The Health Machine: Mobile UX Design That Combines Information Design with Persuasion Design

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Abstract. The author's firm combined information design with persuasion design to design a mobile phone application intended to change people's behavior about diet and exercise. The objectives were to change people's behavior and to avoid obesity and diabetes. The paper describes the user-centered user-experience development.

Keywords: culture, design, development, diet, exercise, health, information, nutrition, persuasion, social networks, user interface, user experience.

1 Introduction

Obesity and resultant Type 2 diabetes are major health concerns in the United States of America (US) and throughout the world. For those people wishing to maintain or improve their health, currently existing health-oriented mobile-phone applications provide many usable, useful functions, including medicine-intake monitoring, pain management, weight loss programs, exercises tutoring, and health-indicators tracking (*e.g*., blood pressure and heart rate). According to the American Diabetes Association, a combination of exercises, healthier food, and weight control will be more effective to alleviate or prevent diabetes. Unfortunately, seldom do the applications combine many of these functions; they tend to be specialized. Above all, these products do not provide an overall "persuasion path" to change users' short-term and long-term behavior, leading to a healthier lifestyle.

2 The Health Machine Concept

Aaron Marcus and Associates, Inc. (AM+A) embarked on the conceptual design of a mobile-phone-based product, the Health Machine, intended to address this situation. The Health Machine's objective is to combine information design and visualization with persuasion design to help users achieve their health objectives, especially regarding obesity and diabetes by persuading them to adapt their lifestyle to include healthy eating and appropriate exercise. The Health Machine is intended especially for those people who have low income and less education, and thus may have less awareness, knowledge, and access to information about obesity and diabetes. AM+A intends,

through the useful, usable, and appealing mobile device application, that the targeted users can be motivated to successful regimens of weight control and exercise, and to learn about and maintain a healthier life-style in the long-term. The Health Machine aims to answer these two critical questions: How can information design/visualization present persuasive information to promote sustainable, short-term and long-term health-behavior change? How can mobile technology assist in presenting persuasive information and promote behavior change of low income and less educated people?

3   Personas

Personas/user profiles are characterizations of primary user types intended to capture essential details of their demographics, contexts of use, behaviors, motivations, and their impact on the design solution. For the Health Machine, AM+A defined these:

Persona 1: Alan Marx, 67, Owner, Small Business. Mr. Marx was diagnosed with Type 2 Diabetes at the age of 66 after being borderline diabetic for several years. The condition is a mixture of heredity, lack of sufficient exercise, and eating portions that are too large. His weight climb until in October 2009, it reached 238 lb. for someone 6'1" in height. After being diagnosed with diabetes, assigned the use of a glucose meter, "required" to attend five classes on diabetes and nutrition, and urged to lose weight and increase exercise, he embarked on a sudden, massive change in health maintenance. He was motivated by fear of death and desire to achieve a workable goal. He succeeded in losing 50 pounds (down to 188, three pounds from his target goal of 185) in three months by reducing his calorie intake to about 1500 calories, noting on paper his daily nutrients, and increasing his daily exercise: to one hour on a treadmill at 4 mph, 100 sit-ups, and variable weight-lifting (15-50 lb.) three times per week. Since his initial achievement, he has become tired of constant data entry, and his weight has drifted upwards. He seeks to keep his weight below 200 lb. He wants a mobile device that will be easier for him to monitor his nutrients, log his exercise and glucose readings, and visualize his data, which was not possible with his manually-entered data.

Persona 2: Anna White, 57, Head of single-parent, multi-generational family Anna White is an African-American grandmother with a grade-school education who has worked as a domestic most of her life. She now weighs about 200 lb and is five feet two inches. She heads a single-parent family taking care of two children and three grandchildren. She has been diagnosed with Type 2 diabetes but is not very well in-formed about her condition, its causes, and options available to her through a commu-nity medical care-center.

Persona 3: Manuel Jiminez, 70, Husband, Founder of a gardening and lawn-care service. Manuel Jiminez is a legal immigrant from Mexico who started a gardening and lawn-care service now mostly managed and run by his son. He suffers from Type 2 diabetes, weighs approximately 250 lb., and is five-feet, six inches tall. He finds he doesn't have time to do the exercise he needs to add to his daily schedule because of continuing work pressures to contribute to the family income.

4   Use Scenarios

Based on the user profiles cited and an interview with one actual person similar to Persona 1, AM+A determined use scenarios comprising the following tasks: Enter nutrient data with least effort, e.g., scanning food data labels, scanning restaurant offerings data labels, and going online to collect appropriate nutrient data.

