

# Dynamic Text Messaging in a Persuasive Gaming Environment to Promote Participation in Self-Tracking of Health Status

Yong-Xiang Chen<sup>1</sup>, Hsin-Wen Liang<sup>2</sup>, Pin-Hsin Lin<sup>2</sup>, Jui-Chun Hsia<sup>3</sup>,  
Chia-Hao Chang<sup>2</sup>, Chen-Yu Wang<sup>3</sup>, Yi-Ping Hung<sup>1,2</sup>

<sup>1</sup>IoX Center, National Taiwan University, Taipei, Taiwan

<sup>2</sup>Graduate Institute of Network and Multimedia, National Taiwan University, Taipei, Taiwan

<sup>3</sup>Department of Computer Science and Information Engineering, National Taiwan University,  
Taipei, Taiwan

ntu.csie.hp@gmail.com, hung@csie.ntu.edu.tw

**Abstract.** Numerous researchers have described the importance of self-tracking one's daily life in the pursuit of a goal. However, many people are unable to maintain such a regimen. In this study, we sought to resolve this problem by making the process of self-tracking more fun and attractive. We investigate the effectiveness of three encouragement systems on influencing individuals to participate in an e-Diary system used to record health status. The three systems were: "self-tracking promoting message (SPM) only," "self-tracking promoting message (SPM) + individual game," and "game promoting message (GPM) + social game." Our results revealed 328% improvement in participation performance (compared with baseline) associated with messages aimed at promoting participation in the social game. Qualitative analysis of the interviews helped to explain these results. We proposed the integration approach of dynamic text messages and social gaming to modify behavior. We believe that assigning one individual to send game promoting messages every day was key to the persuasive power of the social game, and then this persuasive power will contribute to target behavior.

**Keywords:** Dynamic Text Message, Social Game, Self-tracking

## 1 Introduction

Numerous researchers have described the importance of self-tracking one's daily habits in the pursuit of a goal. For example, Helsel. et al. reported that self-tracking behavior makes the process of losing weight more efficient [1]. However, many people are unable to maintain such a regimen, particularly when using a paper diary. In contrast, e-diary systems have gained considerable popularity for use in recording food intake, medication, and physical activities. Despite advances in sensing technology, some types of subjective data must be input manually, such as sleep satisfaction

and one's mood or goals. Many people are unable to maintain the discipline required for self-tracking activities [2]. In this study, we sought to resolve this problem by making the process of monitoring more fun.

Previous researchers have suggested the use of persuasive tools, such as text messages, to make self-tracking more enjoyable [3]. In this study, we adopted dynamic text messaging as a means of reminding participants to input self-tracking data. We also assigned one individual (the leader) to send text messages manually every day, and each individual responded with messages that were visible to the entire group. Ross et al. described the benefits of yoga in improving one's health [4]. In this study, we applied the proposed system to encourage participants to engage in self-tracking.

## 2 Method

The purpose of this study was to investigate the effectiveness of three encouragement systems on influencing individuals to participate in an e-Diary system used to record health status. The three systems were as follows: "self-tracking promoting message (SPM) only," "self-tracking promoting message (SPM) + individual game," and "game promoting message (GPM) + social game." Self-tracking data was stored in the participant's smart phone prior to processing and synchronization on a system server. The obtained data was used in quantitative as well as qualitative analysis.

### 2.1 Win-Win a Diary

We developed an e-diary app named Win-Win a Diary (WWaD), which prompts the user to answer questions pertaining to their health status. After the questions are answered, the app uploads data related to participation performance to a server via the internet. WWaD can also be configured to send a notification to remind users to fill in WWaD twice a day. The questions used in the experiment are listed in Table 1. The answers include the recording of input times (e.g. 9:30 pm) and multiple choices answers (e.g. my mood is "very good" now). Participants were required to spend only 3-5 minutes filling in WWaD each day.

**Table 1.** Self-tracking questions posed by WWaD

What time did you wake up this morning?
What time did you go to bed last night?
How satisfied were you with your sleep last night?
How was your mood after waking up?
How much time did you dedicate to yoga practice today?
How was your mood after completing your yoga routine?
How is your mood now?

