

Evaluation of an Interactive Web-based Application to Promote Healthy Behavior in Order to Maintain a Healthy Weight – Preliminary Findings

Saskia M. Kelders

Fleur Markus

Susanne Kerkhof

Andrea Werkman

Netherlands Nutrition Centre
Den Haag, the Netherlands

Julia E.W.C. van Gemert-Pijnen

E.R. Seydel

University of Twente
Enschede, the Netherlands
s.m.kelders@utwente.nl

Abstract— Web-based interactive applications may combine the interactive and tailored nature of successful behavior change interventions with the wide reach needed to target the general population. There is a lack of insight in the requirements for successful interactive web-based applications in prevention. The objective of this research is to evaluate the Healthy Weight Assistant (HWA) of the Netherlands Nutrition Centre and give recommendations for optimization of this application. This study consists of questionnaires (n=703, follow-up n=431), real-time usability-tests, log-file analysis and qualitative analysis. From the preliminary results we see that improvement with maximum effect and minimal change of the HWA can be found in motivation to keep using the application and motivation to change behavior. This can be achieved by sending automatic (tailored) reminders, restructuring the second stage in the application (motivation and goal setting) and by adding a tab ‘my goals’ to the application.

Keywords—healthy living; internet; interactive; nutrition; exercise; prevention

I. INTRODUCTION

The mission of the Netherlands Nutrition Centre is to “increase the understanding of food qualities and to encourage consumers to eat healthily and safely” [1]. The Centre aims at the general population in the Netherlands to prevent illnesses that are associated with being overweight and unhealthy nutritional habits. This general population is traditionally reached through mass media campaigns via television and advertisements in print media. Previous research showed that information only does little to change behavior, while tailored and interactive interventions are more successful at achieving this goal [2,3,4]. These interventions are traditionally delivered face to face and are only reachable through care providers, making them less suitable for prevention. Web-based interactive applications seem to be a solution that may combine the tailored and

interactive nature of successful interventions with the wide reach of traditional mass media campaigns. Recent studies show the potential of these applications for the achievement of weight loss [5,6] and to some degree weight management [7]. Most studies are focused on applications aimed at treatment or secondary prevention. There is a lack of insight in what the requirements for successful interactive web-based applications in prevention are. The objective of the current research is to evaluate the Healthy Weight Assistant (HWA) of the Netherlands Nutrition Centre and to give recommendations for optimization of this application. Research questions are: *What do users expect from the HWA? How do users value the HWA? What effect does the HWA have on its users? What can be done to improve the HWA? What are the requirements to successfully change behavior via an interactive web-based application?*

II. METHODS

A. Description of the Healthy Weight Assistant

The interactive internet application under investigation is called the Healthy Weight Assistant (fig. 1). Its goal is to support people with a healthy weight and people who are slightly overweight (BMI between 18 and 28) to achieve and maintain a healthy weight by focusing on healthy behavior (nutrition and exercise). Its end goal is not to support the achievement of weight loss, but to support the achievement of healthy nutrition and exercise behavior. The development of the HWA is based on a pilot study that assessed the possibilities for an interactive internet application to support healthy behavior [8]. The rationale behind the HWA is the Transtheoretical model [9].

The HWA consists of 4 different stages. These stages are marked in the application by a ‘to-do list’ and tabs in the ‘diary’ (fig. 2). When users first enter the program, they start with the intake. In this stage the users answer questions about their weight, nutritional behavior, exercise behavior



Figure 1. Screenshot of the HWA



Figure 2. Screenshot of the diary

and emotions related to their behavior. This results in tailored advice on all aspects, which can be used in the next stages of the program. The second stage is motivation and goal setting. Users are asked what their motivations are and the application helps them to make these motivations clear to themselves, thereby also focusing on clarifying the emotions related to behavior. They are coached to set useful and realistic goals. The third stage is about 'difficult moments'. Users are coached to think about difficult moments (moments which are tempting to perform non-healthy behavior) and to provide solutions for these moments. The HWA coaches the user throughout this stage by giving computer-generated feedback. The last stage is monitoring behavior and achievement of goals by means of a diary. Users can fill out the diary with nutritional and exercise information and give feedback on the achievement of their own goals.

