. To achieve outcome goals, an app will provide users with a choice of behaviors/risk factors that will be addressed to succeed with their “active outcome goal(s)”. This app will consist of a list of choices based on the behaviors/risk factors associated with the active outcome goal (Fig. 10 and Fig. 11).



**Figure 10** - Draft version of choosing behavioral target screen



**Figure 11** - Choosing behaviours to achieve outcome goals

After choosing the personally important outcome goals (values) and favourite activities, the user will connect these two, creating a mental loop of their goal and the behaviours that will take them there.

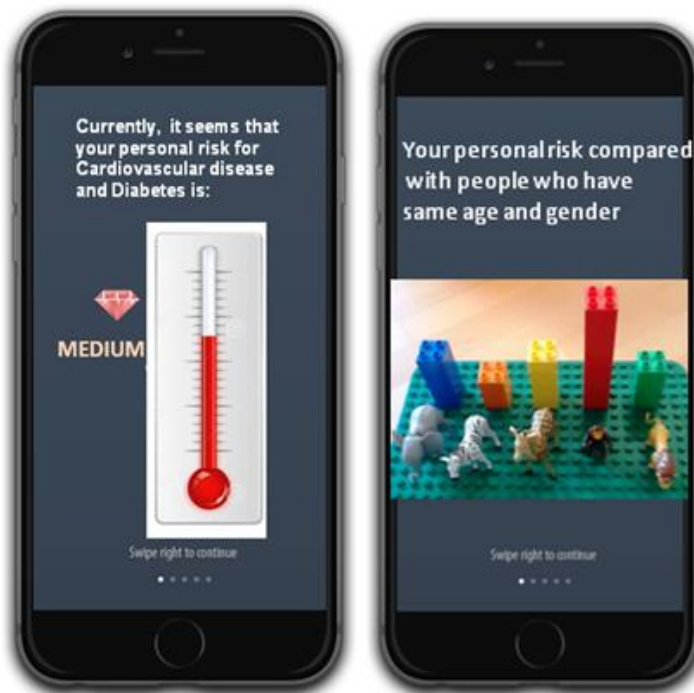
### **3.4. Health risk assessment**

For the PRECIOUS field studies, we will take into account user characteristics and health risks that may affect the use of the service. This risk score may be calculated from previous medical exams, and other factors will be assessed with simple questions. The list of variables to be included is as follows: gender, age, weight, height, body mass index (BMI), blood pressure, cholesterol, current physical activity level, current nutrition, current stress, tobacco use, alcohol use, presence of health conditions (arthritis/arthrosis, respiratory problems, heart problems, depression, anxiety, diabetes, digestive problems, pain and others).

According to a number of behavioral theories, including protection motivation theory and the health belief model, individuals' perceived and actual health risks can act as motivators for behavior change. However, studies have shown that the experience of risk or threat alone does not lead to behaviour change because the process is dependent of other psychological factors, such as self-efficacy. With low self-efficacy, individuals will not believe in their capacities to make a change, and they will therefore reject the threatening information. Therefore, in PRECIOUS, the main focus is on increasing users motivation and confidence to perform health behaviours and achieve their personally relevant goals.

#### **3.4.1. Risk factor feedback**

The risk factor feedback offers information to the user about the risk level for developing CVD, obesity and T2D. The risk level will be displayed as a thermometer and graduated in several levels: *very low*, *low*, *medium*, *severe* and *very severe risk*. The levels are established according national health guidelines (e.g. <http://cvdrisk.nhlbi.nih.gov/> or <http://www.heartage.me/your-heart-age/you>, depending on the country of each user [CVRC15]), but it must be noted that the accuracy of such algorithms for calculating CVD risk is dependent upon accurate and complete data input. Users will also have the option to receive normative information about the risk level among the general population in the same gender, age and country (Fig. 12). After users' checking activity, they are directed into an arm of the app based on their chosen behavior/risk factor. After this risk factor feedback, a new screen summarizing the current user's situation, his/her personal goals and his /her willingness to change behaviour will be displayed.



**Figure 12** - Draft version of feedback concerning health risks

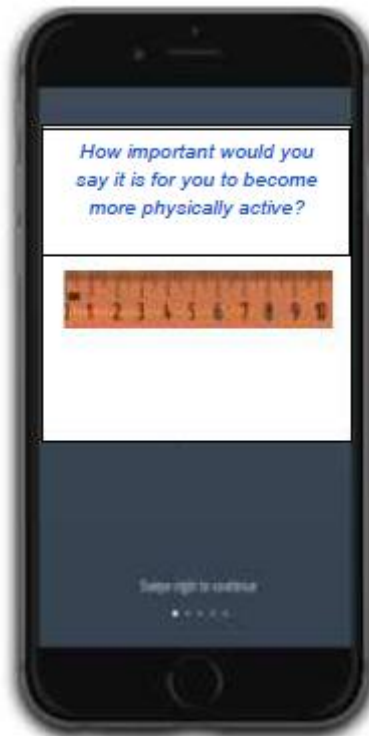
#### **4. Theoretical basis and function of action-phase apps**

##### **4.1. Physical activity-specific apps**

This stream of sub-applications will be initiated if users indicate that physical activity will help them to achieve their outcome goals. These will be available otherwise, but will not be suggested unless this is the case. See section 4 of deliverable 3.2 for further information about the rules governing system behavior and app suggestions in response to user inputs.

##### **4.1.1. Physical activity - Importance ruler**

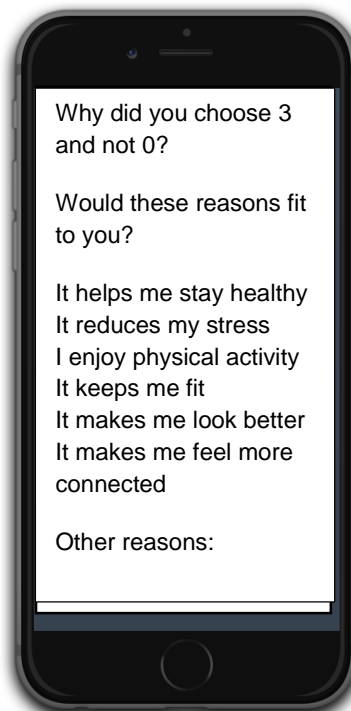
With the importance ruler app, users are asked about how important they perceive physical activity on a scale of 1 to 10, where 1 means *not at all important* and 10 means *very important*. Users must respond with a digit (Fig. 13). *How important would you say it is for you to become more physically active?*



**Figure 13** - Draft version of physical activity importance ruler screen (I)

Users are then asked why they chose that digit and not a lower number, and select multiple options from a list (Fig. 14) for eliciting change talk. The multiple choice options are populated from the user's 5 top-ranked outcome goals.

- If a high number (9 or 10) is selected, the system will display a reflection of the importance of physical activity for that individual, such as “*OK, it seems as though physical activity is VERY important to you*”.
- If users choose 0 then they are asked what can help them to choose a higher digit; a scroll-down menu with several options is presented. Among these options, changing the previously chosen activity will be offered. In case, no option or activity is chosen, the system will offer the possibility to change the outcome goal or reorganize them.



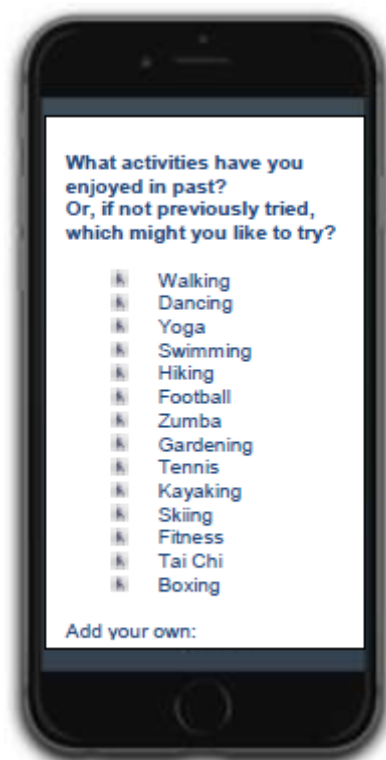
**Figure 14** - Draft version of physical activity importance ruler screen (II), eliciting reasons for physical activity

The rationale for importance rulers is supporting change talk, which is a central element in motivational interviewing. Change talk is one of the mechanisms that make the user realise that they may have the will, the abilities and the persistence to make the change. Change talk is usually produced spontaneously in the interaction within a motivational interviewing. This is unfortunately not yet possible with the existing technology -computers cannot understand and react to human reflections in the same supporting, empathetic and accurate way than a trained motivational interviewer can-. In addition, it is very inconvenient for the user to type their reflections on the smart phone. For these reasons, and for earlier scientific evidences (Friederichs et al., 2014), PRECIOUS system will offer the users multiple choice options that might reflect their innate change talk. What makes the options likely to match user reflections is the fact that we populate the answer options with their earlier choices in the “Outcome goal setting app”. Therefore, another motivational interviewing principle is also followed; mirroring user choices back to them.

#### **4.1.2. Physical activity - Identifying favorite modalities**

In this app, favorite physical activity modalities are screened to choose specific activities that users have enjoyed in the past and/or might like to try in the future. All physical activities have the following information stored in the backend: Name of physical activity, photo icon, link to maps, link to google result, text info blurb, possible intensity levels (and MET value for each intensity), partners for monetization (Fig. 15). Additionally, each physical activity will have the following associated fields based on user inputs: *Is physical activity favorited? Is physical activity in Top 5? Is physical activity specifically linked to chosen reasons?* Then, if

more than 5 physical activities are selected, the service will offer random suggestions for some of the different favourite physical activities indicated by the users.