## 2.2 Win-Win a Game

We developed a mobile game called Win-Win a Game (WWaG), which is based on raising a virtual pet. The game can be played in either individual or a social version. WWaG divides the growth of the virtual bird into three stages: egg, chick, and adult. In the individual version, participants feed the bird by navigating through a virtual world in which the location of rice (bird food) is indicated on a map. Figure 1 presents a screenshot of WWaG. Participants try to derive the optimal path through the game in order to improve their scores. Virtual gardening tools, which are obtained by completing the self-tracking questions, are used to redistribute rice on the game world in order to increase yield. The number of gardening tools that a participant obtains corresponds to their participation in filling out the questions. The chicks hatch from the eggs to become adult birds (nine varieties) when participants reach a score threshold. Figure 2 presents a screenshot showing a list of the adult birds, referred to as the bird index (birdex). Participants are able to raise two adult birds each week as long as they complete the self-tracking system every day.

The social version of the game includes elements of intra-team cooperation and team-to-team competition in the form of a leader board, virtual treasure, and team chatroom. We listed the score and ranking of participants on the leader board and posted the average score of the entire team at the top of the leader board. Participants can also obtain information pertaining to the location of treasure as long as they complete their self-tracking requirements each day. The treasure is automatically assigned by the system to a nearby area in the game world of their teammates. The chatroom is used to notify teammates of the treasure location, thereby developing cooperation, with one team member passing on the location of the treasure and the other one digging it up. Figure 3 presents the structure of the individual game and social versions of the game.