- Review current and past data in table and chart modes, especially for new trends or for information that might change filters or goal targets for nutrition or exercise.
- Share data with other family, friends, physicians, groups, and "competitors."
- Read/react to communications about one's data, status, or trends.
- Compare one's own data with friends, with "stars" or heroes/heroines.
- Read/see information about proper food preparation, how to balance low fat and low salt content with good taste.
- Read/see exercise information, e.g., body positions for particular muscle groups.
- View future implications of current behavior.
- Read/see examples of equipment or food or restaurants that might be of interest.
- Upload/download photos relevant to progress as emotion/documentation markers.

5   Research

Comparison Study. Before undertaking conceptual and visual designs, AM+A first studied approximately 20 highly reviewed health iPhone applications. Screen comparison and customer review analysis, contributed to improvements of initial ideas for the Health Machine's detailed functions, data, information architecture (metaphors, mental model, and navigation) and look-and-feel (appearance and interaction). These iPhone applications [Marcus, 2011] are the following:

Diabetes-Related	Nutrition	iMuscle
Diabetes Log	Nutrition Menu	C25k Couch to 5K
Diabetes Planner and Carb Counter	Lose it!	
		Other Health
Diabetes Pilot	Exercise	BMP Calculator
Glucose Buddy	iFitness	Water your Body
Diabetes Helper 3.2	LiveStrong.com	Sleep Machine

Research Results. AM+A concluded that usable, useful, and appealing user-interface (UI) design must include incentives to lead to behavior change. Good, health-oriented mobile-phone applications should provide group comparisons, charts, illustrations, goals, competition, and/or step-by-step instructions to motivate people to change their behavior. The Health Machine needs to combine persuasion theory, provide better incentives, and motivate users' to achieve short-term and long-term behavior. Large, up-to-date databases are required. Users always demand large and searchable database, especially databases that are customizable. Customizable, flexible databases, by

which users and their network of family and friends can easily add more information, are critical as a factor in increasing usage and an inevitable competitive advantage. In addition, in comparison to traditional manual data-input methods, a multiple data-entry system including label scanning and database searching is required to facilitate users' data-input process. Also, the device must encourage and strengthen team-oriented behavior change. Based on studies of persuasion theory, we discovered that team-oriented social comparison is a superior incentive for behavior change. Co-operation and competition within and among teams can encourage people to exercise more and carry out better diet control. Virtual rewards (*e.g.*, "stars", new skins for blogs, *etc.*) and real financial rewards (one corporate study [Associated Press, 2010] showed $500 can make a significant difference) can both be provided as motivation incentives for teams.

Last but not least: the Health Machine should be fun to use. Well-designed games will serve as an additional appealing incentive to teach, to train, and to inform users about how to select meal combinations wisely, how to exercise efficiently and effectively, and other techniques of nutrition and exercise. Also, the Health Machine should allow users to share their experience with friends, family members and the world, primarily through Facebook, Twitter and blogs.

6 Persuasion Theory

Based on Fogg's persuasion theory [Fogg, B. J., and Eckles, D., 2007] to create behavioral change, we defined five key attributes for the application:

Increase frequency of using application

- Motivate changing some living habits: work out, food choices, weight control
- Teach how to change living habits
- Persuade users to change living habits (short-term change)
- Persuade users to change life-style (long-term change)

Motivation is a need, want, interest, or desire that propels someone in a certain direction. From the sociobiological perspective, people in general tend to maximize reproductive success and ensure the future of descendants. We apply this theory in the Health Machine by making people understand that every action has consequences on their health condition change and their future.

We also adapted Maslow's *A Theory of Human Motivation* [Maslow, 1943], which he based on his analysis of fundamental human needs:

- Safety/security need is met by visualizing the amount of food expense saved.
- Belonging/love need is expressed through friends/family and social sharing/support.
- Esteem need is satisfied by social comparisons that display weight control and exercise improvements, and by self-challenges that display goal accomplishment.
- Self-actualization need is fulfilled by being able to visualize progress of health indexes and moods, and by predicting the change of the users' future health.

6.1 Impact on Information Architecture

Increase Use Frequency. Games and rewards are the most common methods to increase use frequency. AM+A developed a prototype pet training game and a meal combo game. In terms of the rewards, users will be awarded by both virtual rewards (such as "star" nominations and new skins for blogs) and real money rewards. In addition, we chose social comparison as another incentive to increase use frequency. Users may form groups with families/friends and participate in competitions.