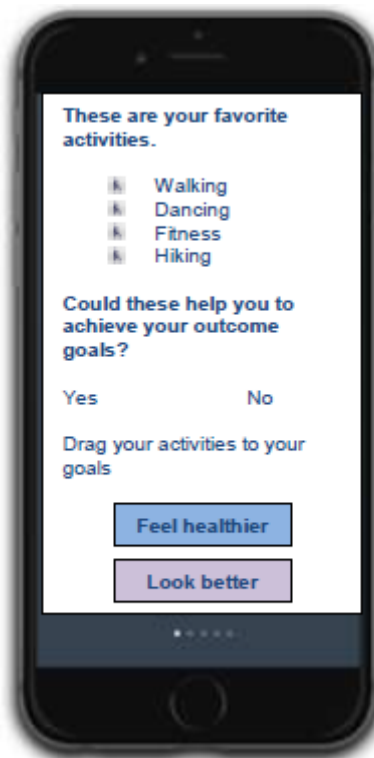
**Figure 15** - Draft version of physical activity favourite modalities screen

The rationale for choosing favorite modalities is the wide evidence about intrinsic motivation, i.e. enjoyment, fun, and positive challenges are strong predictors of behaviour change (see deliverable 3.3 for an extent description of intrinsic motivation and self-determination theory; [D3 3 Interim motivational service design document-1.](#)).

#### **4.1.3. Physical activity - Linking physical activity and active outcome goal**

In this app, users are shown their previously identified favourite physical activities and their “active outcome goal”. Then, they are prompted to choose physical activity modalities they feel will help them to achieve their outcome goal (making specific links between the two); (Fig. 16). Users can also indicate that these physical activity modalities might not help. For instance, they can choose: “*show more physical activities*” and this will display additional favorite physical activities; or “*physical activity won’t help me to achieve this outcome goal*” this will send the users back to “Choose Behavior/Risk factor target” app. After making specific links, these are stored in the system and shown to the user. This will reinforce purpose and meaning.



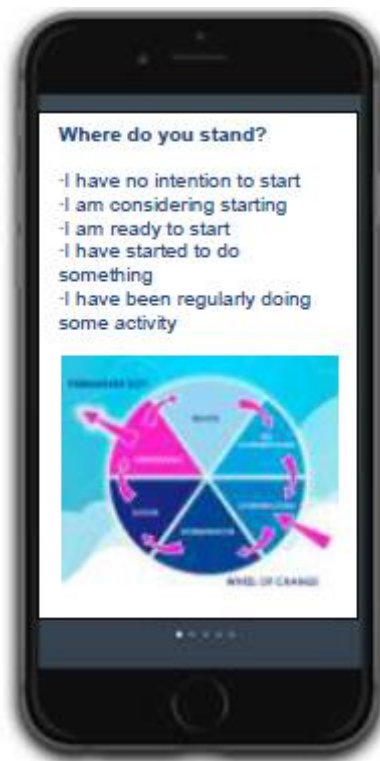


**Figure 16** - Draft version of linking physical activity and active outcome goals screen

The rationale for linking physical activity and active outcome goal is that here the user sees the connection and meaning between intrinsic motivations, outcome goals and action strategies aimed at behavior change.

#### **4.1.4. Physical activity - Identifying intentional status (stage of change)**

This app consists of a multiple choice question which assesses a user's intention or stage of change for physical activity. The user is first reminded of the activities they autonomously linked to their outcome goals. User then chooses the current stage with regards to those specific activities. Users' choice should be stored as "current stage". Depending on the user's item selection, one of the "cheese portions" will be highlighted (Fig. 17) and the next suggested apps will be tailored.



**Figure 17** - Draft version of identifying motivational status screen

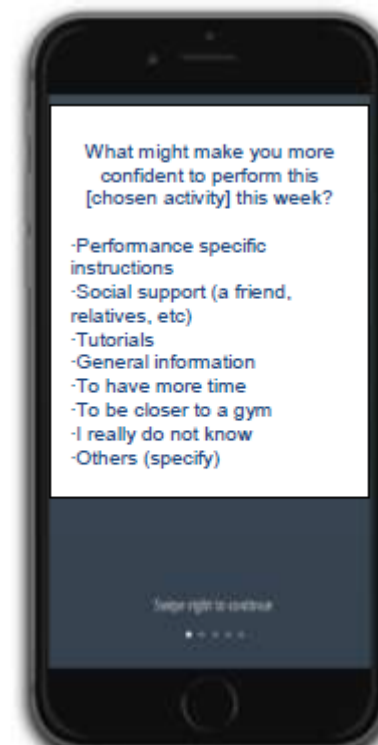
#### **4.1.5. Physical activity - Confidence ruler**

In this app users are screened about their confidence to be physically active on this specific week. They will be surveyed with a numeric scale (Fig. 18). They will be asked what might make them more confident that they could carry out their chosen activities that specific week (multiple choice); (Fig. 19). The responses will then suggest additional tools (e.g. messenger, problem solving tool, etc.).

Confidence ruler is a transition point for the users. This is the point where we offer them the chance to translate intention and motivation into concrete action. We offer tools that are founded on behavioural research and that have shown to be most efficient in behaviour change, namely behavioural goal setting, action planning and self-monitoring (see deliverable 3.3 for theoretical background; [D3 3 Interim motivational service design document-1.](#)). Following the principles of the self-determination theory and motivational interviewing, we do not force them, however, to take this step, but if the users still feel uncertain about activity, they can return to motivational tools. Examples: *"I would feel more confident that I can achieve my physical activity goal, if I..."*, *"had a clear goal in mind for each day"*, *"had a detailed plan how to achieve my daily goal"*, *"if I would regularly follow my progress"*.



**Figure 18** - Draft version of confidence ruler for physical activity screen (I)



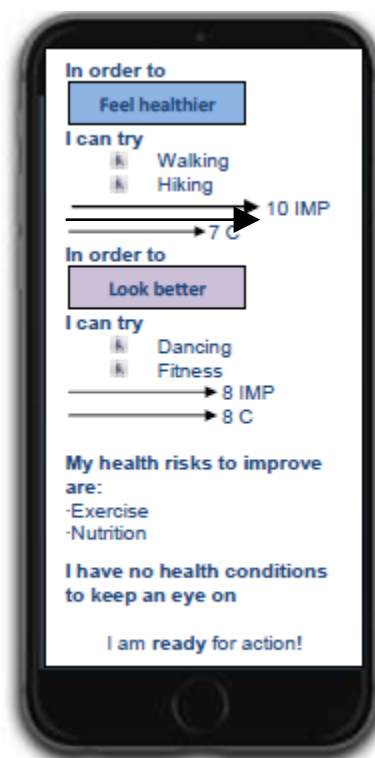
**Figure 19** - Draft version of confidence ruler for physical activity, second part screen (II)

#### 4.1.6. Physical activity - Big feedback

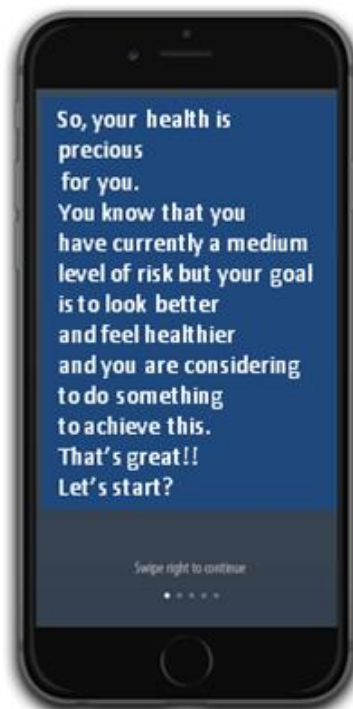
This app delivers feedback messages which integrate choices, outcome goals and user's performance. It is tailored to user inputs from previous apps. Many different messages are possible and these will be created for each possible case. Variables to be called here include:

- Active outcome goal
- Identified behavior/risk factors
- Favourite physical activities
- Physical activity - outcome goal links
- Importance of physical activity
- Stage of change for physical activity

An example of this big feedback is displayed in Figures 20 and 21.



**Figure 20** - Draft version of linking physical activity and active outcome goals screen



**Figure 21** - Draft version of big feedback summarizing current user's situation concerning outcome goals, behavior and motivation

#### 4.1.7. Physical activity - Past success and looking forward

This app will prompt users to consider and think back to previous positive experiences with physical activity. This app is not intended to collect or call any variables but to reinforce motivation, efficacy and sense of mastery of the users (Fig. 22). This method is in fact, intended to increase the users' perceived confidence by asking about past successful experiences with questions such as: "*I would like to ask you to think back of a moment in time when ultimately you succeeded in doing something very difficult/pleasant/enjoyable while practicing physical activity*" [different options now]:

*What did you have to do?*

*How did you ultimately succeeded?*

*How did you feel when doing such activity?*

Etc.

The users will be asked to imagine that she or he would become more physically active and that she or he would maintain this new level of physical activity for a period of five years, for instance. As the next step, the user is asked to imagine what possible beneficial effects such as increase in physical activity would entail for his or her health and/or lifestyle, how would he/she feel, and would this consideration have influence on how he/she feels about being more physically active.

This app can work together with the confidence ruler app to monitor and reevaluate how these visualization exercises can modify users' confidence to behavior change. When confidence ruler app receives lower scores, this past success and looking forward app will actuate.



**Figure 22** - Draft version of past success for physical activity screen

#### **4.1.8. Physical activity - Problem solving**

This app provides users with the capability to link specific barriers to physical activity with specific solutions (see deliverable 3.2. for algorithm specifications). In this sense:

- If a user's personal barrier is not listed, he/she should be able to add one.
- If the user has selected a specific barrier, but no viable solution is offered by the system, he/she should be able to add a new solution.
- The backend would therefore need to contain the following:
  - o A list of specific barriers. Each barrier would have associated with it a number of possible solutions for the system to suggest.
  - o A list of possible solutions
  - o A list of the specific barrier-solution links made by each user.

An example is displayed in Fig. 23.



**Figure 23** - Draft version of problem solving for physical activity screen

Another motivational tool of the PRECIOUS system will be called “Recipes”. PRECIOUS will create a maximum autonomy supportive environment where users can fully and transparently control how and why interventions are suggested, and subsequently manipulate these connections to their own desire. This aligns with the principles of PRECIOUS system based on providing choice, meaningful rationales and tailoring to users’ capabilities. Users will be able to design “if-this-then-that” or “if-this-then-don’t” rules in an easy and understandable way in order to connect their own behaviour to certain actions. In this way, users are able to create their own interventions to some extent. On the other hand, users can alter and modify rules of already existing interventions, for instance cancelling all notifications regarding physical activity when rain is expected in the area (Fig. 24). See deliverable 3.2. *Final report on behavioral representation and virtual individual model*, for algorithm specifications.