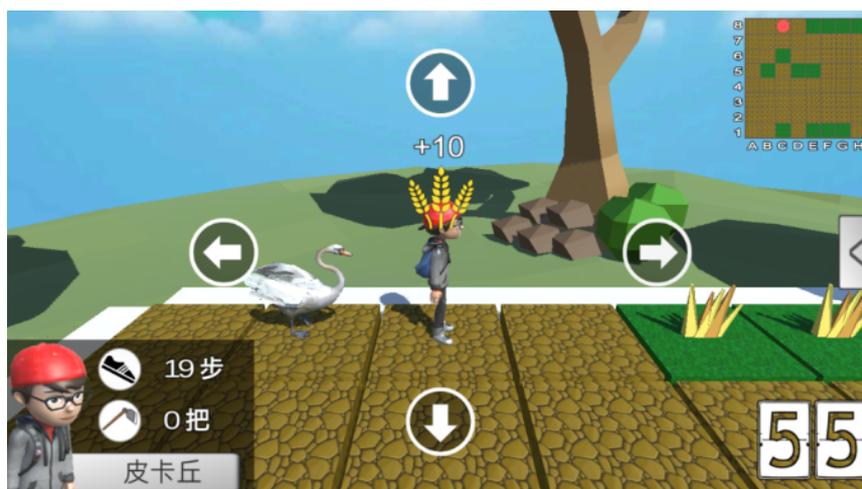


Fig. 1. Screenshot of WWaG

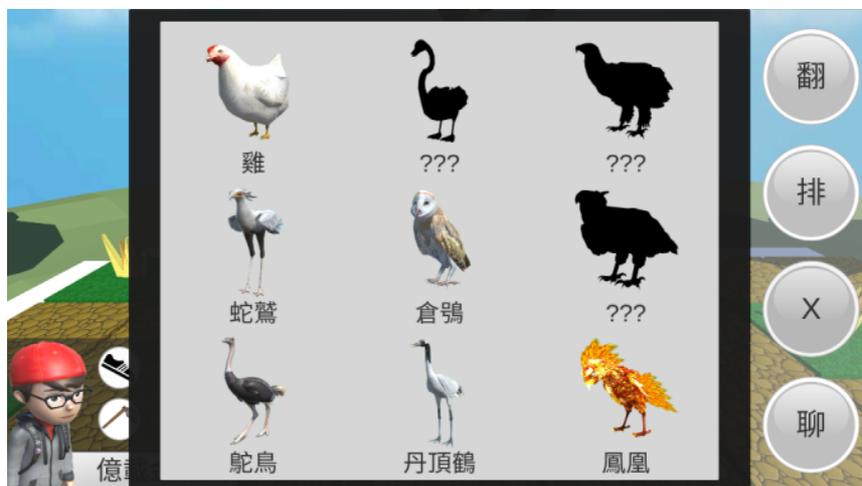


Fig. 2. Screenshot showing bird index (birdex) in WWaG

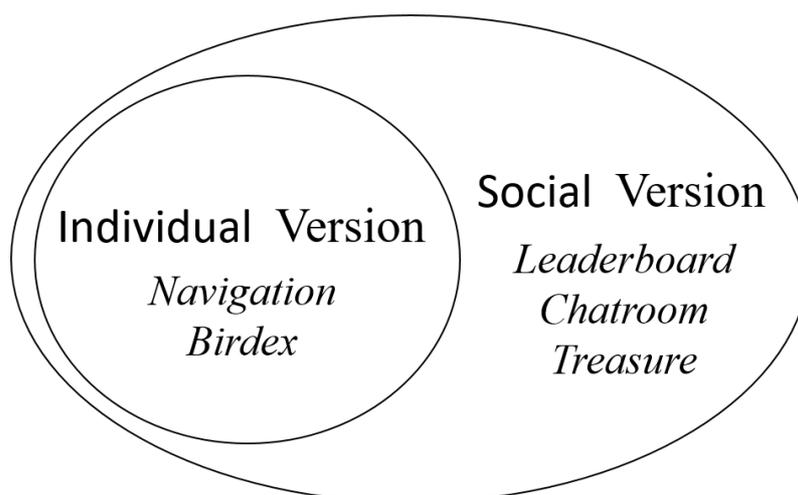


Fig. 3. Structure of individual game and social game

### 2.3 Dynamic text messaging

Previous researchers have investigated the influence of dynamic text messages that present different content everyday with the aim of conveying eight types of message: messages that reduce barriers, pros and cons lists, public testimonies, rewards and

encouragement, motivational messages, personal testimonies, information, and time management tips [3].

In this study, we invited four club staff members to act as leaders in manually sending text messages to the participants (in accordance with guidelines set out by researchers) once an evening. One type of message was meant to promote self-tracking, whereas the others were meant to promote game play. Sample messages are listed in Tables 2 and 3.

**Table 2.** Sample messages to encourage self-tracking

Message Type	Sample Message
Remind participants that a new week is starting	Press "<" to fill in the previous day's record.
Motivation	Every race begins with the first step! Run and fill in your WWaD now!
Advantage of target behavior	Yoga helps to stabilize your mood. Try to pay attention to and record the emotions before and after each practice.
Rewards and Encouragement	Six members have filled in WWaD. Congratulations! Keep it up!
Time management tip	Complete your WWaD requirements immediately when you see the message so that you won't forget.
Information	The aim of meditation is to become "mindful." Meditating with your eyes closed calms you more effectively.
Experiences of others	Observe your mood changes on WWaD and ask your partners if they aware of their own changes.

**Table 3.** Sample message to promote game play

Message Type	Sample Message
Remind participants that a new week is starting or sending tips about using the game	Fill in WWaD to obtain a hoe in WWaG. Fill in all of the questions to win virtual treasures. A new week is beginning - do your best!
Give yourself a small target	Dear friends, try to finish today's questions to obtain a virtual treasure and improve our score!
Indicate that the team is leading or behind	Now our team is in the lead. Keep it up!
Point out the number who have consecutive days of input	The top three performers on our team are AA, BB, and CC, congratulation! Keep it up!
Persuade a member via comparison	AA, only a few scores and you can beat BB (the other team). Go go go !
The comparison result of this week	The winner this week is our team with an average score of 425. Tomorrow, we begin a new game. Let's try hard to win again.

## 2.4 Subjects and procedures

Participants who did not have the habit of practicing yoga regularly and self-tracking themselves were recruited from the Kundalini Yoga Club of National Taiwan University (NTU). After describing the experiment to members, new recruits signed a content form. The 25 participants were divided into four groups depending on baseline test results over a period of two weeks, as follows: social game (two groups – 6 participants on the red team and 6 participants on the white team), individual game (one group – 7 participants), and no-game (one group – 6 participants). The experiment was conducted in three stages. In the first stage (baseline stage), participants installed the e-diary WWaD app (developed in our lab) on their smartphones and used it without WWaG for two weeks (also without receiving dynamic text messages). In the second stage, we assigned participants to use the WWaD in conjunction with one version of WWaG for four weeks. In the last stage, we interviewed the participants using predefined semi-structured questions (30 minutes) to derive their experience using WWaD and WWaG. A total of 20 participants completed the experiment, for which they were compensated \$25.

