Learning healthy habits with a mobile self-intervention

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ABSTRACT
Health interventions aim to influence behavior by creating healthy habits that substitute existing unhealthy ones. Habits are often deeply ingrained but also easily disrupted in new situations. This makes the changing of habits a life-long learning and adaptation process rather than a one-time task with limited duration. Therefore, modern understanding of learning may be applied in designing effective and sustainable health interventions. We have designed the "Mindless Change" mobile intervention based on a framework of modern learning theories. The self-intervention guides the user in a habit formation through small daily changes, supported by a user selectable simple cartoon type of avatar with varied dialogue. We conducted a four-week pilot study with 66 participants to assess the feasibility of our intervention and especially the contribution of the avatar. Users found the self-intervention intuitive and easy to use but the attrition remained a challenge in this open pilot where participants were not provided any external motivation, support or incentives to start and continue using the service. The results suggest that even a simple non-anthropomorphic support avatar can be beneficial for the health intervention, which encourages us to investigate the concept further.

Categories and Subject Descriptors
J.3 [**Computer applications**]: Life and medical science – *health;* J.4 [**Computer applications**]: Social and behavioral sciences – *psychology, sociology*; K.3.1 [**Computing Milieux**]: Computer Uses in Education – *Collaborative learning, distance learning*.

General Terms
Design; Experimentation; Human Factors, Theory

Keywords
Mobile intervention design; learning theories; dialogue support; pilot test; habit change; behavior change.

1. INTRODUCTION
Our everyday choices greatly affect our health. Most of our health related behaviors such as diet, physical activity, sleep and use of substances are more determined by ingrained habits rather than conscious decisions, and health interventions should hence target a habit change [24]. In order to change their behavior, people need to understand the reasons for the change, be sufficiently motivated to do it, acquire required behavioral skills to overcome barriers and have the ability to adapt to different circumstances in order to maintain the change. In essence, habit changes are a lifetime learning process. Although the mobile health research field is vibrant and lots of applications have been developed [15, 10], there are few success stories in the field [7]. A large part of eHealth intervention studies suffer from low adherence to the program [14], and many interventions are based on ad-hoc design without a solid theoretical background [19]. Even the behavioral and motivational theories based interventions sometimes fail to transform theories into practical design or the applicability is limited by the amount of empirical data [9]. Furthermore, a learning-oriented framework for health intervention design seems to be still missing.

Some design guidelines and frameworks have been developed for technology-based interventions. Consolvo et al. propose eight strategies for designing technologies for lifestyle change: technologies should be abstract and reflective, unobtrusive, public, aesthetic, positive, controllable, trending/historical, and comprehensive [2]. The strategies are based on behavioral and social psychological theories and their own empirical work. From the learning theory point of view, the reflection can be considered to be in the very center of modern view of learning. Also the emotional aspects (aesthetic, positive) are very important in an effective learning process. The persuasive systems design (PSD) model is a design framework proposed by Oinas-Kukkonen and Harjumaa [18], aimed for designing and evaluating persuasive systems. It presents ways to analyze the persuasion context (the intent, the event, and the strategy). The model's design principles are divided into primary task, dialogue, system credibility, and social support categories. The active dialog and social connections are also in very essence of modern learning. Sundar et al. present a theoretical framework for preventive health applications mainly based on Self-Determination Theory (SDT) [22]. They map the three main constructs of SDT to user interface design in a straightforward manner: competence to navigability, relatedness to interactivity, and autonomy to customization. However, these properties of UI-design are utilized in good applications even

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without the help of this theory. In this case, the SDT principles have been applied in a rather trivial manner. Müller et al. compare the approaches of persuasion and reflective learning [16]. Both approaches utilize feedback loops to trigger behavioral changes. However, merely seeing past behavior does not trigger reflection, which is an active and mindful process.

Human avatars are widely used feature in technological health interventions [1]. They are often implemented as anthropomorphic because humans appear to prefer medical avatars that look human [20]. They can provide a form of social interaction that, according to social cognitive learning theories, may contribute to learning [1]. The creation of an anthropomorphic avatar is a challenging and complex task. The imitation of a human being requires complex modeling of bodily movements, emotions and intelligence, and thus the implementation of such an avatar may be unfeasible in practice for many interventions due to lack of resources.