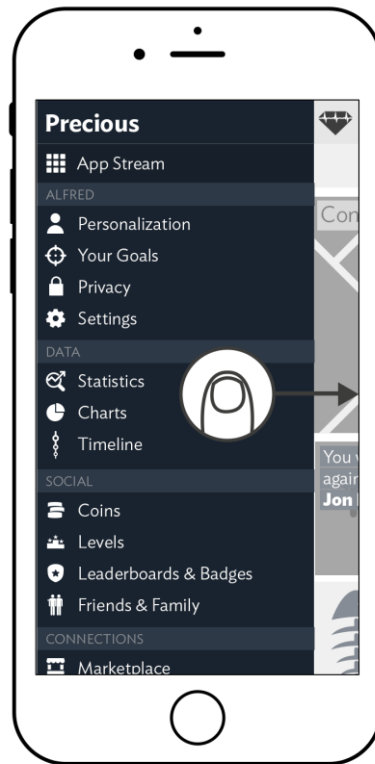


**Figure 24** - Draft version of recipes for physical activity screen

#### **4.1.9. Physical activity - Data report**

This app forms the core of the action-phase of the physical activity arm, and provides users a glimpse into their recent physical activity behavior. In the settings section (during personalization or at any given time), users can personalize the level of detail they wish regarding their physical activity behavior. They can also choose the preferred type of data visualization (e.g. statistics, analytical approach, in a gamified way such as feeding a pet); (Fig. 25). The system will also include a proactive data addition from the user (not strictly captured by their phone and sensors) which will be treated as a separate app. Missing information can be due to data not captured by the phone, illness, vocational period, not carrying the phone, etc. The user will have always open the possibility of adding or correcting information.





**Figure 25** - Example of the opening screen

#### **4.1.10. Physical activity - Normative information**

Normative data and general recommendations will be unlocked and always available after completing certain activities and monitoring. The normative data will refer to activity patterns and healthy lifestyle general recommendations (e.g., *“what is physical activity?”*, *“What is the intensity (moderate versus vigorous) of a physical activity?”*, *“What much physical activity should I get?”*, *“General information on benefits of regular physical activity”*, etc.), caloric expenditure related to physical activity, and normative values related to different questionnaires administered and variables collected (e.g., heart risks, etc.).

#### **4.1.11. Physical activity - Goal setting**

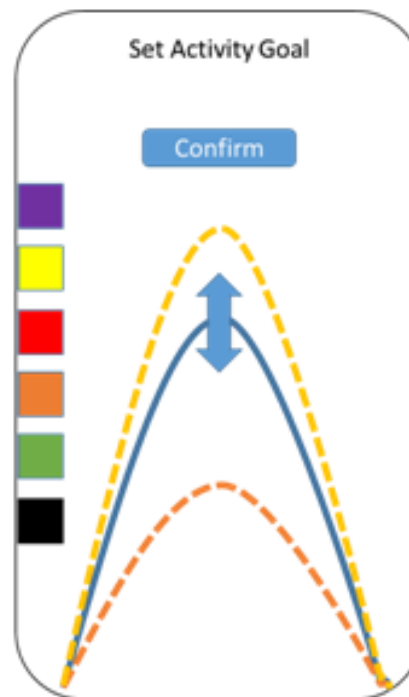
This app will allow to measure users' activities and then turn it all of them into MET values, which again, will be translated into daily steps. This functionality will serve to test how realistic the goal is compared to past behaviour and it will display warning messages if the user sets a goal that is 20% higher than their average steps.

There will be several possible optional features such as:

- The amount of activity may be displayed with users' favorite activity or in calories (e.g. *“You have taken 5374 steps today = 40 min of football”*).
- Users can adjust what time a new measurement day begins.

The gamified functionality of this app will consist of attractive visualization of goals and progresses (Fig. 26). When the users open the app, they see an image of a mountain that

represents the amount of steps they have taken during the previous day. They then adjust the goal for the current day by dragging the mountain higher or lower with a finger. The higher the mountain, the more steps one's daily goal is. Once the goal has been set, the mountain turns pale (as a mountain further in the horizon) and the daily activity starts to build in front of it as another mountain with vivid colours. The users can thus see in real time how they approach the goal as the mountain grows taller. Once the 'activity mountain' is as high as the 'goal mountain', a flag appears on top of it to show that the daily goal has been reached. If the user fails to reach the goal for several consecutive days, the app will suggest *the problem solving tool* (see section 4.1.8 of present deliverable).



**Figure 26** - Draft version of Physical Activity goal setting screen

#### **4.1.12. Physical activity - Self-monitoring and logging**

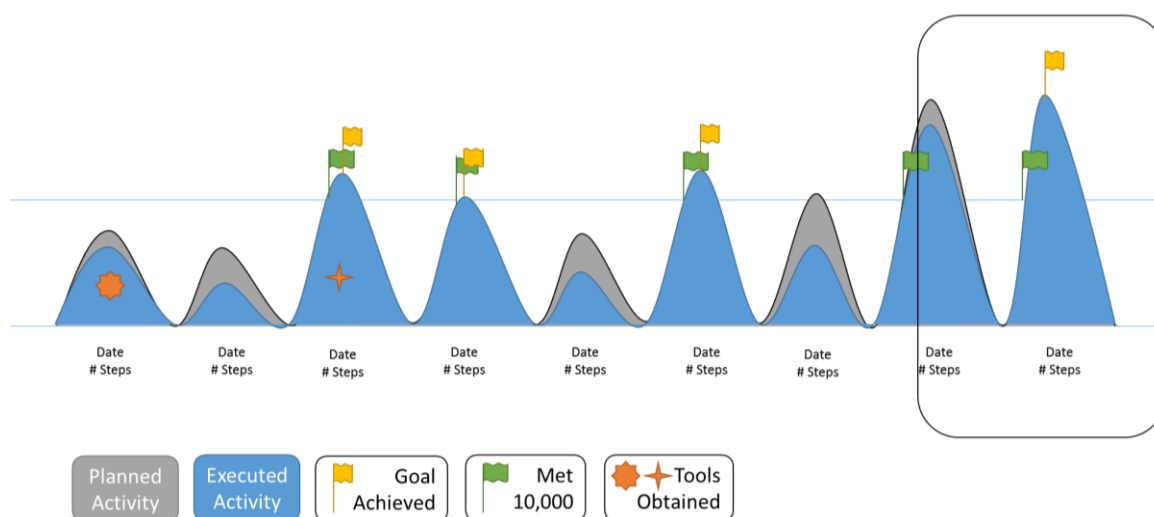
This app will control self-monitoring and logging allowing the system to continuously monitor specific predetermined parameters and at the same time, allowing the user to introduce their own data at any time. PRECIOUS offers several options for self-monitoring.

The PRECIOUS journey history view will act as a general self-monitoring platform in which all the user actions are displayed and success in the actions is reflected with a rising or falling line.

In the mountain app (Fig. 27), the users will see whether they reached their daily goal. They also have several other options for monitoring their progress:

- By zooming out, the users see a panorama of mountains: the past goals and the amount of steps they have taken each day with a line that indicates the average steps taken thus far.

- There are also options to compare one's achievements to physical activity guidelines, to friends activity, and to own activity in an earlier time period.
- A more detailed tool for physical activity self-monitoring is the action planning tool presented next. In the action planning tool the activities are planned in greater detail and the user will confirm that each activity was performed as planned.



**Figure 27** - Draft version of the mountain app screen for monitoring

#### 4.1.13. Physical activity - Action planning

The action planning app will support the execution of behavioural goals (e.g., chosen activity, which again helps the users to achieve their outcome goals). The system will present a time schedule for organizing the goals along the graphic hierarchy (from day-to-day or week-to-week). This app will also allow the users to prepare day routines (timetables) to achieve their outcome goals (Fig. 28).

Action planning consists of detailed when, where, how, or how often plans for each activity. Once the users click an option that takes them to action planning, the service will suggest the favorite activities that were stored in app identifying favourite modalities (see section 4.1.2. of present deliverable) and ask the user to first pick one activity, and the to choose a specific time and place for that activity. The user is offered a chance to use the action planning app every time they indicate a desire to initiate activity. They can also choose the action planning app directly from the tile menu.



**Figure 28** - Draft version of action planning screen

The action planning app needs to store:

- Which activity the user chose.
- The date and time of the activity, does it repeat every week.
- Does the user want a reminder before the activity and the content of the reminder (e.g. a reminder to pack sports equipment).
- The activity can be added to users' calendars if they use a matching electronic calendar.

For the users of the mountain goal setting app, a specific action planning tool will support the achievement of the daily goal. PRECIOUS will suggest the user their favorite activities or the activities that were performed the same time last week. As the users choose activities, they see how the mountain gets filled with the chosen activity. Their task is to pick activities as long as their daily mountain is full. For instance, the user may choose to take the bike for 30 minutes. After that, they see that they still need to fill in another activity, to reach their daily goal.

#### **4.1.14. Physical activity - Sustained motivation, continuous game play**

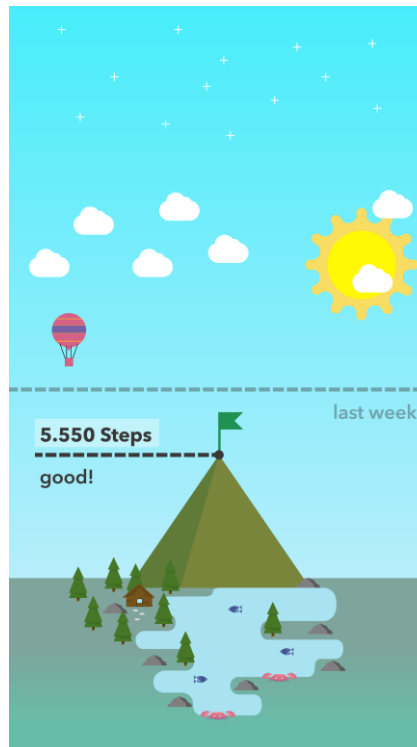
PRECIOUS contains several continuous gamified elements that will guide the user through the service and will offer repeated challenges to favour sustained interest and motivation.

##### **4.1.14.1. The Journey - the history view**

The most visible of the continuous game play elements is *The Journey*, the history view that displays all completed actions on a landscape view. All succeeded or failed activities will affect the history view.