**Table 4.** Experiment setting and division of participants

Group(participants)	Self-Tracking Tool	Message Type	Game Type
SPM only (initial:6;dropped:2)	WWaD App	Self-tracking promoting message	--
SPM + Individual game ( initial:7;dropped:2)	WWaD App	Self-tracking promoting message	WWaG-Individual
GPM + Social game ( initial:6+6;dropped:0+1)	WWaD App	Game promoting message	WWaG-Social

All of the experiment data were collected using a server. We also recorded the interviews with the participants. The transcripts were later analyzed by three research team members, wherein interview data was separated into message-related and game-related data before summarizing the findings.

## 3 Results

We collected a total of  $20 \times 28 \times 7 = 3920$  data points pertaining to self-tracking status. And the filling rate is calculated as “weekly filling rate = weekly total filling questions / weekly total questions”. In the following, we present quantitative as well as qualitative results.

### 3.1 Quantitative results

Our results determined a 328% improvement in participation performance (compared with everyone’s filling rate in baseline stage of social game group) associated with messages aimed at promoting participation in the social game.

**Table 5.** Performance in maintaining self-tracking system among groups

	Baseline	W1	W2	W3	W4	Average (W1-W4)
SPM only	10%	0%	0%	0%	1%	0%
SPM + Individual game	15%	13%	17%	21%	22%	18%
GPM + Social game	10%	46%	58%	52%	52%	44%
Red team	10%	42%	68%	65%	63%	59%
White team	11%	51%	49%	36%	39%	44%

We observed a 22% improvement among players participating in the individual game who were sent messages to encourage participation in self-tracking. We did not observe any improvement among individuals receiving only messages aimed at promoting participation in the self-tracking app. In fact, we actually observed a 99% decrease in the participation of these individuals by the end of the study period. Table 5 presents the results of participation performance in the various groups, which differ from the results in [5], in which researchers reported no improvement when a social game was included. Qualitative analysis of the interviews helped to explain these results.

Despite a small sample size, our quantitative results revealed that the social game and game promoting messages improved the performance of participants with regard to maintaining the habit of using WWaD .

In the third stage, we conducted a 30-minute interview with each participant to collect their views regarding the use of the proposed system. The responses of participants support the above results.

### 3.2 Qualitative results

Qualitative data was analysed in order to reveal the reasons for the quantitative results we obtained.

#### SPM only.

Participants in this group received only messages encouraging participants to fill in self-tracking data. In the interviews, the participants reacted favourably to all messages, which they described as attractive and unobtrusive, due to their brevity. Participants also reported a sense of expectation concerning the dynamic text messages because the messages send a positive content. Nonetheless, it appears that the messages did not maintain their persuasive effect for long time. For example, P12 mentioned that although she really liked the messages, she still tended to forget to use the app.

**SPM + individual game.**

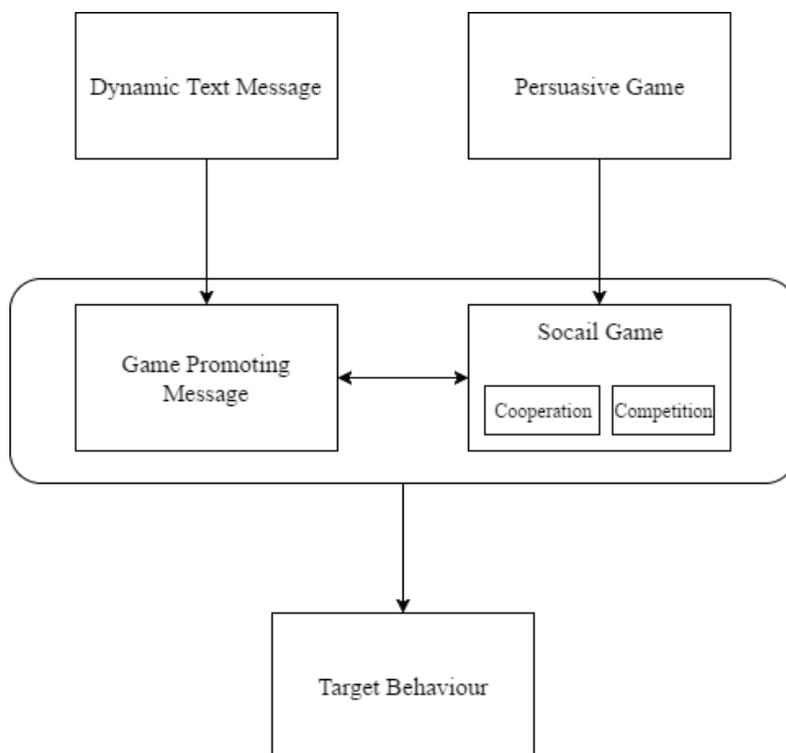
Participants in this group used WWaD as well as the solitaire game version of WWaG. Again, they received only messages aimed at promoting participation in filling self-tracking data. P9 found the individual version of the game somewhat dull due to the fact that was unable to share her achievements with others on WWaG. Nonetheless, she said that she was still willing to play WWaG in the future because she likes the virtual birds and is curious about those that she did not collect during the experiment. P4 found the game rules easy to follow but would prefer to see the birds he collected in the game itself instead of having to use Birdex. P19 reported enjoying WWaG.