B. Research Instruments

This study consists of four evaluation methods (pre- and posttest design questionnaires; real time usability-tests; log-

file analysis; qualitative analysis of forum posts, e-mail contacts and free-text responses in the questionnaires). Respondents were recruited by means of an announcement in a newsletter of the Netherlands Nutrition Centre. Interested readers could reply and leave an e-mail address. At the start of the study an e-mail was sent to these addresses. The e-mail included a link to an online questionnaire. Only the respondents that filled out this questionnaire completely were given the information to access the Healthy Weight Assistant and were included in this research.

1) *Online questionnaires:* Respondents filled out two online questionnaires; questionnaire 1 at the start of the study, before they had access to the HWA and questionnaire 2 after they have had access to the application for six weeks. The content of both questionnaires is shown in table I. The questionnaires are based on theory and, where possible, existing validated questionnaires were used. In table 1 the existing questionnaires we used are marked by the references in brackets. The constructs 'motivation for participation', 'expectations HWA', subjective behaviors, and 'usage HWA' were assessed using one item measures like 'Why do you want to use the HWA' (motivation) and 'How often did you use the HWA' (usage). Knowledge was assessed by a 10 item true/false questionnaire based on the Netherlands classification model [13] (nutrition) and a 10 item true/false questionnaire based on the Dutch Norm for Healthy Exercise [14] (exercise). Stage of change for healthy nutrition behavior and stage of change for healthy exercise behavior were both assessed with 1 item with 5 distinct answering categories (one for nutrition and one for exercise) [15]. Satisfaction and usability were measured by 19 items (five-point Likert scales: 1 'I don't agree at all' to 5 'I totally agree') based on work of Steele et al [16] and of Vandelandotte and De Bourdeaudhuij [17]. The complete questionnaires are available upon request from the corresponding author. Invitations including a link to the online questionnaire were e-mailed to the respondents at the appropriate time (at the start of the study and six weeks after filling out the first questionnaire). Respondents were given three weeks to complete the questionnaires. When no response was collected after two weeks a reminder was sent

TABLE I. CONTENT OF QUESTIONNAIRES

Questionnaire 1	Questionnaire 2
Motivation for participation	
Expectations HWA	
Nutrition behavior [10]	Nutrition behavior [10]
Subjective nutrition behavior	Subjective nutrition behavior
Exercise behavior [11]	Exercise behavior [11]
Subjective exercise behavior	Subjective exercise behavior
Knowledge nutrition	Knowledge nutrition
Knowledge exercise	Knowledge exercise
Attitude healthy behavior [12]	Attitude healthy behavior [12]
Stage of change healthy behavior	Stage of change healthy behavior
	Usage HWA
	Usability HWA
	Satisfaction HWA

including the final date for filling out the questionnaire.

2) *Real-time usability-tests*: Real-time usability-tests have been conducted with 9 respondents in order to assess the usability of the system, to identify problems experienced by users, to gain insight in the way the system is used and to gain insight in the way the users would like to use the system. Respondents for these tests have been recruited via online questionnaire 2. Respondents could indicate their interest in participating. Of the interested group, 9 respondents have been included, based on how many times they have used the application. 4 Respondents that did not actually use the application were included, 3 respondents who used the application occasionally (1 to 4 times within the six week period) were included and 2 respondents who used the application on a more regular basis (more than 4 times within the six week period) were included.

Every real-time usability-test started with a short interview to assess the motivation for use and expectations (first time users) or impressions (occasional and regular users). First time users then registered to the HWA and started using the application following the steps for first use. Occasional and regular users used the application how they would ordinarily use it and after that, started the scenario based test, in which they performed certain tasks (scenarios) which led them through the application. The scenarios consisted of tasks that the typical user would want to complete when using the HWA to achieve their goals. Each usability-test ended with another short interview in which the respondents state their experiences and comment on their overall impression of the application.