##### **4.1.14.2. Mountain climber**

Another continuous gamified element is *The Mountain climber* self-monitoring tool. The longer the users use the tool, the more impressive panorama of mountains they generate. The mountains will differ visually based on their height: an especially active day will create a snow-topped mountain, whereas a low-activity day will only create a low hill (Fig. 29).



**Figure 29** - Draft version of *mountain climber* visualization

#### 4.1.14.3. Health-a-Gotchi

In the past there has been a very successful game called Tamagotchi, which positions the user in the role of being responsible for an avatar that needs to be taken care of (e.g., food-intake, sleep, entertainment etc.). This principle is transferred by *Health-a-Gotchi* to the domain of preventive health care. The avatar in the game is kept alive and physically and mentally in good shape whenever the player treats its body healthily (and diligently records the data). As in the original game, the avatar can even die or become very unhappy when it is not treated with the expected care. In our case, the system thus rather represents a mirror of the user's body where the consequences of unhealthy behaviour are exaggerated and visualised. Thus, this application provides useful gamified feedback to players while at the same time encouraging them to become more active to change their lives.

*Health-a-Gotchi* may comparable to Tamagotchi represent the avatar like a chick or may use a representation of the user (specifically designed filters using the front-facing camera of the smartphone or modifying an uploaded picture).

#### 4.1.14.4. Conquer the city

Third continuous game element in PRECIOUS is the *Conquer the city* app. This app uses GPS coordinates, coupled with the in-built Maps function on a user's smartphone, to create a competitive physical activity game. By circling a block, users are able to capture it. This shows up not only locally on the user's device, but also on the devices of all other PRECIOUS users. Other users can capture the block for themselves by circling it again on their own. *Conquer the City* also allows users to work in collaborative missions or team up. Achievements are rewarded with different badges, points and leaderboards (e.g. thresholds of square kilometers captured), Leaderboard is also based on occupation of squared meters of the users of *Conquer the city*. Healthcoins are distributed according to distance walked and land covered by the user. This app has been developed by University of Vienna, and is currently working in a beta version.

## 4.2. Diet-specific apps

After choosing diet as the behavior through which they wish to pursue their outcome goals, users will proceed into the diet-specific arm of the system.

### 4.2.1. Diet - Importance ruler

With the importance ruler app for diet, users are asked: "*On a scale of 1-10, how important is it to you to make a change to your diet?*" Users respond with a digit (see Fig. 30).



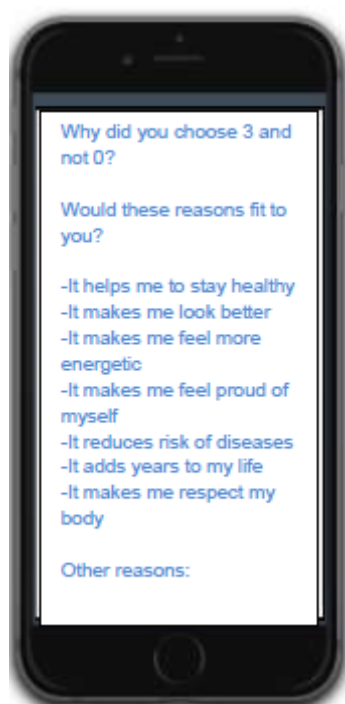
**Figure 30** – Draft version of diet importance ruler screen

Users are then asked “*Why did you chose [digit] and not a lower number?*” Multiple choice options can then be chosen from a list for eliciting change talk. The multiple choice options are populated from the user’s 5 top-ranked outcome goals.

If a high number (from 9 to 10) is selected, the system will display a congratulations message on the screen to reinforce the importance. If users choose 1 and 2 then they are asked what can help them to choose a higher digit; a scroll-down menu with several options is presented from the outcome goals the user chose earlier. In case no option is chosen, the system will offer the possibility to change the outcome goal or reorganize them (in case the users have selected various goals).

#### **4.2.2. Diet - Confidence ruler**

With app “confidence ruler for diet”, users are asked about their confidence in being able to choose a new approach to achieve a healthier diet on this specific week. They will be surveyed with a numeric scale (Fig. 31). Then, they will be asked what might make them more confident that they can carry out their chosen activities that specific week (multiple choice).



**Figure 31** – Draft version of confidence ruler for diet, second part screen (II)

The responses will then open additional tools (e.g. dietary challenges, messenger, problem solving tool).

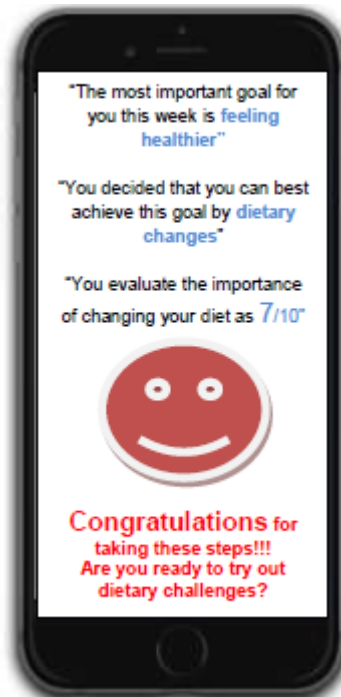
##### **4.2.2.1. Diet - Big feedback #1**

After the users have completed first motivational assessments (chosen the outcome goal, chosen diet as a mode to achieve the goal, indicated the importance of healthy diet to

them and chosen their first dietary challenges), PRECIOUS delivers a feedback message (Fig. 32). This message integrates all the choices and actions the user has taken, tailored to user inputs from previous apps. Many different messages are possible and these will be created for each possible case. Variables to be called here include:

- Active outcome goal
  - *“The most important goal for you this week is feeling healthier”*.
- Choose behavior/risk factor target
  - *“You decided that you can best achieve this goal by dietary changes”*.
- Importance of diet
  - *“You evaluate the importance of changing your diet as 7/10”*.
- *Congratulations for taking these steps. Are you ready to try out dietary challenges?*

The big feedback is based on motivational interviewing principles, such as mirroring, reflective feedback and summarizing users’ information. The message will be written in an empathetic and encouraging style, recognising all user efforts. Confirming the users that their responses have been heard and communicating it back to them aims to reinforce the relatedness with the service and clarify the user values and goals to themselves.



**Figure 32** – Draft version of example of big feedback#1 screen

#### **4.2.3. Diet - Identifying motivational status (stage of change)**

The big feedback ends with the question *“Are you ready to try out dietary challenges?”*. This is the point where the users indicate their stage of change. That is to say, how ready they are to move into action. The option *“I’m ready to try”* takes the user to the 3-day challenges. *“I feel I need to learn more about diet”* leads user to informational modules. *“I’d prefer to track my diet”* opens specially designed modules.

Users’ choices should be stored as “current stage - dietary approach”.



#### 4.2.4. Diet - Home page

In this mini-app, users are asked to choose which approach to managing their diet they would wish to pursue. These include:

- Easy-to-measure dietary behaviors.
- Learn about diet.
- Tracking tools.

All approaches offered will have the following information stored in the backend: Name of approach, photo icon, link to google result, text info blurb, partners for monetization (see Fig.33). Additionally, each approach will have the following associated fields based on user inputs:

- ☐ Is approach favorite?
- ☐ Is approach in Top 5?
- ☐ Is approach specifically linked to chosen reasons?

Then, if more than 5 approaches were selected, they are asked to narrow this down to a top-5. The system logs the number of favorited approaches.

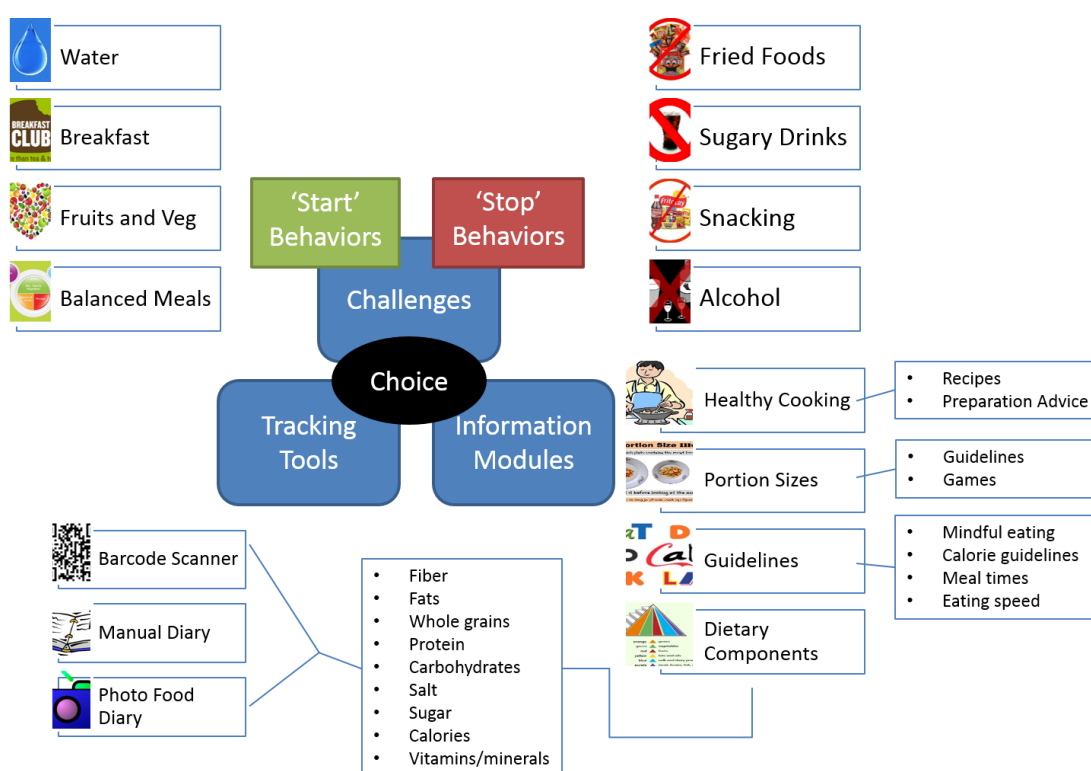


Figure 33 – Diet favourite modalities map

#### 4.2.5. Diet - Challenges

Dietary challenges will offer users the opportunity to change one small easy-to-measure component of their diet linked to improvements in risk factors. Each individual challenge will allow users to set a goal, plan toward achieving it, and monitor their daily progress. Successful completion of the challenges will also result in rewards of points and

badges (see Table 1). Before starting the challenge, individuals will receive 1-2 screens of information about the importance of each dietary component, which in some circumstances will be presented in a gamified way (e.g., separate healthy and unhealthy snacks as fast as possible).