Most traditional education technologies have been developed in the behavioral learning context [8]. Behavioral learning is based on principles of punishment and reinforcement. Behavioral methods can assist learning especially for novice learner but they are not very efficient as only methods as they may only produce mechanical learning, and punishment may also invoke reactance [3]. Constructive learning approach, in contrast, is an active, experiential and reflective learning process.

We have developed a mobile health intervention "Mindless Change" that utilizes both behavioral and constructive components of learning theories as a basis. The intervention also utilizes a simple cartoonish avatar, which is much less complex and requires less effort to create and use than a full anthropomorphic avatar. The avatar is an attempt to implement one component of a learning-oriented framework, supporting active dialogue and reflection. The design is centered on the active learner and several other components contribute to the intervention effects as well. In this paper we shortly describe the design of Mindless Change intervention and present results from a 4 week feasibility pilot (N=66).

2. THEORETICAL BASIS

The theoretical basis of Mindless Change lays strongly in learning and behavioral theories. The framework is not in conflict with previous frameworks such as Consolvo, Oinas-Kukkonen/Harjumaa, Sundar or Müller [2, 18, 22, 16]. They have all their foundations more or less in the behavioral theories but the difference lays mainly on the viewpoints, ours is the only one which has its roots derived directly from learning theories even most of these have their foundations also on the fields of psychology and sociology. The base is similar but the way of looking things is different, thus producing different emphasizes and design decisions.

Understanding of learning has shifted from a teacher-centered to student-centered education: "The disciplines are being replaced by more reflective, pragmatic and experiential approaches, which place the individual learner much more at the heart of the learning process." [12]. Constructivist theory claims that people construct their own understanding of the world through reflection of their experiences [8]. Kolbe's learning cycle is a simplified presentation of the process: Concrete experiences lead to reflections, which produce thinking, abstract concepts and new actions, which are then generating new experiences [12]. Illeris defines four types of learning [11]:

1. Cumulative or mechanical learning can be applied on mentally very similar contexts like in a habit of going for a walk and getting a beer afterwards as a reward (no beer, no walking).
2. Assimilative or learning by addition links new elements to an existing scheme in a similar context. An example would be a habit of walking after work because it feels good but skipping the walk on vacation. The absence of familiar cue (coming home) disables the habit loop [5].
3. Accommodative or transcendent learning breaks down the old schemes and rebuilds them with new elements. As an example, this could happen through understanding the personal meaning of physical activity in everyday life, such as going for a bicycle ride or a swim on vacation.
4. Transitional or transformative learning is typical in crisis-like situations: changes are fundamental, urgent and unavoidable. For example, getting a heart attack due to physical inactivity can force a person to start walking more.

A behavior change is a life-long learning process starting with cumulative small steps towards assimilative learning and progressing to accommodative learning along with increased awareness and reflection. Learning itself can be illustrated as a process of three dimensions: content, incentive, and interaction [11]. Accommodating new content requires motivation from within and interaction with the outside world. Content and motivation are initiated by the interaction. According to Suoranta and Vaden, "learning is a centrally intersubjective human activity which belongs to and is part of our being in the world."[23]. The dimensions of learning also match with the principles of SDT (autonomy, competence and relatedness) [4], and emphasize that a social interaction is a central aspect of learning [27]. In SDT terms, interaction equals relatedness, the learning of new content relates to competence, and incentive and autonomy are both supporting user motivation. SDT has been also applied in educational settings [17]. In this study, they found out that supporting autonomy, competence and relatedness increased the students' motivation. The practices for increased autonomy include providing choices and meaningful rationales for activities, acknowledging students' feelings, and minimizing pressure and control. Practices for enhancing competence include optimally challenging tasks and providing personal development related feedback as opposed to norm-based evaluation. Practices for enhancing relatedness include respectful and caring attitude towards students.

Learning aims to build competence to perform tasks. People have certain capabilities but also capability beyond their current competences. The zone of proximal development (ZPD) is the level to which a person can advance with the help of others who are already in a slightly more advanced level [8]. This has two implications: 1) support from others is essential, and 2) the steps should be small enough to be within reach. The importance of simplicity and small and concrete steps in behavior change process has been also emphasized in a persuasive design [18, 6].

We have listed some key design principles drawn from learning theories (Table 1). The principles are not independent but interrelated, and should all be taken into account as a checklist when designing interventions. It is not an exact list of requirements but a list to be reflected upon when making design choices.