The real-time usability-tests have been recorded using MORAE software (version 2.1, TechSmith). The screens

have been captured, all entries have been saved and the respondent's facial expressions as well as all audio have been recorded. The respondents have been instructed to think aloud during the whole test.

3) *Log-file analysis*: Google Analytics has been used to gain insight in the usage of the application. This tool allows us to track the number of users of the HWA, the most frequently visited pages of the HWA and the average length of visits. Also, the application itself stored everything users entered in the application. This information about demographics, behavior, goals which may or may not be achieved and diary entries will be analyzed to gain insight in the way the HWA is used and what the effects of the application are. This data will be combined with the data from both questionnaires.

4) *Qualitative analysis*: A qualitative analysis of forum posts, e-mail contacts and free-text responses in the questionnaires will be carried out. The HWA is linked to a forum where users can share experiences with the application, ask questions and make recommendations about the HWA. The posts of this forum have been collected and will be qualitative analyzed to gain insight in the user experience. Also, all e-mail contacts between respondents and researchers have been stored and will be analyzed qualitatively. Finally we asked a number of free-text questions in questionnaire 2. These answers will also be a part of the qualitative study. All gathered data will be coded following the same coding system. This coding system is based on usability literature [18, 19] and adapted to the specific needs of our study (table II).

TABLE II. CODEBOOK UTTERANCES FOR QUALITATIVE ANALYSIS

			<i>Description</i>	<i>Code</i>	
				<i>Current</i>	<i>Desired</i>
HWA	Technical	Loading times	Speed, waiting times	A1.1	B1.1
		Other	Browser compatibility, error messages	A1.2	B1.2
	System	Navigation	Being able to find information, knowing where you are in the application	A2.1	B2.1
		Interface	Look and feel	A2.2	B2.2
		Automatic linking/inserting values	Automatically inserting previously entered data, combining data and information	A2.3	B2.3
		Showing progress	Visualisation of progress of users	-	B2.4
	Communication	Feedback	Getting response to inserted values	A3.1	B3.1
		Language	Understandability, use of tone	A3.2	B3.2
		Personalization	Tailored to the individual user	A3.3	B3.3
		Motivation	Being stimulated to (keep) use(ing) the HWA	A3.4	B3.4
	Added value		Perceived added value of the application for the users	A4	-
	User friendly	Ease of use	General comments about perceived ease of use	A5.1	-
		Efficiency	Efficiency in time and effort	A5.2	-
	Other		Cannot otherwise be classified	A6	B6
Personal situation			All utterances not about the application, but related to personal circumstances.	C	
Research			All utterances not about the application, but about the research.	D	

III. PRELIMINARY RESULTS

703 Respondents filled out questionnaire 1 and received access to the HWA. Six weeks after use 431 respondents filled out questionnaire 2. As soon as the data from the HWA itself have been extracted (demographics and user goals among other things) they will be combined with the results from the survey and analyses will start.

We have, in part, analyzed the free-text responses from questionnaire 2 and the forum posts up to this time (n=287). The results (table III) can be categorized in experienced problems and desired (new) features. The experienced problems are technical, content related and related to the target group. Technical problems (access to HWA, navigation within HWA and long loading times) are illustrated by the following quotes from different respondents; *“I didn’t use it, I couldn’t enter”, “I’m sorry, but I find it a bit unstructured, you have to go from one thing to another and when you go back, you end up somewhere completely different, you have to look for everything, it bugs me very much”, “Loading takes too long, especially for people with a slower internet connection”*. About content related problems (efficiency problems, advice not tailored enough) respondents say the following; *“Cumbersome and very time-consuming”, “I expected more of the possibility to get a personalised advice”*. Comments about respondents feeling that they were not the intended users were numerous. Examples of these comments are *“The Healthy Weight Assistant is helpful for people who know little of healthy living. I learned little new”, “Everyone who has ever been on a diet already knows these advices”*.