Increase Motivation. The users' future health condition prediction is understandably an important. By viewing their current health conditions and predicted future scenarios in the next 20-30 years, users will have a stronger impression and awareness. Because setting goals helps people to learn better and improves the relevance of feedback, the Health Machine asks users how much expense budget they want to save on healthier food, what calories/blood glucose level they want to achieve, and how much work-out they want to accomplish. Users receive suggested action plans to achieve each goal.   We also created 10 monthly challenges. The incentive of self-accomplishment will encourage users to achieve step-by-step changes that will generate long-term changes. Social interaction also has an important impact on behavior change. The Health machine leverages social networking and integrated features like those found in forums, Facebook, Twitter or blogs. Users can send notes or messages to their social groups and share ideas with other people. The social ties will serve as an additional incentive to motivate behavior change.

Improve Learning. To improve learning, the Health Machine integrates contextual tips to explain how to eat healthier and increase exercise, the complications associated with diabetes, and ways to cope with too hi/low glucose levels. Users can also update latest research articles and news about diabetes and obesity. We also seek to make the education process both informative and entertaining. Games are proposed to teach users how to choose the right proportion, amount, and type of food for each meal without boring them.

7   Information Architecture

The Health Machine's theoretical information architecture components, which appear in the accompanying figure are explained below.

My Condition. Provides timely information about food in order to enable the user to make healthy choices. The application will also assist in the recording of food nutrition consumption, such as calories, glucose, carbohydrates, *etc*., and making a record that can be of use to the patient as well as physicians, nurses, dieticians, and other healthcare service providers. Exercise is another crucial factor in the equation for controlling weight. To help patients with obesity and diabetes achieve and maintain a healthy body condition, the Health Machine supports the development of healthy exercise habits, training and teaching users with the appropriate means and amount, and enabling the integration of new activities into the user's lifestyle in a way that increases the probability of both short-term and long-term success.
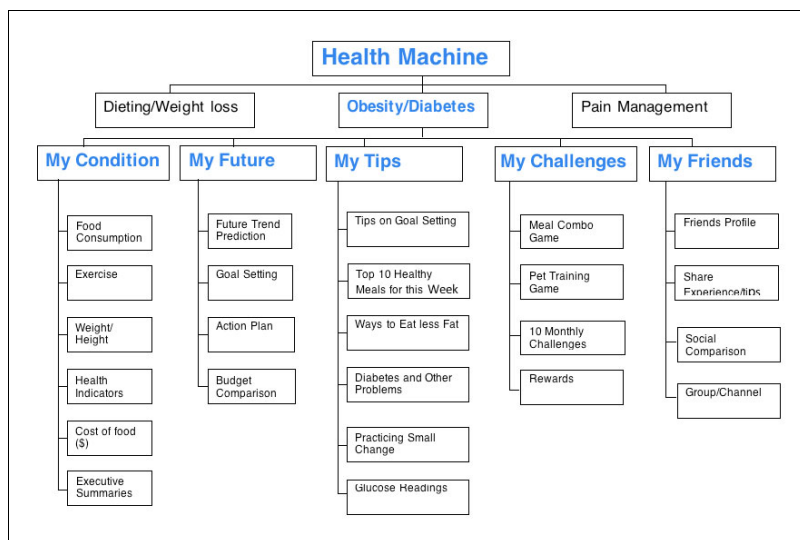
Fig. 1. Health Machine information architecture

Food Consumption. Records nutrition-components of food. Provides data-entry of information. Sums up the nutrition intake for each meal. Calculates and displays meal nutrition. Adds new food items to database and shares with other users. Provides ability to save selected food combinations for easy, efficient re-use.

Exercise. Records exercise type and duration. Sums up the energy consumption for each exercise activity**.** Outputs energy consumption. Adds new exercise items to database and shares with other users.

Weight/Height. Records weight/height data. Charts weight/height records and trends.

Health Matter indexes Monitoring. Because daily health-indexes monitoring is part of diabetes management, the Health Machine provides storing glucose readings. This enables the user to understand correlations between changes in diet and exercise and blood glucose levels. Users with diabetes also need to watch their heart rate and blood pressure. Users will be able to use the measures for setting goals and visualizing their process that may be of significance for their self-analysis purposes. The Health Machine also allows users to track their moods and associates them with their improvements of life-styles, a good incentive for behavior change. Compares the record with benchmarks and personal goals by table or chart display (*e.g.*, bar chart or line chart).

Food Cost. Records food expenses. Sums daily food expenses per meal components.

Health Thermometer. In the user-interface, the small health thermometer is always displayed at the top of the screen to show the user's current health condition summary. This display will be computed from a mixture of health factors that would be determined in consultation with a physician. This thermometer would be consulted as often as the user might monitor the mobile phone battery level or signal strength.