Table 1. Components of the design framework

Principle	Description	Theoretical reference
Active dialog	Encourage active dialog by rich and motivational feedback, raise curiosity, and offer new stimulus and possibility for reflection.	Learning as an intersubjective dialog
Reflection	Experiences should be followed by reflection: support different means of reflection and create meaning for user actions.	Constructive learning, social development theory
Autonomous planning	The user should define customized goals and tasks.	Constructive learning
Peer support with ZPD	Select peer group according to the user activity and skill level.	Zone of proximal development (ZPD)
Small steps	Offer low threshold of acting, allow the user to evaluate and adjust the challenge level.	Types of learning, ZPD
Process support	Make the important components of learning visible as instructions how to proceed.	Behavioral learning
Positive feedback	Consider all user activity as positive, a sign of motivation and interest.	Behavioral learning, dimensions of learning
Affordance for emotions	Playfulness, emotions, humor, variability, creating a full life-experience.	Dimensions of learning, intersubjective dialog
Affordance for knowledge	Making relevant knowledge available and connect it with user activity.	Behavioral learning, Constructive learning

3. FROM THEORY TO PRACTICE

"Mindless Change" is a mobile intervention designed to support a behavioral change process. It is based on the principles of our design framework. The core concept of the intervention application has been inspired by the "Mindless Eating Challenge" [13] in which the aim was to aid users to design and make small and easy changes in one's eating environment or daily eating related habits. We have expanded the concept by introducing learning theories as a theoretical background, and including also physical activity and stress related target habits. The word "mindless" refers to the mindless nature of unhealthy behaviors and, more importantly, achieving new habits with "mindlessly" easy and small steps [25]. The Finnish word for mindless ("mieletön") also means positively unexpected and "cool".

The application is divided into two parts: the registration phase and the main application. The flow of the registration is shown in Figure 1. In the first stage, we introduce the aim of the application

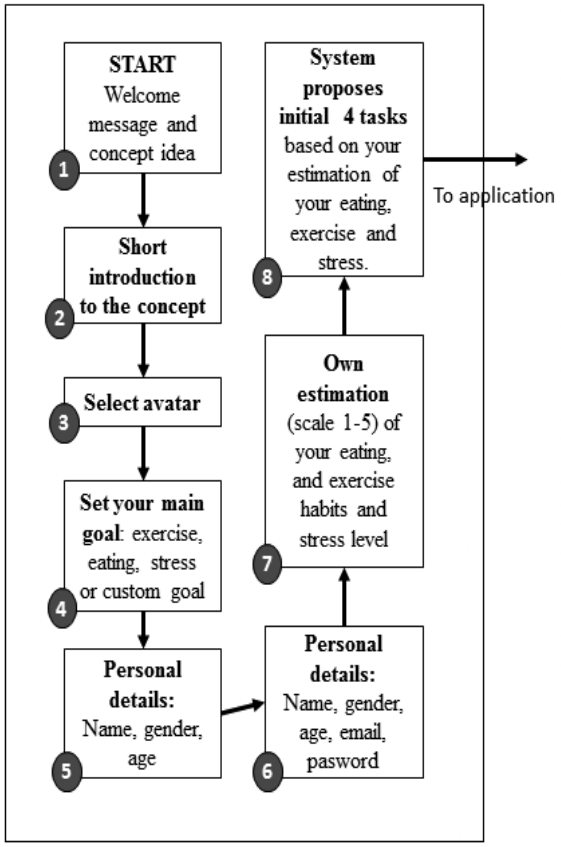
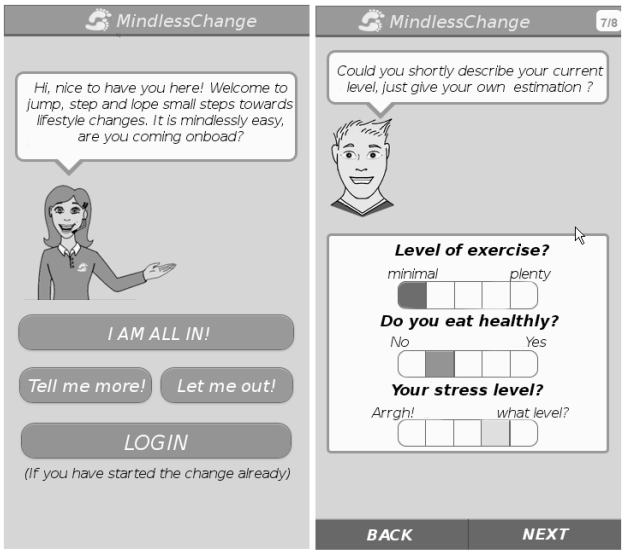