The desired features respondents suggest are related to a more intelligent system, motivation, communication and visualization. A more intelligent system means the system uses previously entered data so users do not have to enter the same data more than once and that the system combines entered data with other sources of information (of the Netherlands Nutrition Centre for example). Comments about this were *“It would be nice if you could automatically see how many calories there are in the meals you enter in the diary”, “It’s a pity you don’t get an advice on the meals you enter in the diary (calories, fibres or fats), now you have to check that at the website of the Netherlands Nutrition Centre”*. There were many comments about motivation to keep using the HWA and motivation to change behaviour. Illustrating quotes are *“A short daily reminder for a couple of weeks or a weekly reminder including a link to the HWA would help me make a habit of using the HWA”, “Before you start you get a lot of information. After you filled out all questions it’s up to yourself. I miss a little support then”*. Within the context of communication, a desired new feature was (more) feedback on entered information; *“When you use the diary intensively, it might be good to have a professional look at it who gives you personal advice”*. Respondents also felt visualization of progress and achieved goals would be an improvement of the HWA; *“I would like a graph or something, where I can monitor my weight. This is especially helpful when you want to loose a few pounds”*.

TABLE III. RESULTS FREE-TEXT RESPONSES AND FORUM POSTS

Problems experienced	Desired features
Access	More intelligent system
Navigation	Motivation
Loading time	Communication/feedback
Efficiency	Visualization
Advice	
Target group	

IV. CONCLUSION AND DISCUSSION

Although this study is still mainly in the data-analysis stage, the preliminary results are promising. According to the enthusiastic responses, many people are interested in using an interactive online application to support achieving and maintaining a healthy weight. The people reached by the Healthy Weight Assistant are people who would otherwise only have access to information to change their behavior and not to the more interactive and tailored interventions that have been shown to support behavior change. To them, the HWA has the potential to provide the support they need.

Already this research brings forth many opportunities to improve the HWA and clarifies requirements for interactive web-based applications to support behavior change. From the preliminary results we see that improvement with maximum effect and minimal change in the design of the HWA can be found in motivation. Motivation to keep using the application can be enhanced by sending automatic (tailored) reminders. Motivation to change behavior can be enhanced by highlighting goal setting and visualizing progress. This can be done by restructuring the second stage in the application (motivation and goal setting) and by adding a tab ‘my goals’ to the application. Finally adapting the forum so all users can start new threads might increase loyalty to the HWA and provide social support. The next step will be to implement these improvements and measure the effects in a Randomized Controlled Trial.

REFERENCES

- [1] Netherlands Nutrition Centre. URL: <http://www.voedingscentrum.nl/Voedingscentrum/English>.
- [2] W. Hardeman, S. Griffin, M. Johnston, A.L. Kinmonth and N.J. Wareham, “Interventions to prevent weight gain: a systematic review of psychological models and behaviour change methods”, *Int. J. Obesity*, 2000; 24: 131-143, doi:10.1038/sj.ijo.0801100.
- [3] K. Rothert, V.J. Stretcher, L.A. Doyle, W.M. Caplan, J.S. Joyce, H.B. Jimison, L.M. Karm, A.D. Mims and M.A. Roth, “Web-based Weight Management Programs in an Integrated Health Care Setting: A Randomized, Controlled Trial”, *Obesity*, 2006; 14, doi: 10.1038/oby.2006.34.
- [4] M.L. Dansinger, A. Talsioni, J.B. Wong, M. Chung and E.A. Balk, “Meta-analysis: the effect of dietary counseling for weight loss”, *Annals of Internal Medicine*, 2007; 147(1):41-50.
- [5] D.F. Tate, R.R. Wing and R.A. Winett, “Using Internet technology to deliver a behavioral weight loss program”, *JAMA*, 2001; 285(9): 1172-1177, doi:10.1001/jama.285.9.1172.
- [6] D.J. Wantland, C.J. Portillo, W.L. Holzemer, R. Slaughter and E.M. McGhee, “The Effectiveness of Web-Based vs. Non-Web-Based Interventions: A Meta-Analysis of Behavioral Change Outcomes”, *J. Med. Internet Res.*, 2004; 6(4):e40, doi:10.2196/jmir.6.4.e40.
- [7] L.P. Svetkey, V.J. Stevens, P.J. Brantley, L.J. Appel, J.F. Hollis, C.M. Loria, W.M. Vollmer, C.M. Gullion, K. Funk, P. Smith, C. Samuel-Hodge, V. Myers, L.F. Lien, D. Laferriere, B. Kennedy, G.J.