**Table 1** – Diet challenges specifications - example text for the app

Behavior	Challenge	Description	Information
'Stop Behaviors'	Reducing unhealthy snacks	Often the snacks we first reach for are high in fat, sugar, salt and low in fibre, and we often eat more than we realise. The aim of this challenge is to reduce the number of unhealthy snacks you have in a day.	Snacking can be part of a healthy diet, provided it's in the right amounts and that you choose a healthy balance of foods and drinks. Snacks can especially play an important role at work and in our daily lives to help maintain energy levels, but it is important to understand if you're craving a snack because you're hungry or to overcome tiredness or boredom. Snacks can also be a great way to increase variety in the diet. It's not a good idea to consume too many foods high in saturated fat, salt and sugar like desserts, sugar-containing drinks, fried snacks, biscuits and cakes, as these are often energy dense and therefore can often if consumed in too large quantities cause weight gain and increase the risk of type 2 diabetes and cardiovascular disease. Instead, we would recommend you opt for foods high in fibre, starchy carbohydrates, fruit and vegetables. The aim of this challenge is to try and reduce the number of unhealthy snacks (don't forget your sugary drinks count) you have in a day. Some ideas could include; oatcakes, crackers, fruits, vegetable sticks, low fat yogurts, and nuts/ seeds are great snacks that you can enjoy at any time, but this isn't an extensive list so why not get inventive!
	Reducing sugary drinks	It's all too easy to reach for that sweet refreshing sugary drink, but frequent consumption of sugar-containing foods and drinks can increase risk of tooth decay. The aim of this challenge is to see if you can reduce the number of sugary drinks you consume each day.	Sugar adds flavour and sweetness to drinks, but frequent consumption of sugar-containing drinks can lead to overconsumption of calories, leading to weight gain and can increase the risk of tooth decay, especially if good dental hygiene is not practiced. Why not try diluting fruit juice with some sparkling water instead of having a sugar-sweetened soft drink, or trying a reduced/no sugar alternative?

	Reducing fried portions	<p>Foods that are fried, are high in fat, and therefore the overconsumption of these type of products can lead to an increase in weight and an increased risk of cardiovascular disease and type 2 diabetes.</p> <p>This challenge is aimed to help you track and reduce the number of fried portions you eat</p>	<p>Fast food is typically high in trans fat, saturated fat, sodium, and calories. And it also tends to be low in nutrients and almost totally lacking in fruits, vegetables, and fiber. The regular consumption of fried foods, can lead to an overconsumption of calories, fat and salt. This can have a significant effect on your health. The increase calorie fat intake can lead to an increase in weight along with an increase in cholesterol. These result in an increase in your risk of cardiovascular disease.</p> <p>Why not try this challenge, to try and reduce the number of fried portions you consume in a week? There are plenty of simple ways you can reduce the number of fried portions you have, whether is selecting an alternative product i.e. swapping that bag of crisps, to baked snacks, or using alternative preparation methods when cooking at home, for example why not try baking those fish goujons instead of deep fat frying them, or grilling those slices of bacon instead of frying them.</p>
	Reducing alcohol	<p>Alcohol can have many negative effects on your health and sleep quality, and over consumption can increase your risk of cardiovascular disease and type 2 diabetes.</p> <p>This challenge is aimed to help you track and reduce the alcoholic drinks you have.</p>	<p>After a long day, many of us like to unwind with a nice glass of something. But, over consumption of alcohol can have a bad effect on our health. Regularly drinking over the guidelines can lead to serious health problems, from liver damage to a greater risk of getting cancer or having a heart attack. On top of the effects it can have on your health, it's important to remember that alcohol contributes to your calorie intake and therefore overconsumption can lead to weight gain and further increase your risk of cardiovascular disease and type 2 diabetes. There are lots of simple ways you can reduce your alcohol drinks for example:</p> <ul style="list-style-type: none"> <li>• Stick to single measures and use sugar free drinks for mixers.</li> <li>• Switch from pints to half pints or bottles and opt for a smaller wine glass.</li> </ul>
	Reducing fast food meals	<p>Fast food is convenient but is often high in fat, sugar and salt. Overconsumption of takeaways can have several negative health effects and can lead to an increased risk of developing type 2 diabetes and cardiovascular disease.</p> <p>The aim of the app is to enable you to track and</p>	<p>These days with us all having busy schedules eating out is very tempting. It's estimated that the average person eats one in every six meals out of home. This means that the choices you make when eating out can potentially have a large role to play in your health. Of course there are some occasions when eating out is a special treat and an opportunity for some indulgent options but it is important to manage the frequency of these treats, and when you do go out for a treat it is important to make healthier choices.</p> <p>The aim of this challenge is to see if you can reduce the number of times you have a takeaway or eat out.</p>

		try and reduce the number of unhealthy takeaways you consume in a week or month.	Although it may seem difficult to eat healthily outside of the home, there are now many healthier options available. Restaurants and takeaways often have different portions sizes available so why don't you try choosing a smaller portion or avoid ordering fried sides and fizzy drinks. If you do fancy a fizzy drink why not select a diet version, or if your meal does not come with vegetables, why not ask to swap an element for some. Many food outlets now have the nutrition information available, so you could make use of this to choose options with fewer calories, saturated fat, salt or sugar. Why don't you use this challenge to see if you can reduce the number of takeaway meals you eat in a week or month?
'Start Behaviors'	Increasing water intake	Water is essential for life and it is very important to get the right amount to be healthy. The aim of this challenge is to easily track and increase your fluid intake, to ensure you meet the European recommendations.	Water is essential for life and it is very important to get the right amount to be healthy. Your body is made up of nearly two-thirds water and so it is really important that you consume enough to stay hydrated. The amount of fluid you need depends on many things including the weather, how much physical activity you do and your age, but European recommendations suggest 1.6L of fluid per day for women (about 8 200ml glasses) and 2L of fluid per day for men (about 10 200ml glasses). This is on top of the water provided by food you eat. There are many ways to increase your water intake including; drinking tap/sparkling water (try adding slices of fruit if you want to add flavour), drink tea and coffee (in moderation, don't forget they contain caffeine), milk (try skimmed or 1%), fruit juices and smoothies (but bear in mind these often have a high sugar content, so check the nutritional label) , soft drinks (remember they contain sugar, this adds to your calorie intake and potentially damage teeth). Alcoholic drinks do not count towards your daily water.
	Eating breakfast	Breakfast is a very important meal, to start the day. Skipping breakfast has been shown to increase the risk of developing type 2 diabetes. The aim of this challenge is to help you track having breakfast each morning.	Breakfast is a very important meal, to start the day. Skipping breakfast has been shown to increase the risk of developing type 2 diabetes. Breakfast is important as it allows you to top up your energy stores for the morning's activities and to help stop you snacking before lunch. Not only is it important to have breakfast, it is important to ensure it is healthy and balanced. Try to make sure you have at least one portion of whole grains, one portion of protein and at least one portion of fruit or vegetables.
	Increasing fruit and vegetables	We all know the importance of eating fruit and vegetables, but very few actually achieve the WHO's	We all know fruit and vegetables are an important part of our diet and they provide essential nutrients like fibre, vitamins and minerals. The World Health Organisation (WHO) recommends that a healthy diet contains: fruits, vegetables, legumes (e.g. lentils, beans), nuts and whole grains (e.g.

		recommendations. Why not use this challenge to track the number of portions you consume and see if you can challenge yourself to meet the WHO's recommendations.	unprocessed maize, millet, oats, wheat, brown rice). It recommends an average adult should consume at least 400 g (5 portions) of fruits and vegetables a day. Potatoes, sweet potatoes, cassava and other starchy roots are not classified as fruits or vegetables.. There are many ways you can increase your intake of fruit and vegetables including; why not try a new fruit of vegetable a week, add a handful of fresh or dried fruit to your breakfast cereal, add pureed vegetables to a sauce, or add grated carrot or courgette to a mince based dish.
	Eating balanced meals	No single food contains all the essential nutrients the body needs to be healthy. The nutritional value of y diet depends on the overall balance of foods that is eaten over a period of time and your individual needs. A healthy diet is likely to include a variety of foods, from each of the main food groups. The aim of this challenge is to help you compare the balance of your meals compared to the recommendations and your targets.	No single food contains all the essential nutrients the body needs to be healthy. The nutritional value of your diet depends on the overall balance of foods that is eaten over a period of time and your individual needs. A healthy diet is likely to include a variety of foods, from each of the main food groups; starchy foods (e.g. bread, potatoes, and rice), dairy products (e.g. milk and cheese), Meat and fish, fruit and vegetables and finally foods high in fat and/or sugar (e.g. cakes, sugary drinks and sweets). A healthy diet should provide us with the right amount of energy. This energy should come from a balance of the five food categories above. In the EU there is no one set of guidance. Each member state has their own guidance. Therefore to get the most out of this challenge you need to to input the recommendations of your member state. These can be found from a number of resources. If you do not want to input this information the challenge will base recommendations of EU reference intakes.

Sources: BNF15; WHO, 2015.