Figure 1. The registration

(step 1, screenshot in Figure 2a) and encourage the user to get started. Next, the user is asked to select a support person (avatar) (step 3) from ten different options. The avatar selection is placed at the beginning to give the user a feeling of control and get him or her engaged to the habit change project. This is related to our design framework as supporting autonomy and having some affordance for emotions early in the "game". The avatar in our



a) *b)*

Figure 2. The example screenshots from the registration phase

application is mainly giving supportive small talk, not exact exercise or dieting guidance. It is also about interaction and relatedness, you are not alone in your process. The next step is the selection of the user's main behavioral goal from three options or a custom-made one (step 4). It is about autonomy and reflection, you will make the selection of your goal and have to think about the direction you want to take. Basic background information is collected during steps 5 and 6 for statistics and user identification. Rough estimates of the user's "skill level" in the areas of eating, exercise and stress are then inquired (step 7, screenshot in Figure 2b). This information and the main goal are used to suggest the user a relevant initial set of tasks (step 8). This is according to our framework's requirement of small steps within the zone of proximal development. The task library consists (114 tasks) behaviors which are 1) related to selected goals, 2) suggested to be beneficial according to research evidence, 3) doable daily (to accelerate habit formation), and 4) "binary" i.e. doable as whole or not at all (to simplify assessment and facilitate habit forming it is easier behavior e.g. to "eat a vegetable" vs. "increasing eating vegetables"). The user can also change tasks or even create own custom tasks, which support the feeling of autonomy, user's own understanding and opinions are respected and the program is agreed by the user. Even it is useful to propose initial sets of options to the user, we should not offer any fixed choices at the very early of the process, which the user can not influence. Even most of the users would not change any settings, the presence of choice should be always available. The choice has an influence even when not utilized by the user. After the user is satisfied with the set of tasks, the registration is complete and the user is transferred to the main application.

The application is built around the concepts of intersubjective dialogue [23] and dialogue support [18]. The user is always greeted by the self-selected support avatar (Figure 3) when opening the application. The five different support avatars for both genders have different styles of speaking (serious, funny, neutral, friendly and strict) and their lines of dialogue are retrieved semi-randomly from a library of around 1700 prompts. Figure 3 shows the available supporters and their styles.

Although the system is not intelligent as such, the purpose of

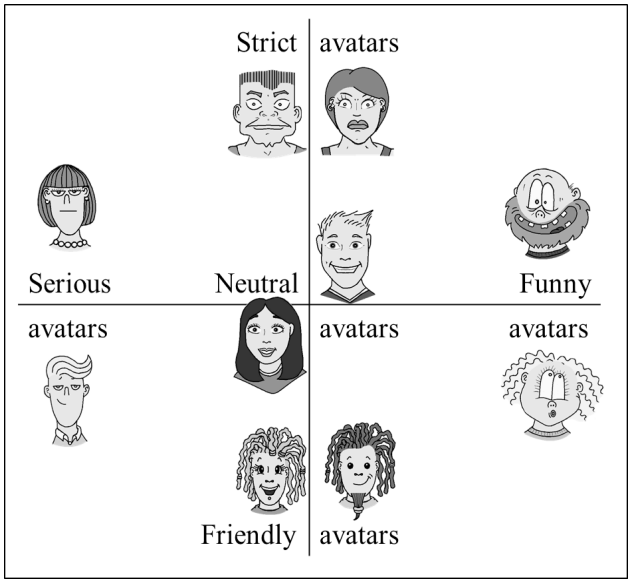


Figure 3. The supporting avatars and their "personalities"