Executive Summaries. Sums up daily total calories, glucose levels, and blood pressure. Diabetes literature emphasizes testing glucose several times per day and at different times. Many people test glucose once per day, *e.g.,* in the morning before breakfast. Because exercise will reduce calories, and change glucose level and blood pressure, advanced Health-Machine functions might be able to calculate the calorie/glucose/BP levels in order to spare users having to do multiple tests every day. Outputs daily records.

My Future. Users will first view their current health scenario in a chart format. The chart illustrates users' current estimates based on current behavior: risk of heart attack, stroke, and diabetes in the next 20-30 years. Viewing these charts, users will have a visual impression of their health condition and the severity of their obesity and/or diabetes challenges. By changing the goal setting factors (weight, blood pressure, glucose, cholesterol level, *etc.*), users will view their different health scenarios in the future and thus decide the appropriate health indexes they would like to pursue and maintain. These series of health matter indexes or indicators will then be set as the users long-term goals. In accordance with the goals, suggested action plans will be provided. Users can customize their action plans, and then set them as their short-term plans. In this way, the users are expected to reach their long-term health goals though achieving the detailed action plans step-by-step. Their future health scenario will also serve as a critical incentive for them to keep going to achieve their longer-term goals.

Current Health Condition. Generates reports. Displays users' risk of having heart attack, stroke, hemiplegic paralysis, stupefaction, *etc.* Current data can be displayed by text, table, chart, visual image, map, or diagram, as appropriate.

Goal Setting. Offers a means for setting diabetes management goals. Set monthly health factors goals, such as weight, blood pressure, glucose, and cholesterol levels. Predict future heath condition change under different goals settings.

Action Plan. Generates recommended daily and weekly action plans based on monthly goals. Allows users to customize action plans.

Budget Comparison. Enables weekly food expense budget setting. Compares actual food expense with budget. Demonstrates cost savings for users with diet management and control.

My Tips. Provides tips on personal goal settings. Provides recommendations on healthy meals everyday. Updates tips through the Internet. Informs user about knowledge of complicating diseases resulting from obesity and diabetes. Provides tips about how to eat less fat. Provides advice how to increase exercise with little change in daily life. Top 10 Healthy Meals this Week synchs with mobile phone Website (or major diabetes/obesity research Websites). Updates top 10 healthy meals weekly. Ways to eat less Fat. Updates research articles on healthful, delicious diets and healthful cooking and eating styles. Diabetes and other Problems provides articles about diabetes and its complications. Practicing Small Changes provides tips about ways to increase exercise while incurring minor change in daily life. Glucose Readings provides articles about symptoms of low/high glucose levels and ways to deal with such conditions.

My Challenges. Apart from the tips, educates users through entertainment and games. For example, the Health Machine can offer games that can teach users to decide the right proportion and combination of food for their meals. In addition, a pet-training game could be designed for some users to have a better understanding of self-health management: how they treat a virtual "pet" reflects how they treat themselves. The 10 Monthly Challenges allows users to challenge themselves to achieve a series of behavior-changing goals. By accomplishing each of the challenges, users are expected to pursue short-term behavior adaptations and later form and maintain healthier life-styles. Virtual and real rewards would be provided to users, associated with winning games, competitions, and challenges. Users could share their reward information with their social groups, and gain more support from family, friends, and others. The Meal combo game teaches users to select wisely healthy food or food combinations for breakfast, lunch, dinner, and snacks. When players choose a healthier food, they will be rewarded a higher mark. They may also earn extra scores from healthy food combinations. Some people even give more care to their pets than to themselves. The virtual "pet" training idea is to track the exercise and food intake of the users and demonstrate the results in terms of how they treat their pets. Users will learn to behave healthier as they notice the change of the pet's mood and health condition. The pet will also send tips and notes to the users, and persuade them to eat healthier food and take more exercises.

My Friends. Adoption of a new, healthier lifestyle is best accomplished with the help of a support group. To encourage users to change behavior, the Health Machine would allow users to tap into social networks. Co-operation/competition within and among group members will serve as a strong social factor to motivate users' behavior change. Moreover, interactions can also consist of information-sharing among selected individuals through Facebook, Twitter, blogs, and other social media.

Friends Profile. Establishes friends profile database, and allows the participation of family members, friends, and celebrities.

Social Comparison. Enables individual comparisons on diet control, weight control, and exercise amount with friends, stars, people from other cities and countries, etc. Enables group competition. Friends and family members can form different groups and hold weight lost or exercise competitions. Users are expected to receive encouragements from group members and incentives to beat other teams.