#### 4.2.6. Diet - Learning modules

##### 4.2.6.1. Content

**Table 2** – Diet information modules' descriptions

Information Module	Description
Dietary guidelines	<p>The aim of this learning module will be to educate the user about dietary guidelines set out by EU, with the aim of helping them understand how the dietary guidelines fit into their diet. The section will include tips on how to ensure they meet the dietary guidelines and the importance of adhering to the recommendations. The dietary guidelines referred to will be the reference intakes set out in EU FIC legislation and for the typical adult are as follows:</p> <p>Energy; 2000kcal Total Fat; 70g</p>

	<p>Saturates; 20g Protein ; 50g Carbohydrates; 260g Of which is sugars; 90g Salt; 5g</p> <p>The learning module would be followed by a short quiz which would allow the user to test their understanding. The user will be able to choose the level of difficulty of the learning module they select and repeat the module to improve their score in the quiz. The higher the difficulty and their score the more rewards the user will earn.</p> <p><b>Idea: in the laboratory study we had a nutritional knowledge task. In the task the player is asked to rank in order 5 food-attitude images at time (drag and drop function), from the one containing the least to the one containing the most sugar or other ingredients per 100g. Each nutritional knowledge task included 4 sub-tasks.</b></p> <p><b>The results indicated that a more positive user experience is associated with winning, positive rewards and competition with another non-located player. These findings will be integrated into the design of further mini-games to increase users' nutritional knowledge within PRECIOUS.</b></p> <p><b>For example, we could ask the player to rank in order several food-attitude images while competing with another player. The system should control the scores of the opponent so that the player wins (motivation) and receive positive feedback, regardless his/her performance.</b></p>
Portion sizes and balanced diet.	<p>The aim of this learning module will be for the user to learn about appropriate portion sizes and how they should balance their meals, to help the user manage their food intake and therefore reduce the risk of overconsumption. Finally the module will explain how foods often have guidance on their labelling to the recommended portion size by manufactures.</p> <p>The learning module would be followed by a short quiz which will include visual challenges to test the user understanding. The user will be able to choose the level of difficulty of the learning module they select and repeat the module to improve their score in the quiz. The higher the difficulty and their score the more rewards the user will earn.</p>
Specific dietary components: <b>energy</b>	<p>The aim of this module will be to educate the user about calories, the risks of overconsumption and the effect they can have on health, what the reference intake is and help them learn the about the calorie contents of foods. Finally the module will explain how they can use nutritional tables to help them identify low energy products. EU Reference Intake Energy; 2000kcal.</p> <p>The learning module would be followed by a short quiz which would allow the user to test their understanding. The user will be able to choose the level of difficulty of the learning module they select and repeat the module to improve their score in the quiz. The higher the difficulty and their score the more rewards the user will earn.</p>
Specific dietary components: <b>fibre</b> (whole grain choices)	<p>The aim of this module will be to educate the user about fibre; what it is, where it can be found, the health impacts of not consuming enough and the benefits of increasing more fibre. The module will also explain to the user about there being no reference intake, but provide information around different guidance.</p>

	<p>Finally the module will provide information of key sources and how the user could use nutritional tables to identify good sources.</p> <p>The learning module would be followed by a short quiz which would allow the user to test their understanding. The user will be able to choose the level of difficulty of the learning module they select and repeat the module to improve their score in the quiz. The higher the difficulty and their score the more rewards the user will earn.</p>
Specific dietary components: <b>fats</b> (good vs. bad)	<p>The aim of this module will be to educate the user about fats; what it is, the different types, where it can be found, the health impacts of consuming too much. The module will also explain to the user about the reference intake set out in EU FIC, and how they can use nutritional tables to identify good and bad sources of fat.</p> <p>EU Reference Intake Total Fat; 70g. EU Reference Intake saturates; 20g.</p> <p>The learning module would be followed by a short quiz which would allow the user to test their understanding. The user will be able to choose the level of difficulty of the learning module they select and repeat the module to improve their score in the quiz. The higher the difficulty and their score the more rewards the user will earn.</p>
Specific dietary components: <b>protein</b>	<p>The aim of this module will be to educate the user about protein; what it is, where it can be found, the role it plays in the body and the health impacts of not consuming enough, The module will also explain to the user about the reference intake set out in EU FIC and how the user could use nutritional tables to identify high protein sources.</p> <p>EU Reference Intake; 50g</p> <p>The learning module would be followed by a short quiz which would allow the user to test their understanding. The user will be able to choose the level of difficulty of the learning module they select and repeat the module to improve their score in the quiz. The higher the difficulty and their score the more rewards the user will earn.</p>
Specific dietary components: <b>carbohydrates</b>	<p>The aim of this module will be to educate the user about carbohydrates; what they are, the subcategories, where they can be found, their role in the body and the health impacts of consuming too much, with a particular focus on sugars. The module will also explain to the user about the reference intake set out in EU FIC, and how they can use nutritional tables to identify foods that are high in sugars.</p> <p>EU Reference Intake Carbohydrates; 260g EU Reference Intake sugars; 90g</p> <p>The learning module would be followed by a short quiz which would allow the user to test their understanding. The user will be able to choose the level of difficulty of the learning module they select and repeat the module to improve their score in the quiz. The higher the difficulty and their score the more rewards the user will earn.</p>

Specific dietary components: <b>salt</b>	<p>The aim of this module will be to educate the user about salt; what it is, where it can be found, the role it plays in the body and the health impacts of consuming too much, The module will also explain to the user about the reference intake set out in EU FIC and how the user could use nutritional tables to identify low salt foods.</p> <p>EU Reference Intake salt; 6g</p> <p>The learning module would be followed by a short quiz which would allow the user to test their understanding. The user will be able to choose the level of difficulty of the learning module they select and repeat the module to improve their score in the quiz. The higher the difficulty and their score the more rewards the user will earn.</p>
Specific dietary components: <b>vitamins and minerals</b>	<p>The aim of this module will be to educate the user about various key vitamins and minerals; what they are, where they can be found in food, the role they play in the body and the health impacts of consuming too much and not consuming enough, The module will also explain to the user about the reference intake set out in EU FIC and how the user could use nutritional tables to identify low salt foods.</p> <p>The learning module would be followed by a short quiz which would allow the user to test their understanding. The user will be able to choose the level of difficulty of the learning module they select and repeat the module to improve their score in the quiz. The higher the difficulty and their score the more rewards the user will earn.</p>
Healthy cooking: ways to best prepare food and healthy recipes	<p>The aim of this learning module will be for the user to learn about healthier ways to prepare foods, and new healthy recipes to increase the variety in their diet. This information will be provided through a series of information pages and links to other resources available. The user will earn a reward for completing the module and also repeatedly referring back to resources.</p>
Past success and looking forward	<p>This will prompt users to consider and think back to previous positive experiences with diet. Also, it is expected to foster motivation by creating a successful future scenario with positive outcomes regarding diet and related benefits for the user. This app is not intended to collect or call any variables but to reinforce motivation, efficacy and sense of mastery of the users.</p>

**Sources:** BNF15; EUreg; WHO, 2015.

#### 4.2.7. Diet - Tracking tools

Diet tracking in PRECIOUS is comprised of three main tools: 1) food intake monitoring system with digital image treatment algorithm for food intake recognition, 2) Food barcode scanner and 3) Manual input from the user. The following sections will describe each of these methods in detail.

##### 4.2.7.1. Food intake monitoring system

The PRECIOUS food intake monitoring system is based on sensors and machine-learning algorithms that track the user's food intake, store the nutritional information on the cloud and give feedback to the user with healthcare-related advices. The food intake



monitoring is enabled via a PRECIOUS application<sup>1</sup> through a number of different (and independent) methods. It is accessible through a dedicated button in the main screen of the application, as illustrated in Fig. 34. Firstly, the user can take a photo of the food and the system will try to detect and recognize the type and amount of food by applying digital image processing algorithm which can be done either on the smartphone or in the cloud. Alternatively, a barcode scanner has been integrated in the app, which will enable the nutritional information of the food to be more accurately evaluated by the user scanning the barcode with their smartphone and linking the barcode to an entry in a food database. Finally, the user can also choose to enter manually the name of the meal and amount of food and the app will consult a database to get the nutritional information. Another method is by tracking the user's context (specifically location) and apply data mining in order to search for the nearby restaurants and their menus and then suggest the user several options. Realisation of some of these methods in the PRECIOUS app are explained briefly in this section.



**Figure 34** – On the left, the PRECIOUS project Android application running on Samsung Galaxy gear smartwatch. In the right, the main screen of the application tested on the smartwatch.

#### **4.2.7.1.1. Digital image treatment algorithm for food intake recognition**

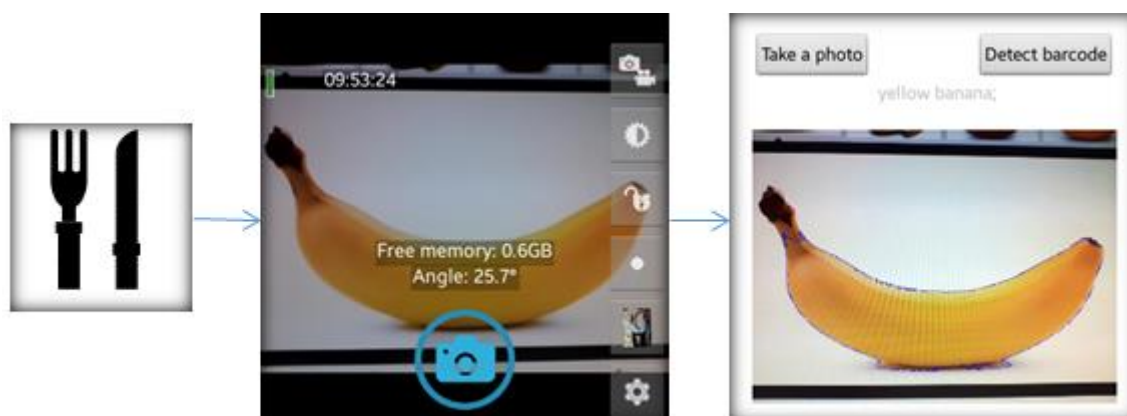
The food intake image recognition algorithm receives a photo from the smartphone's camera or a wearable device and then uses image processing to detect and recognize the food objects and their amount. The preliminary design of the algorithm is done in the smartphone and therefore the low processing power has been taken into account. Thus, the algorithm is based on low cost processing functions.

The first step of the image treatment is to ensure that the captured colour spectrum of the objects is the proper one and no artificial light has led to bad white balance; this is done by the automatic colour balance algorithm. Once colour balance is done, colour spectrum filtering is applied to the image in order to perform colour-based object segmentation. Thus, a

<sup>1</sup> Currently available only for Android devices.

colour mask is created for each colour which is used for the object detection. The object detection finds the contours of the mask and retrieves the object inside those contours. Once the object is detected, feature matching is applied in order to recognize the object. In order to ensure proper segmentation, the algorithm continues by applying object border detection and then the colour spectrum filter, object detection and object recognition are done. The operation is demonstrated in Fig. 35.

