Stress-Mentor: Linking Gamification and Behavior Change Theory in a Stress Management Application

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Abstract. Gamification is widely accepted in mobile health applications as one way to enhance user experience. Moreover, linking gamification with insights from behavior change theory offers a promising approach to ensure user's adherence and long-term behavior change. Gamification is, however, hardly found in current stress management applications. To close this gap in research, we present Stress-Mentor, a stress management app that realizes established behavior change techniques within an extensive gamification framework.

The main gamification elements of Stress-Mentor are an avatar, an agent, the accomplishment of regular tasks, experience points, virtual currency, and badges. These features are activated consecutively to keep the user interested. Each gamification element is linked with several behavior change techniques. The regular tasks teach a broad range of proven stress management techniques.

Stress-Mentor's usage duration is limited by design to ensure the user's autonomy. After the three month usage period, users should be able to apply the stress management methods in their daily life without the app. The presented gamification concept can be easily adapted for other applications to support mental and physical health.

Keywords: Gamification · Mobile health · Behavior change

1 Introduction

The effective combination of insights from behavior theory and gamification in mobile health systems is a promising approach in order to ensure users' adherence and long-term behavior change. Recent reviews of stress management applications (apps) show, however, that the use of evidence-based content from behavior theory strongly varies across apps [1–4] and that gamification is even less often applied [5].

2 Stress-Mentor

To fill this gap, we designed and implemented a novel stress management application, named Stress-Mentor. It realizes effective behavior change techniques from psychological interventions using an extensive gamification framework. The respective behavior

change methods are based on an established taxonomy [6]. They are highlighted within the text by quotation marks. Stress-Mentor's most distinctive characteristics are limited usage duration by design and the following tiered gamification methods to keep the user interested (Fig. 1).
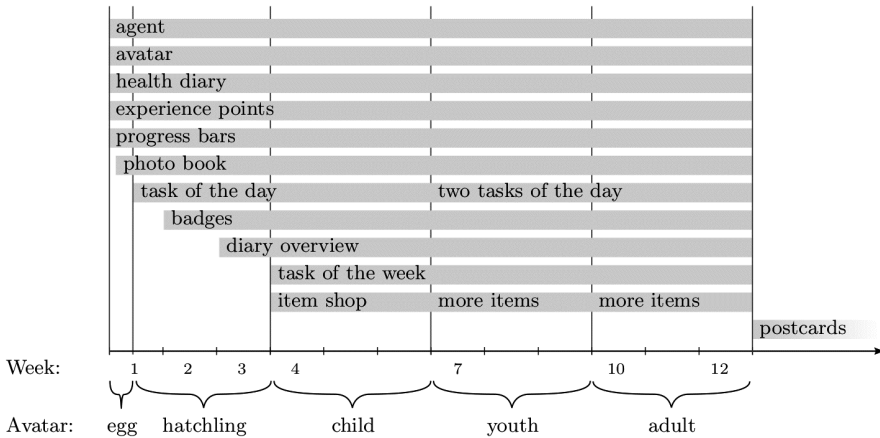

Fig. 1. Timeline of gamification methods in Stress-Mentor.

2.1 Avatar

The avatar, a bird-like cartoon animal residing in a forest scene, is used for vicarious reinforcement. Vicarious reinforcement describes the behavioral effects of observing and interpreting the rewards and punishments experienced by others [7]. To realize this powerful finding from social cognitive theory, the avatar's appearance is linked to a health diary. In this diary the user enters stress-relevant behaviors (sleep, nutrition, and exercise), well-being (subjective stress level, emotional state), and the occurrence of positive and negative events (daily hassles and social uplifts) in the past 24 h. Each diary category has an impact on the avatar's appearance depending on the last seven entries (e.g. less stress leads to a fuller plumage) to "provide information about consequences". The avatar's overall condition mirrors to what extent the health recommendations in the diary were followed during the past week ("provide contingent rewards"). This approach has been shown to support continuous usage behavior over a four week interval, compared to a control condition with a static avatar (see [8] for details). Moreover, the avatar's size mirrors the progress within the app ("provide feedback on performance").

In addition to this indirect feedback, direct feedback based on current health recommendations [9–12] is given through a color scheme analogous to traffic light colors, while the user is entering the data and in an overview diagram [13]. The avatar's size provides feedback regarding the user's progress within the app. To track the avatar's development and to counteract change blindness, the user is given the opportunity to make photos of the avatar (photo book, Fig. 2, left) and to share these photos with friends ("provide opportunities for social comparison").