Share Experience/tips. Users would be able to obtain more support from their social groups. For example: people having obesity or Type 2 diabetes problems can form social support groups to share experiences and advice with each other.

Group/Channel. Users can watch health, exercise, cooking, and food channels through their mobile phones to learn other related information.

8   Initial Sketches, Evaluation, Redesign, and Next Steps

Based on the information architecture, AM+A prepared initial sketches of key screens, which, together with a questionnaire, were intended to elicit feedback from

potential users including healthcare trainers. AM+A planned to interview six people (two per persona) and two healthcare providers who train people who have been diagnosed recently with Type 2 diabetes. The survey for trainers appears in [Marcus, 2011]. Because of legal regulations related to official healthcare providers, it was possible to interview only one patient and one skilled trainer of patients. AM+A interviewed a Registered Clinical Dietician (RCD) from a major healthcare organization serving a wide demographic community in northern California. She provides training to obese and diabetic patients. Her detailed comments [Marcus, 2011] in particular,
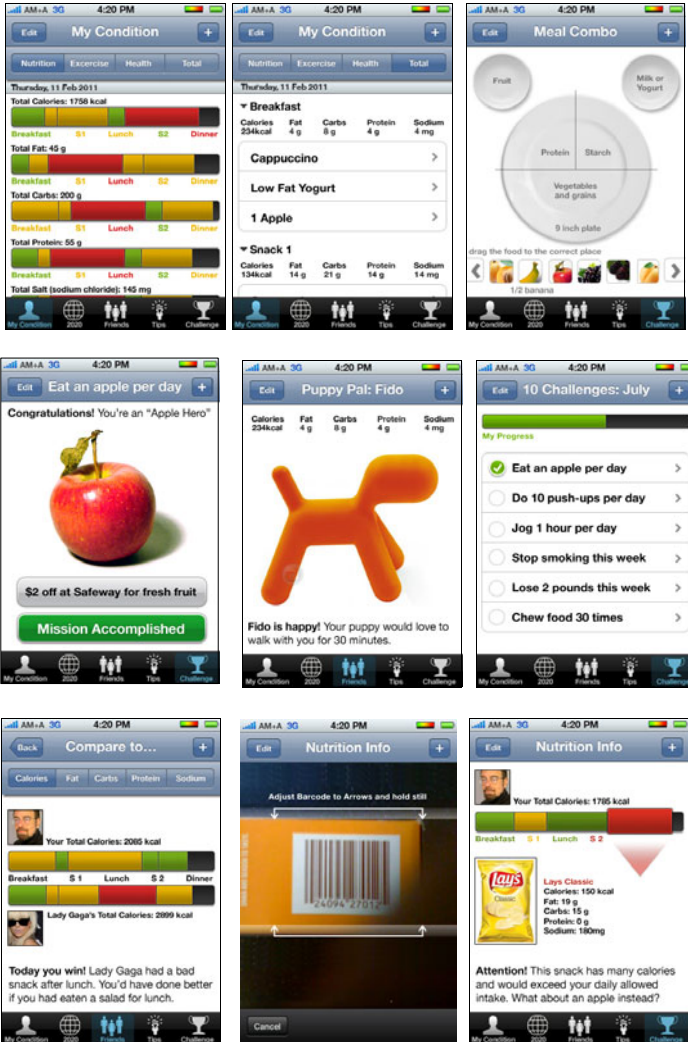

Fig. 2. Key Revised Screens

provided informally and anonymously, helped to drive changes in the screen designs. Based on the limited feedback, AM+A made minor changes in the information architecture, removing one item under My Condition. With regard to screen designs, AM+A made the controls more consistent with the platform guidelines (iPhone), and improved the simplicity of the text and imagery, in response to the nutritionist's specific comments. The accompanying figures display key screens.

Based on the user-centered design process described above, AM+A plans to continue improving the Health Machine. Tasks include: revise target personas and use scenarios; conduct multi-cultural evaluations; revise information architecture plus look and feel; and build initial working prototype. Future use scenarios will include desktop Website access in addition to mobile access to install or edit data.

9 Conclusions

The self-funded Health Machine project is a work in progress. AM+A has shared its approach and lessons learned. If the Health Machine approach is proven to be correct, it could have significant benefit for people in the US and elsewhere. AM+A is seeking to persuade other design, education, and medical groups to consider similar development. This incremental product development process has already been demonstrated successfully with a previous project, the Green Machine [Marcus and Jean, 2009], versions of which were taken up by a by major corporation for commercial development.

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