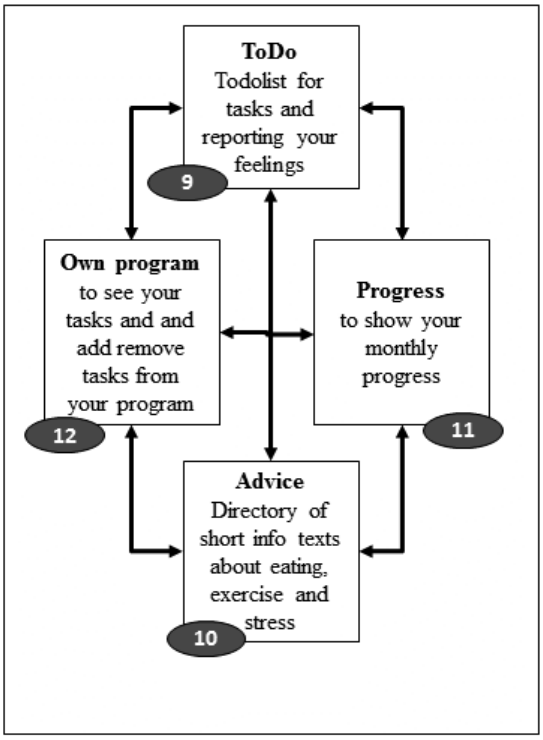


Figure 4. The application

different supporter personalities is to create an illusion of real human dialogue by offering varied expressions through the extensive prompts library. The prompts consist of greetings, encouragements, health topics and even funny random comments to introduce some surprising elements in the daily use of the application. The emphasis is on the emotional content: positive reinforcement and praise for achievements. The support avatar is present in every screen. This aims to maintain active dialogue and reinforcement. Thus the coach has many roles derived from our design framework: simple dialog triggering reflection, giving positive feedback, creating emotions and also offering useful small pieces of information.

The application consists of four simple main screens. The application structure resembles the Kolbe's cycle of learning with different phases for experience, reflection, abstraction and re-planning/action [12] (Figure 4). The user is given a simple list of essential steps to follow but the freedom of choice is also allowed. The aim is to engage the user into a simple learning cycle, in which everything happens in small steps reinforced by the supporting avatar. This is well aligned with the requirement we set in the Table 1.

Act screen (step 9, Figures 4 and 5a) is the home screen which shows the tasks relevant for today ("to-do list"). The user can mark each task done or undone which are both acknowledged by clearing the task from the to-do list. To spark additional reflection, the current feeling can be expressed by choosing a corresponding smiley face (happy, neutral, sad) and writing a short comment. The current feeling is shown in the Act screen (Figure 5). The screen is about getting the feeling of achievement and competence and having also some means of reflection.

In the Progress screen (step 11, Figures 4 and 5b), the user can view his or her monthly progress, which is presented with a footstep icon for each day the user has accomplished at least one task. The color of the day reflects the user feeling on that day, i.e.,

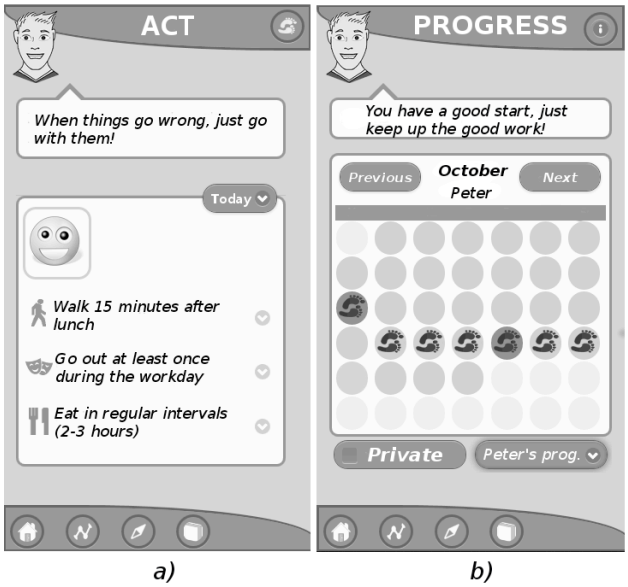


Figure 5. The example screenshots from the application

green color means a happy day, yellow means neutral and red means not so good day. If the user unchecks the privacy setting (Figure 5b, word "Private"), other users of the application can see his or her progress and he or she can see the progress of others in turn. This is currently the only "social" feature in the application. Its purpose is to give the user a reference to other people's progress in a similar habit change project. Showing that there are people in a similar position supports the need of relatedness [4].

In the Advice screen (step 10, Figure 4), the user can browse a collection of selected information snippets and short articles in layman language in the domains of eating, exercise and stress management. This provides material to the user to reflect upon and create coherent schemes reinforced by "scientific evidence". Education/information alone would not be enough but in connection of the habit change process it can help in the construction of beliefs. The supporting avatar also occasionally offers additional pieces of information in the prompts, creating more personal channel of information.