**GPM + social game .**

Most of the participants in this group reported that messages aimed at prompting game play were immediately effective. Furthermore, the rules of the social version of WWaG also prompted them to participate in the use of WWaD. P16 reported feeling like a member of a team when she received messages. P7 described feeling motivated when she received messages. It also appears that the games enhanced their sense of responsibility with regard to cooperating with teammates in the competition. P1 reported that she had spent too much time playing games in the past, such that she was not particularly interested in the game at first. Nonetheless, that she did not want to be the weak link and hoped to make a contribution to her team. Ultimately, she found that playing WWaG did not take up too much of her time. P8 reported playing seriously only because she wanted to win the competition. P10 claimed that he would report the location of virtual treasures immediately because he hoped his teammates would be able to score in time.

## **4 Discussion**

Our results revealed that sending self-tracking promoting messages alone was ineffective; however, this result may have been due to the small sample size. Nonetheless, the game-playing groups presented notable improvements in participation performance, indicating the persuasion potential of this type of game. The progress made by players in the game could be the topic of messages aimed at motivating players. For example, "Today, we are getting close to team BB. Let's work together to pass them tomorrow!" We determined that dynamic text messages aimed at game promotion were particularly effective in promoting cooperation and competition and that these effects were mutually beneficial. Figure 4 illustrates how dynamic text messages and games could be designed and integrated to maximize their persuasive capability.



**Fig. 4.** Integration of dynamic text messages and social gaming to modify behavior

These experiments were conducted in collaboration with Kundalini Yoga Club of NTU, which meant that the participants already met at a weekly yoga class and were therefore familiar with each other. In the interviews, participants in the social game groups claimed that their familiarity with the other participants induced in them a sense of responsibility for the group. As a result, even the participants who were disinterested in the game itself were more likely to participate in the game and maintain their self-tracking system. In contrast, the familiarity with other participants was of no benefit to individuals in the non-game group and the individual game group. From this we can infer that face-to-face encounters increase familiarity among members; however, familiarity is not necessarily sufficient to influence individuals in performing the target behavior.

The social game was shown to leverage a sense of responsibility, which proved highly effective in altering the behavior of participants. This suggests that social games could be particularly effective in situations where the subjects have an opportunity to meet. Mutsuddi et al. reported that dynamic text messages improved the performance of participants in their experiment [3]. However, in our experiment we believe that assigning one individual to send game-related messages every day was key to the persuasive power of the game. Overall, messages directly prompting participation in the WWaD did not bring large improvement, whereas those associated with gameplay proved highly effective.

## 5 Conclusions

This paper outlines a novel approach to persuading individuals to maintain a regimen of recording their progress in practicing yoga by combining dynamic text messages within the context of a social game. Participants from an actual yoga club were asked to follow an exercise regimen and keep track of their results. Despite a small sample size, our results suggest that this approach is quite effective. We organized an inter-group game with a leader tasked with sending game promoting messages to persuade participants to engage in the game. Future researchers could increase the sample size and extend the duration of the experiment. To overcome the difficulties involved in assigning group leaders to send messages every day, a system module could also be developed to enable the automatic forwarding of messages from a central database.

## Acknowledgments

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