2.2 Agent

The agent, a wise owl, serves as the user's mentor. It instructs the app usage and introduces new app features ("provide instruction"). It also "provides general information" about stress management and about the "consequences of behavior change" in form of short tips (Fig. 2, right). These tips also target "social support", "time management", and the "identification of barriers" (e.g. "It is important to identify barriers in our daily life which prevent us from reaching our goals. When you are aware of them you can include them in your plans"). It also shows encouraging quotations from prominent figures (e.g. "Success is falling nine times and getting up ten" by Jon Bon Jovi.) to "provide general encouragement". Moreover, at the very first start of the app, the agent entrusts the care of the avatar to the user, who in order to raise the avatar and prepare it for its future life, needs to fulfill the tasks given in the application ("agree behavioral contract"). The owl's daily reminders to complete the tasks and to fill out the stress-diary help to "prompt daily practice" and to "prompt self-monitoring behavior".
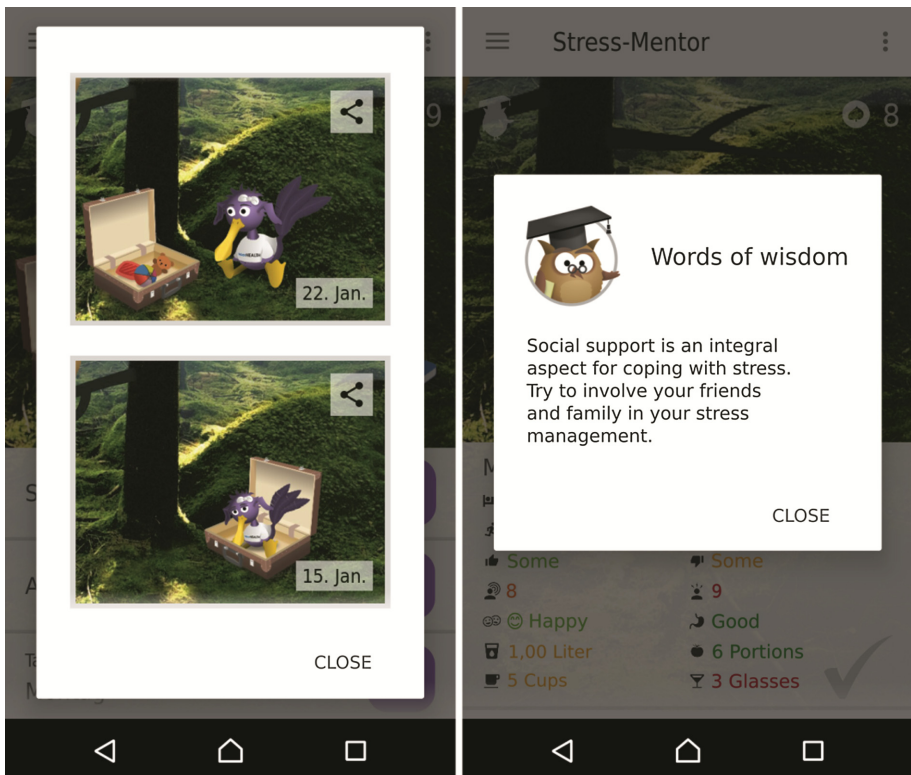

Fig. 2. Left: Example of the photobook to track the avatar's development. Right: The "wise owl" providing general information about stress management.

2.3   Task of Day/Week

In order to progress in the app and raise the avatar, the user has to complete a certain number of tasks which teach proven stress management strategies. These tasks vary from relaxation methods (e.g. breathing exercises, meditation) to tasks to support establishing priorities, learning to accept help from others and refuting irrational ideas. The corresponding behavior change techniques are described in Table 1.

Table 1. List of behavior change techniques according to [6] and how they are realized within the tasks of the day/week.

Behavior change technique	Realization within the tasks of the day/week
Provide general information	Health information for every diary category, e.g. how much caffeine should be consummated at the most
Information about consequences	Information about stress is linked to nutrition, regular exercise, emotions and the appraisal of events
Prompt intention formation	Every day the user can chose 1 task out of 3 which he or she wants to accomplish today
General encouragement	Praise at the end of the tasks
Set graded tasks	Task difficulty increases within the different categories, e.g. relaxation exercises start with detailed audio instructions, followed by shortened audio versions and expert versions with text instructions. By completing the easy tasks more difficult tasks will be available in future sessions
Provide instruction	Multiple types of instruction are used: text, audio files, multiple choice quizzes, and photos
Stress management	Task categories comprise relaxation methods, time management, revealing and refuting irrational ideas, assertiveness training, planning social support, general knowledge about stress management, euthymic methods, and physical tasks for muscle relaxation and stress relief
Model or demonstrate behavior	Physical exercises are demonstrated with different photographs, explaining each step in detail
Provide feedback on performance	The user's knowledge about stress management, irrational ideas and health is tested in quiz tasks with direct appraisal
Teach to use prompts	Embedded in the tasks for time management and relaxation, e.g. short breathing exercises can be performed each time before answering the phone
Prompt practice	Reminders to complete the tasks of the day and tasks of the week
Plan social support/social change	Separate task category, e.g. the user is asked to integrate help from friends and family in his daily life
Prompt self-talk	Used within some relaxation exercises
Relapse prevention	Separate task category, e.g. the user is asked to develop a plan in case symptoms are becoming extremely severe
Time management and prompt barrier identification	Separate task category which teaches effective planning and to set priorities