Finally, the Own program screen (step 12, see Figure 4) shows the active tasks the user has selected. Here the user can browse the entire task library and pick different tasks. For each task, the user can select whether the goal is to do it every day or on certain days of the week. This freedom of choice follows the principles of autonomy and small steps: the training plan is not fixed, but the user is encouraged to experiment with tasks and find out what is best for him or her, which is in the very core of Kolbe's learning cycle.

4. PILOT STUDY

4.1 Objective

The main objective of the pilot study was to assess the feasibility of the Mindless Change application for self-administered health intervention targeting to support behavior changes, and specifically habit changes. As a pilot study, the aim was not to address or prove the actual behavior change outcomes but whether the technical utility and user adherence are in an acceptable level to allow to continue development and later deploy larger scale trials. As a secondary objective, we also aimed to study the effect of the artificial support avatar on user adherence as an encouraging and motivating element.

4.2 Participant recruitment

Participants were recruited through an advertisement on the website of the Finnish organization Nyyti whose mission is to support students' wellbeing, health and life control. The advertisement was also posted by the organization to their Facebook group and reposted by other instances, often related to mental wellbeing. Interested participants were directed to the enrollment survey through the link in the advertisement. The survey contained a brief description of the purpose and procedures of the study, followed by questions about the mobile phone type and email address. Participants gave their consent to use their anonymous data in research by submitting the survey. Recruitment period lasted 4 weeks after which the enrolled participants were sent an email invitation to start using the application. No other incentives, external support or encouragement was provided for using the application.

4.3 Study groups

The application automatically randomized each user into one of the three groups when user first time registered into the application:

1. Self-selected: Users were able to select their support person from ten different options (Figure 3) and to change the avatar at any time by clicking on the avatar face (Figure 5). The instructions for changing the avatar were available in the help menu.
2. Neutral: Users were given a fixed avatar ("Neutral avatar") whose feedback aimed to be mostly informative and neutral in style. The users were given no indication that there were other avatar options available and it was not possible to change the avatar.
3. None: The application did not display any avatar or avatar comments in any screen. Avatar selection was omitted from the registration.

The application was otherwise identical in each group. The "None" group served as a control group for the two avatar groups.

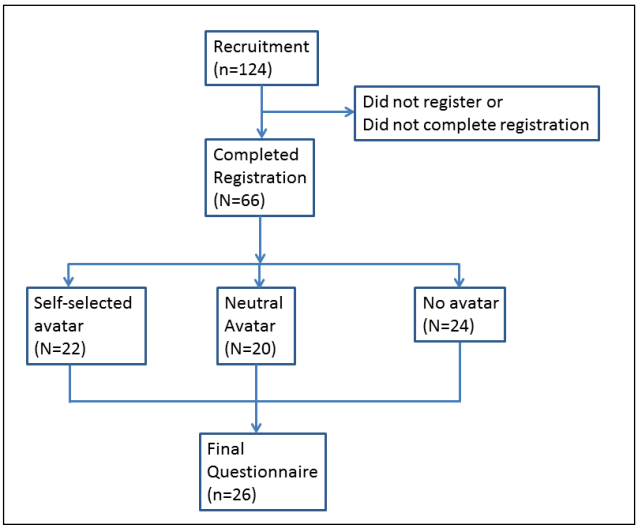


Figure 6. The registration and pilot flow

The allocation was done based on which group contained the smallest number of users at the registration time, to ensure that each group would have a similar number of users. The recruitment and pilot flow is illustrated in Figure 6.

4.4 Data collection

During the registration process, the users were asked for some background data, such as age, gender (male/female), and self-evaluation of exercise, eating and stress on a 5-point Likert scale. After a month from the start of the study period, the users we're asked to fill an electronic questionnaire regarding the use of the application. Users evaluated their exercise, eating and stress levels on the same scale as in the registration process.

4.5 Statistical analyses

Usage of the application was studied as the number of users, days of use (days with at least one logged event), weeks of use (weeks with at least one log event) and tasks the user marked as done. This data was collected from the system database and activity logs. Medians are reported for usage days and tasks since the data is not normally distributed. These results are compared between the three groups the users were allocated in. The differences in completed tasks between the groups were examined using the Kruskal–Wallis one-way analysis of variance. Analyses were conducted in Matlab..

5. RESULTS

5.1 Study sample

Out of 124 persons who enrolled in the study and filled initial questionnaire, 66 (53%) completed the application registration phase ("users"; median age 29 years, 88% females). 33% of the users selected the increase of daily exercise as the main target, 27% healthier eating and 24% stress reduction. 15% of users set a custom goal which they defined themselves. Table 2 shows the statistics for each of the test groups. There were no significant differences between the groups in their exercise, eating or stress related variables.