Once the food detection and recognition is done, the information is stored into the user's food diary and sent to the PRECIOUS server in order to retrieve the nutritional information from a food database.

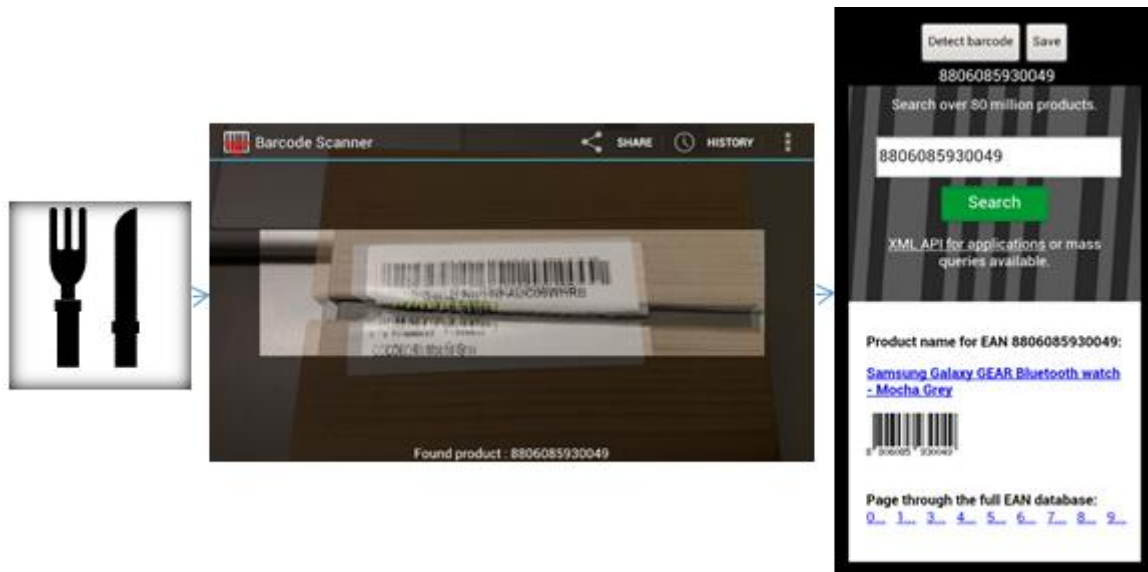


**Figure 35** – Demonstration of the image food detection operation on the Samsung Galaxy Gear smartwatch

#### 4.2.7.1.2. Food barcode scanner

The use of barcode scanners is a fast way for retrieving product information. The PRECIOUS app uses an open source barcode scanner API for obtaining the retrieving the barcode and looking up the name of the food product in a specific database, such as “barcode lookup” [BCLU15]. A demonstration is available on Fig. 36. Thereafter, the product name is sent to the PRECIOUS server and were another database is consulted to provide the nutritional information for the scanned food product linked to the scanned barcode.

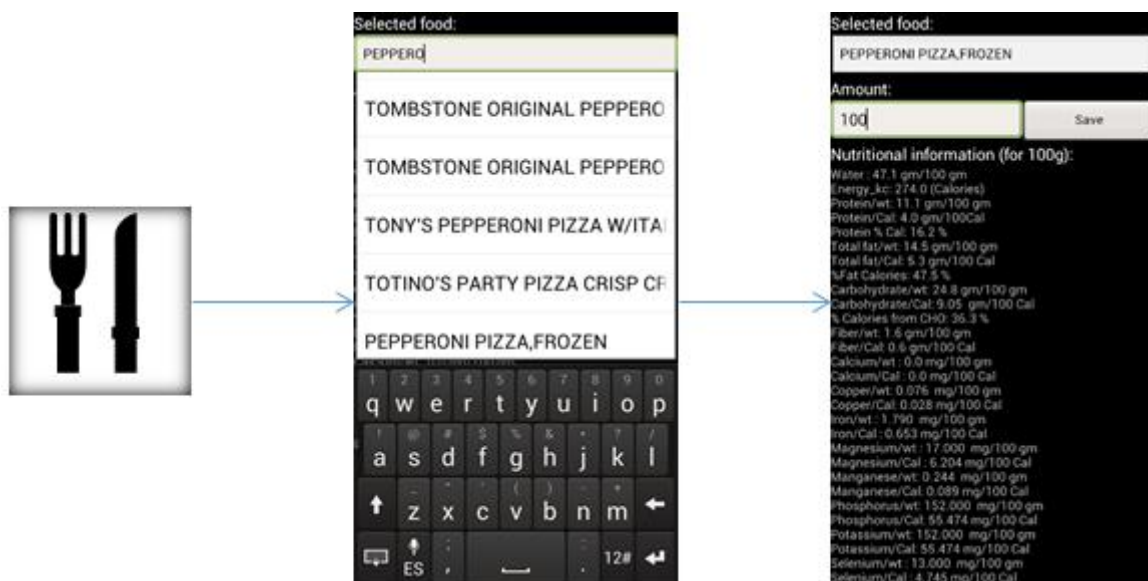
The drawbacks of this process is that, despite the nutritional information being highly accurate, the actual amount of food consumed by the user is not known and it needs to be entered manually.



**Figure 36** – Demonstration of the barcode scanner running on a smartphone (also compatible with the Samsung Galaxy Gear smartwatch)

#### 4.2.7.1.3. Manual input

Another way to store food intake information is to directly write the name and amount of food. The application will help the user by trying to autocomplete the name of the food by consulting the internal database and the available food intake information about the user, as shown in Fig.37.



**Figure 37** – Demonstration of the manual food intake input method running on a smartphone (also compatible with the Samsung Galaxy Gear smartwatch)

#### 4.2.7.1.4. Personal food diary

There is a need to keep the user motivated when using the food intake monitoring system and for that reason the feedback from the PRECIOUS server is very important, but it is not something immediate because the server needs several food intake input in order to

conclude if the user is consuming healthy foods and provide informed advice on which foods to be added (or reduced) from their diet.

Therefore, there is a need of another feature that motivates the user to use the system. A food diary allows the user to see what he or she has consumed over period of time. To that end, it is a way to provide a food consumption history and acknowledge his or her food intake trends. The food diary is a simple calendar where the data coming from all the food intake input method is presented to the user, preferably with attention grabbing visual depictions.

#### 4.2.8. Diet - Problem solving

Problem solving app provides users with the capability to link specific barriers to diet with specific solutions. In this sense:

- If a user's personal barrier is not listed, he/she should be able to add one.
- If the user has selected a specific barrier, but no viable solution is offered by the system, he/she should be able to add a new solution.
- The backend would therefore need to contain the following:
  - A list of specific barriers. Each barrier would have associated with it a number of possible solutions for the system to suggest.
  - A list of possible solutions.
  - A list of the specific barrier-solution links made by each user.

An example is displayed in Fig. 38.



**Figure 38** – Draft version of problem solving for diet screen

Another motivational tool of the PRECIOUS system will be called *Recipes* (Fig. 39). PRECIOUS will create a maximum autonomy supportive environment where users can fully

and transparently control how and why interventions are suggested, and subsequently manipulate these connections to their own desire. This aligns with the principles of PRECIOUS system based on providing choice, meaningful rationales and tailoring to users' capabilities. Users will be able to design "if-this-then-that" or "if-this-then-don't" rules in an easy and understandable way in order to connect their own behaviour to certain actions. In this way, users are able to create their own interventions to some extent. On the other hand, users can alter and modify rules of already existing interventions, for instance:

**IF** it is difficult to have a healthy breakfast because...

·I have no time

**THEN** I will still have a healthy breakfast if I...

·Plan my breakfast the night before ----- Change to: ·Go out and buy a healthy breakfast



**Figure 39** – Draft version of *Recipes* for diet screen

#### 4.2.9. Diet - Sustained motivation and continuous game play.

Similarly to physical activity achievements, all achievements related to the diet module are displayed in the history view *Journey*. This starts with the motivational assessments: every completed assessment will create a symbol on the history view, and the user timeline will appear higher than before. Success in dietary challenges will help the user to achieve a new level in the history view. On the other hand, if the service is not used or the chosen challenges not completed, user's' timeline starts to fall downwards. This is one of the gamified mechanisms that creates a continuous storyline to the service and visually transmits the

message that user should return to the service regularly and complete the actions they have chosen in order to move further in the history view and see new landscapes.

#### **4.2.9.1. Data report**

Users will receive a weekly report of the dietary challenges they have attended and achieved. Reports' periodicity can be always modified actively by users in PRECIOUS' settings.

### **4.3. Sleep - specific apps (FB)**

#### **4.3.1. Sleep data report**

This component will provide users with a basic overview of their sleep data, including depth of sleep, time spent asleep, nocturnal awakenings and other sleep-related variables presented in section 3.2.3 of deliverable 3.2. The report will highlight areas which are below average or could use improvement.

#### **4.3.2. Links to external apps**

This area of PRECIOUS will provide users with links to existing apps (e.g. SleepBot) that might help users improve the areas identified as problematic in the sleep data report.

### **4.4. Stress - specific apps (FB)**

#### **4.4.1. Stress data report**

This component will provide users with a basic overview of their stress data, including the stress-related variables presented in section 3.2.4 of deliverable 3.2. The report will highlight areas which are below average or could use improvement.

#### **4.4.2. Links to external apps**

This area of PRECIOUS will provide users with links to existing apps (e.g. Breathe2Relax) that might help users improve the areas identified as problematic in the stress data report.