- Jerome, F. Heinith; D.W. Harsha, P. Evans, T.P. Erlinger, A.T. Dalcin, J. Coughlin, J. Charleston, C.M. Champagne, A. Bauck, J.D. Ard and K. Aicher, "Comparison of Strategies for Sustaining Weight Loss; The Weight Loss Maintenance Randomized Controlled Trial", *JAMA*, 2008; 299(10): 1139-1148, doi:10.1001/jama.299.10.1139.
- [8] F. Verhoeven and N. Nijland, "Een vitaliteitscoach voor het Voedingscentrum: Statisch of dynamisch?", Enschede: Universiteit Twente 2007, URL: <http://www.gw.utwente.nl/pcgr/oz/voedingscentrum.pdf>.
- [9] J.O. Prochaska and W.F. Velicer, Behavior Change: "The Transtheoretical Model of Health Behavior Change", *Am. J. Health Promotion*, 1997; 12(1); 38-48.
- [10] J. Hammink, Netherlands Nutrition Centre.
- [11] M. Douwes and V.H. Hildebrandt, "Vragen naar de mate van lichamelijke activiteit", *Geneeskunde en Sport*, 2000; 33(1); 9-16.
- [12] M.J. Dutta-Bergman, "Health Attitudes, Health Cognitions, and Health Behaviors among Internet Health Information Seekers: Population-Based Survey", *J. Med. Internet Res.*, 2004; 6(2):e15, doi:10.2196/jmir.6.2.e15.
- [13] Netherlands Nutrition Centre: "Criteria for nutritional evaluation of foods", 2005, URL: <http://www.voedingscentrum.nl/NR/rdonlyres/0AF85A19-79B1-4DB5-A0E8-C8BFFD44B089/0/Criteriaengelssite.pdf>.
- [14] H.G.C. Kemper, W.T.M. Ooijendijk and M. Stiggelbout, "Consensus over de Nederlandse Norm voor Gezond Bewegen", *TSG*, 2000; 78: 180-183.
- [15] G.R. Reed, W.F. Velicer, J.O. Prochaska, J.S. Rossi and B.H. Marcus, "What makes a good staging algorithm: examples from regular exercise", *Am J Health Promot* 1997; 12(1):57-66.
- [16] R. Steele, K.W. Mummery and T. Dwyer, "Development and process evaluation of an Internet-based physical activity behaviour change program", *Patient Education and Counseling* 67, 2007, 127-136, doi:10.1016/j.pec.2007.02.013.
- [17] C. Vandelanotte and I. De Bourdeaudhuij, "Acceptability and feasibility of a computer-tailored physical activity intervention using stages of change: project FAITH", *Health Educ. Res.*, 2003, 18:304-317, doi:10.1093/her/cyf027.
- [18] S.J. Koyani, R.W. Bailey, J.R. Nall, S. Allison, C. Mulligan, K. Bailey and M. Tolson, "Research-based Web design and usability guidelines", URL: http://www.usability.gov/guidelines/guidelines_notice.html.
- [19] Nielsen, J. and Loranger, H., "Prioritizing Web usability", New Riders, Berkeley, 2006.