Table 2. Participants characteristics

	Self-selected	Neutral	None
N (number of users)	22	20	24
Age (median)	32.5	28.5	29.5
Gender male/female	4/18	3/17	1/23
Main goal:exercise	41%	40%	21%
Main goal: eating	18%	15%	46%
Main goal stress	9%	30%	33%
Main goal: custom	32%	15%	0%

5.2 Adherence

At least one task was completed by 58% (38/66) of the registered users. The rest of the users entered the application but never completed any tasks. In "Self-selected" group, 64% (14/22) of the users completed at least one task, and in "Neutral" and "None" groups 50% (10/20) and 58% (14/24), respectively. The differences were not statistically significant.

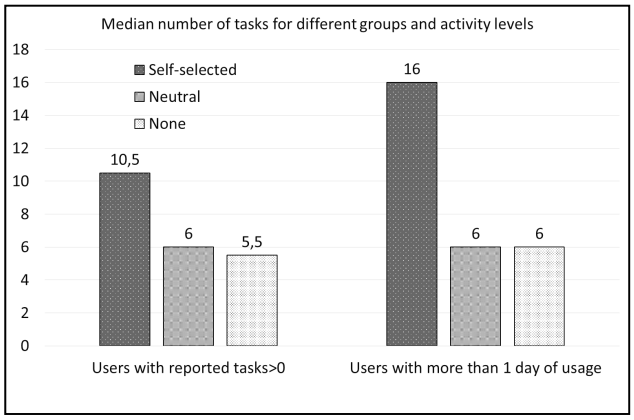


Figure 7. The median number of tasks reported for different groups

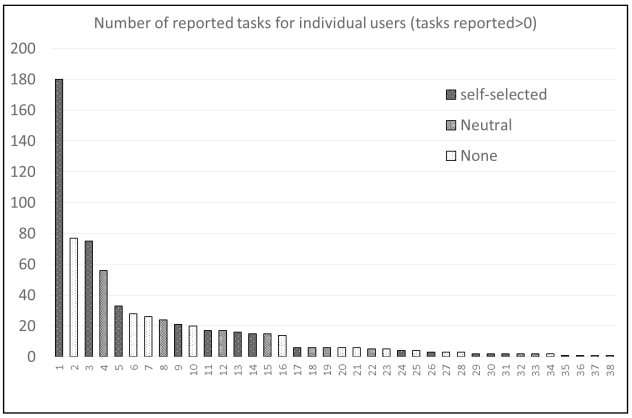


Figure 8. Reported tasks for individual users

Figure 7 shows the median number of tasks completed for all three groups. Even though the "Self-selected" group seems to be the most active, the differences are not statistically significant. When comparing the groups to each other in each of the categories depicted in Figure 7 (users with at least one task and returning users), no significant differences were found.

Figure 8 shows the reported tasks of the individual users sorted in the order of activity. As can be seen there are only very few active users after which the activity drops fast. Sixteen users have at least 14 tasks within the 4 week observation period

5.3 User experiences

26 (38%) participants completed the one-month questionnaire. Nine of them were from "Self-selected avatar", eight from "Neutral avatar" and nine from "No avatar" group. Most of the respondents (77%) said they had felt a need to change their habits when they enrolled in the study, and 65% said they currently felt this need. The application was considered useful by 54% of the respondents. Only 27% reported having used the application actively, and most of the respondents (88%) also said that they had not remembered to use the application. Some commented that the application should have had daily reminders.

Users reported self-evaluation of their health habits before and after the study. There was no statistically significant change, which is reasonable outcome taking account the short period of active use

5.4 Avatar selection in "Self-selected" group

Figure 9. presents the distribution of different avatars the users in the "Self-selected" group chose. The neutral female avatar was the most common choice. The users had the possibility to change their avatar during the pilot but they did not use the choice.