First the user is offered a selection of three stress management exercises per day ("tasks of the day"). These exercises are chosen based on the user's mental and physical symptoms, which are queried weekly. As the user progresses, a second "task of the day" and tasks spanning up to seven days ("task of the week") can be completed to support further practice.

2.4 Visualization of Progress

Each finished task rewards the user with experience points and virtual currency, which can later be exchanged for virtual items in a shop. These items are thematically fitting to the topic of preparing the avatar for its future life, such as a soft blanket, a calendar, or books. They support the visualization of the user's progress by being placed in a suitcase next to the avatar (see Fig. 3, left).
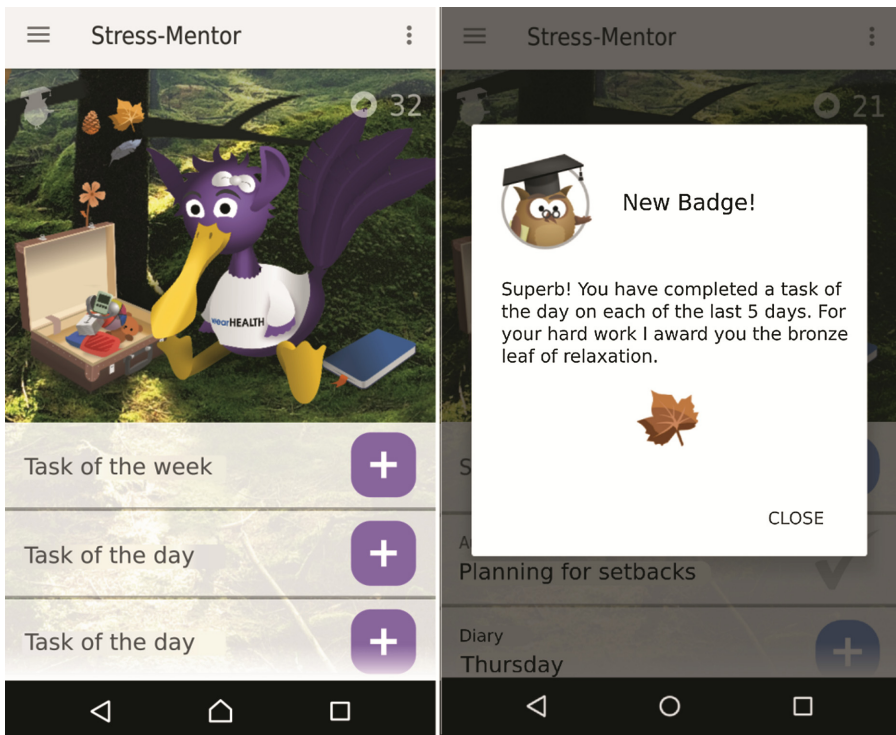

Fig. 3. Left: Screenshot of Stress-Mentor, showing the avatar and the suitcase, filled with virtual items. The badges are placed on the tree-trunk. The experience points are displayed on the right upper corner. Right: The wise owl hands a new badge to the user, who has completed the tasks of the day on a regular basis.

Besides progress bars, another visualization of progress and reward is implemented through badges. Badges can be earned by e.g., consistently keeping the diary and following the health recommendations (see Fig. 3, right).

The aspect of discovery is realized through several methods that are distributed throughout the app (e.g., after reaching a new level the avatar grows, discounts on items in the shop, opportunity for taking photos is not fully predictable). Generating unpredictability in this manner is expected to encourage the user to return.

After finishing the designated usage period, the avatar leaves, symbolizing freedom and autonomy. The user receives postcards from the avatar on a regular basis to "provide follow-up prompts".

3   Outlook

The presented gamification concept can be easily adapted for other applications to support mental and physical health. The behavior change techniques which are associated with the agent, the avatar, the photo book, the experience points, the acquisition of items for the avatar and the badges are not restricted to the stress management context and are therefore useful for a broad range of intervention technologies. The "task of the day" and "task of the week" features offer a universal tool to teach skills and knowledge in mobile health, as their content can be adapted to the respective context. In future studies, we will investigate the effects of this gamification concept on users' intention to use Stress-Mentor and actual usage behavior.

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