## **5. Future work for the motivational service**

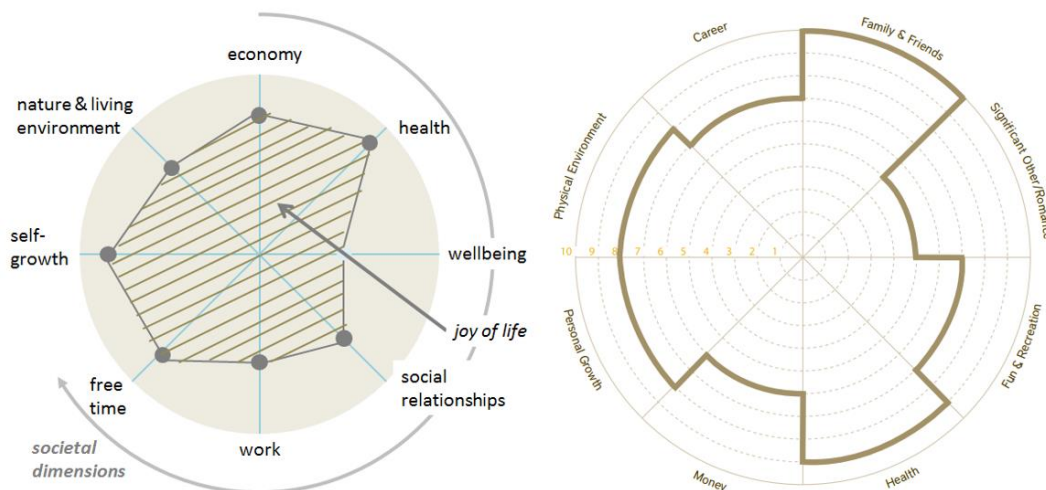
This SDD reflects main components, functionalities and specifications that the initial version of PRECIOUS service will offer to potential users. However, further improvements of the service will be needed and these will be implemented in the future; some of them are expected to emerge from planned field tests within PRECIOUS project lifespan. For instance, the integration of additional sensors, or a more efficient use of social networks taking advantage of their potentialities in terms of fostering motivation (e.g., favouring relatedness and social support). Next we will present some features and insights that have been considered during the development work and the feasibility studies and which may guide future work of PRECIOUS and similar initiatives.

In order to inspect the big picture behind behavioural change, let's consider Fig. 40, *The Wheel of Life*, where some of the various components of human life affecting to behavioural change are depicted. The magnitude of various components can be addressed



by self-evaluation, to start with, to get some overall impression of individual's life situation. Generally, it depends on culture and interpretation which factors are collected to the wheel. Based on individual assessment or other evaluations the wheel can estimate individual's current status in life that can potentially reveal factors not maybe earlier fully realized. These factors can be used to guide app service design and to address especially motivation setup and upkeep. We can assume that the bigger the area of "Joy" is in Fig. 40 the more fulfilling the respective individual's life could potentially be.

Referring to the construction of the wheel, one could postulate that the more independent the variables of the *Wheel of Life* are, the more features of individual's life are potentially considered and could thus be available for motivational service design. World Values Survey [ASEP/JDS] is an international, annual study mapping societal values based on interviews of individuals, country by country. This data could be used to construct some average, nation wide *Wheels of Life*. This data can also be mapped some different way. For instance, similarities of various cultures with respect of their cultural values is depicted in Fig. 41 by using self-organized map techniques.

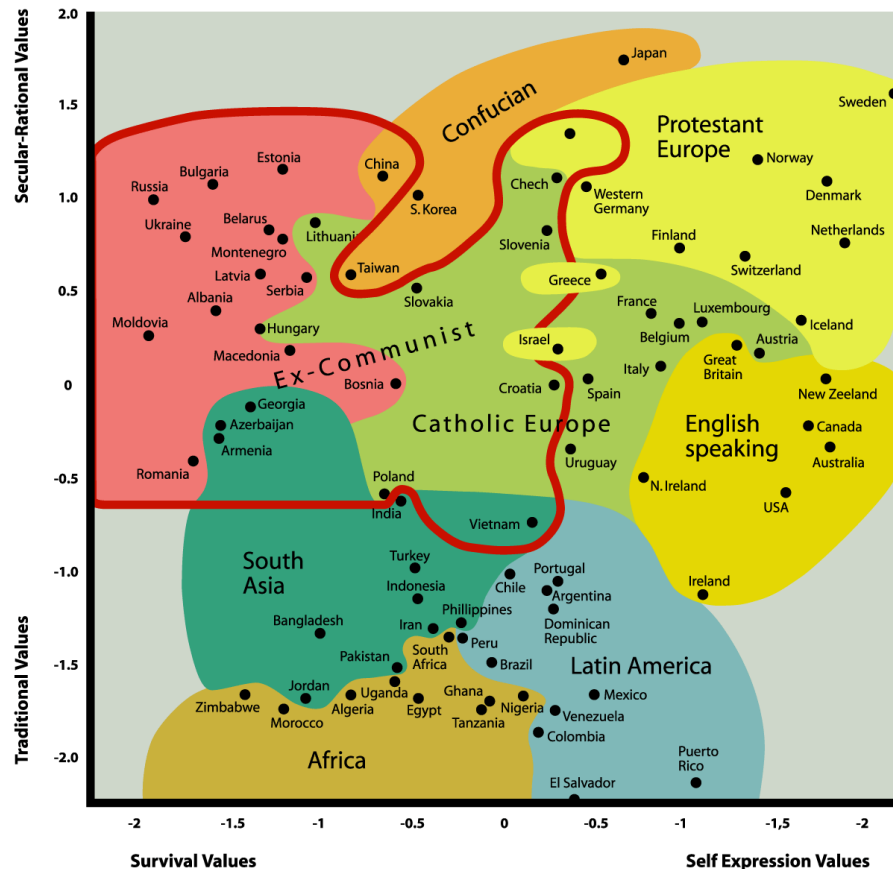


**Figure 40 - Wheel of Life [Coatches15].** Left frame shows a general idea and the right frame a tailored application

It can be speculated that if some individual can further develop and realize own and societal values a more connected or happier life could be obtained. However, happiness as such is not always considered as a purpose of life. Fulfillment of own personal role in life can also be considered by the concept of 'Joy'. 'Joy' is not only fun, but it covers fulfilling many kind of life potentials and elements in personal or communal life. For instance, mountain climbing can be scary and unpleasant from individual's certain perspective, but reaching some mountain top via a struggle is simply so pleasing that it overcomes the relating unpleasant aspects. Concept of "Joy" is in a way illusory because all the respective potentials of any human can't be most likely to be realized in practice. This issue is further discussed for instance by existentialism [Ext15] and authors such as Nietzsche, Kierkegaard, Dostoyevsky, Camus and Sartre.

The concept of Wheel of Life is anyhow an interesting starting point to inspect the utmost difficulty of addressing the challenging field of holistic health and wellbeing. It is trying to address the whole field of human life and relating entangled components of motivation that is obviously a very complex topic indeed. It is however important to note that all the factors depicted in the Wheel of Life connect to individual's motivation and decision making. The

various components of consciousness and physical realization of life make the “issue of good life” a demanding one because, for instance, various components of consciousness have their complex dependencies in individual’s biology, metabolism and in social factors and interactions.



**Figure 41** - Mapping various cultures based on their societal values [WVS04]

Additionally, within the rewards and gamification functionalities, future possibilities to include to the system are: **Karma coins** (non-redeemable and awarded for social activities), reputation levels (awarded for accumulation of karma coins and therefore measure, similar to activity levels, medium to long-term progress in terms of social aspects of the system), **health coins** (redeemable and awarded based on multiple factors), **experience levels** (awarded for accumulation of health coins and therefore, they are redeemable).

Moreover, all motivational feedback and features of the system will be revised and improved, when necessary, after initial testing (planned field tests within PRECIOUS) to ensure the optimisation of the motivational framework.

The development in sensing/monitoring of novel types of user contexts (in addition to location, activity etc.) are emerging within the Internet of Things (Everything) framework and Smart X paradigms (where X is home, city etc.). This includes contextual elements, such as, types of social environments (e.g., public, semi-public, familiar, online, etc.), proximity to other users, links to other devices, applications and so on. This enhanced contextual-awareness allows for better understanding of user's immediate context and the exploitation of the context information for further enhanced motivational service design.



## 6. Conclusions

This SDD covers two main objectives to be met for all of the user-facing apps within PRECIOUS: 1) To fully specify the functionality and core characteristics of user-facing content in each app, and 2) To indicate the rationale for each app, specifying how each component fits into the PRECIOUS motivational framework. Specific working mechanisms for each app are fully described in deliverable 3.2 *Final report on behavioral representation and virtual individual modeling*.

In summary, the physical activity apps, the diet challenges and learning modules, and the stress and sleep apps, aim to provide a nurturing environment, that encourages long-term behavioural changes through the use of gamification principles, a reward system and education. The underlying theoretical framework is based on motivational interviewing and self-determination theories and practical applications, as described in previous deliverables (see [D3.3 Interim motivational service design document-1.0](#)). This model will enable the users to see their progress in a dynamic and interactive manner which will motivate them to achieve more challenges and consequently, to reach their goals.

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## 8. Web resources

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- [Bridge1]  
<http://bridgedesign.com/7-pitfalls-to-avoid-in-mhealth-web-app-design/>
- [BCLU15]  
<https://www.barcodelookup.com/>
- [BNF15]  
<http://www.nutrition.org/uk/>
- [CVRC15]  
<http://cvdrisk.nhlbi.nih.gov/>  
<http://www.heartage.me/your-heart-age/you>
- [Coatches15]  
<http://www.thecoaches.com/docs/resources/toolkit/pdfs/18-Wheel-of-Life-Exercise.pdf>
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<https://en.wikipedia.org/wiki/Existentialism>
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 ANNEX XIII-REFERENCE INTAKES In; REGULATION (EU) No 1169/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL Of 25 October 2011 On The Provision Of Food Information To Consumers, Amending Regulations (EC) No 1924/2006 And (EC) No 1925/2006 Of The European Parliament And Of The Council, And Repealing Commission Directive 87/250/EEC, Council Directive 90/496/EEC, Commission Directive 1999/10/EC, Directive 2000/13/EC Of The European Parliament And Of The Council, Commission Directives 2002/67/EC And 2008/5/EC And Commission Regulation (EC) No 608/2004. 1st ed. Official Journal of the European Union, 2015. Web. 25 Oct. 2015. (<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX%3A32011R1169&from=en>)
- [SDD1] Example of a typical SDD: <https://doc.apsstandard.org/2.1/downloads/service-design-document-template.docx>
- [VF15]

<http://valuesandframes.org/>

[WA05]

[http://www.fsn.ie/uploads/standard\\_inner/wheel\\_addiction.jpg](http://www.fsn.ie/uploads/standard_inner/wheel_addiction.jpg)

[WVS04]

An Inglehart-Welzel Cultural Map of the World: World Secular-Rational and Self Expression Values as a map of world cultures based on World Values Survey data – survey wave 4, finalised 2004.