6. DISCUSSION

This paper has described the design principles of the "Mindless Change" intervention for formation of healthy habits through small steps, and has presented the findings of its first pilot study among a student sample. The main objective of the pilot study was to assess the feasibility of the application in self-administered health behavior intervention. In addition, we studied the adherence in three groups who differed in terms of the type of avatar support they received. The findings show that the intervention has potential, but low adherence remains a challenge. Only 53% of the 124 enrolled participants registered into the application and only half (50%) of the 66 users who tried out the application used it for more than one day. Although this is typical for freely available interventions without any screening of users [14], this is exactly the reason why interventions need to become more engaging. In our case, it could have helped to offer wider selection of tasks and improving the personality of the avatar. Also the peer support was very limited in the first version of the intervention and should be definitely used more in the next phases of the development.

There may be several other reasons for the low adherence. First, open recruitment (web advertisement and enrolment; no personal contact to participants), minimal support and encouragement to use the application (no other form of intervention), and minimal introduction to the intervention principles may attract users who have some interest or need in changing their behavior but who lack commitment to take actions and therefore yield to high attrition. Furthermore, some usage bottlenecks such as lack of reminders, general usability or attractiveness of the interface may further reduce the adherence. Results suggest that especially the former factors explain majority of the adherence problems.

Theories of behavior change could help to explain the low adherence and the high dropout before the study even started. The current application may not be optimal for those users who are in preintentional stage for health behavior changes [21]. The focus on planning and committing to simple daily behavior changes may be more suitable for users who are in intentional or action stages i.e. more committed to changes and just seeking for practical solutions to implement them. We did not assess or screen the participants in this aspect so this remains speculative but further studies should assess this.

In addition, the participants got only very brief introduction to the application and principles of small steps as a way towards healthier lifestyles. It may be that this was not sufficient or credible enough for many of them to increase their outcome expectations and therefore commitment to try out the application and its approach. This, in turn, may be seen as a poor adherence to the program. A more comprehensive and well-designed introduction package and investment on highly persuasive out-of-box-experience might help improving this challenge.

Also, the application was still a pilot version and could not be considered to be in a level of commercial product but still a research prototype. With older smart phones, it may have suffered rather bad usability due to a slow performance. Many features and UI ideas are still waiting for implementation and can help us increase the adherence in the forthcoming versions. For example regular reminders have been shown to be associated with higher adherence in other studies [14, 26], and user feedback also suggests that the intervention would benefit from reminders.

Finally, the attrition rates seen in this study are typical for studies of technological interventions outside RCT settings [14] and should not be considered as a failure. High attrition rates are something we may unfortunately need to expect also in the mobile health domain and will remain a key challenge for improving outcomes in broad populations. With better advertising, the web based interventions has good potential to attract much larger populations producing statistically more reliable measurements thus reducing the effect of attrition. Adherence may be also improved with careful application design and implementation but also via more careful targeting of the applications to specific sub-populations and their needs, and improving screening tools to improve the application utility and better matching the user needs.

There are some encouraging results, too. Looking at the users who did use the application more than one day, the group with self-selected avatar seems to be more active when reporting the small daily tasks, which are the essence of this intervention. The median number of reported tasks for that group was 16 compared to 6 tasks for both "fixed avatar" and "no avatar" groups. Due to a small number of users, the difference did not reach statistical significance. The trend in favor of the self-selected avatar still gives motivation to improve the avatar and conduct further studies.

It is interesting to note that although users in "Own avatar" group were able to choose their avatar from ten options, most of the people picked the neutral avatar. In the selection phase each avatar gave short introduction "speech" in the language style typical for that avatar, so the user knew what kind of style the avatar has. Our initial hypothesis was that the different avatars would bring some element of gamification into the play but it seems that the process of behavioral change was a more serious matter for the users.

It is also interesting to look at the initial goals user selected at the registration phase. The results are shown in Table 2. The "Self-selected avatar" group had the biggest amount of custom goal selections (32% of the users versus 15% and 0% for "fixed avatar" and "no avatar" groups). The free choice of avatar at the beginning could encourage autonomy and initiate further activities of the user.

In conclusion, we designed a mobile habit formation intervention to support daily small changes with self-monitoring and feedback. The design was built on top of our learning theories based framework. The framework provides guidelines for proper use of learning theories in interventions, which is likely to lead to larger effects [26]. We found that the framework helps us to concentrate on the essential elements of UI, reducing unnecessary complexity which could cause the user to deviate from the core task of learning. The framework is still work in progress, in its current state it provides a good checklist to reflect upon on the design process but our plan is to develop the framework further, producing more concrete guidance for an intervention design. Even though the results of this first pilot study were not conclusive, they are a good basis for further investigations and improvements in both the underlying framework and the resulting mobile intervention.

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