Factors Associated with Persistent Participation in an Online Diet Intervention

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Abstract
In recent years, much work has been carried out in interface design and service quality in order to maximise user experience and sustain engagement. We are often unsure, however, what factors really influence user interactions with the technologies. Here we report on an ongoing examination of the relationships between user demographics, self reported attitudes, efficacy, and system feature, and participation on an online diet support site. Our findings indicate that not only the characteristics of the users themselves are associated with sustained engagement with a weight loss site, but also that usage of particular features on the site results in higher return rates. These findings support a push for designers to understand their users and features of their site, in order to maximise engagement with their target audiences.

Keywords
Social network; diet; health; retention; usage; intervention

ACM Classification Keywords
H.5.2 [**Information Interfaces and Presentation**]: Miscellaneous

General Terms
Design, Human Factors, Experimentation.

Introduction

Building user loyalty and sustaining user engagement has always been a priority for online service providers. In some arenas, e.g., e-commerce, where customer loyalty is important, retaining even small numbers of users reaps significant rewards [5]. Social technologies, like Yahoo Answers and Wikipedia, survive by retaining users and their contributions in order to supply services and information [4]. In domains, like health and the environment, where online interventions are becoming more popular, the benefits of retaining users goes beyond financial gains and vibrant networks, and directly impact on user attitude and behaviour. Thus, retaining users in these domains can lead to an increase in the overall impact of the interventions.

Our work investigates the role of online technologies in supporting behaviour change in the overweight and obese. We aim to understand the scenarios and online environments that have high likelihood of intervention success. We wish to design and develop a suite of technologies aimed at maximising online intervention successes and uncover the market segments, for which online interventions work best. To this end we have designed, developed and launched an online social portal based on the CSIRO [1] Total Wellbeing Diet [2] which has been trialled by over 5000 Australians over a 12 week period. The aim of the study was to examine site usage and its relationship to weight loss and findings show that the longer a user interacted with our online portal the more weight they lost but we focus here on understanding how site usage impacted on retention and site usage over time. We propose that many factors influence the nature and intensity of online interactions with the portal, including a users initial weight, their stage of readiness, and the relationships formed online etc. Our findings show that fixed factors such as age and gender are all predictive of engagement with the site, but also that key actions carried out in early stages of user interaction not only predict whether a user will return to the site, but also the duration of active membership. Key social actions such as friending and blog reading as well as diet based actions such as meal planning were associated with persistence in participation. This understanding informs both the types of actions that should be promoted by designers of online dietary systems to retain users and also motivates intervention and communication strategies that could be implemented to attract participants, for whom online interventions are most likely to succeed.

[1] Commonwealth Scientific and Industrial Research Organisation

[2] http://www.csiro.au/Outcomes/Health-and-Wellbeing/Prevention/Total-Wellbeing-Diet.aspx

The Online Total Wellbeing Diet Portal

The Online Total Wellbeing Diet (TWD) portal is a lifestyle web site that combines social networking tools with an online dietary intervention program. It provides resources, tools and social support to individuals interested in sustained long term lifestyle change (see Figure 1).

Figure 1: Online TWD Home page.

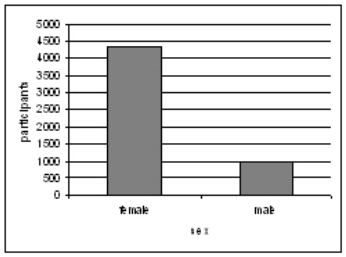

Figure 2: Participant Male/Female ratio

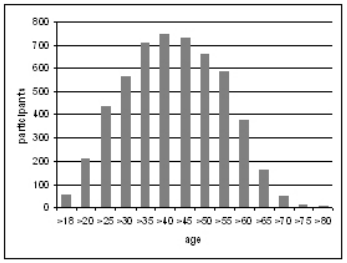

Figure 3: Participant Age distribution

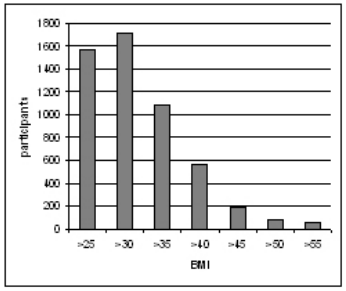

Figure 4: Participant BMI distribution

The Online TWD portal supports individuals embarking on the CSIRO's TWD program. The online information resources included information on the diet itself, recipes, exercises, menu plans, shopping lists, and other health-related articles. The portal included a suite of online planning and recording tools, such as a *Meal Planer* and a *Weight Tracker* that provided real-time visual feedback on decisions and progress [2].

The social component of the portal provided a suite of facilities, where individuals could draw upon the support from others on the diet. Each participant was represented by their *Profile Page*, which contained space for a photograph and image gallery, personal details, a message board, and a personal *Blog*. Public blogs could be seen by all site participants and were listed in a central blog digest. In the *Discussion Forum* participants could ask questions, provide support, seek advice, and discuss ideas and thoughts with the community at large. Finally, the portal contained a traditional *Activity Feed* to communicate with the community the actgivities of other users. Access to each component described above was achieved through a central dashboard shown in Figure 1.

Evaluation

A live user study of the Online Total Wellbeing Portal was carried out in 2010. 5279 overweight or obese adults (See Figures 2- 4) were recruited through a media campaign. Participants completed a behavioral questionnaire and agreed to embark on the CSIRO diet with the assistance of the portal for 12 weeks.

The retention curve in Figure 5 shows the portion of users, who were interacting with the site over the course of the study, i.e. those who logged on each week or in subsequent weeks. We observe a significant attrition in the first two weeks – about 50% of users who visited the site in the first week did not return. These users tried out the site, but failed to engage. Beyond this point, we observe a slower steady attrition rate over a prolonged period of time. The bars in Figure 5 show the attrition rate, i.e., the portion of users who visited the site that week but did not return in subsequent weeks. We observe that the attrition rate hovers around the 20% mark from week 2 onwards. We present here the initial results of an investigation into possible predictors of long term engagement with the online intervention program.

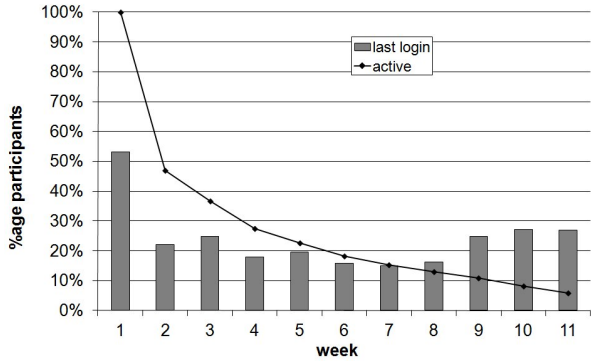

Figure 5: User Retention over 12 weeks.

Results

The success of online interventions relies on many factors including the participants themselves (their attitudes, stage of readiness, and feeling of control), the intervention itself, and its delivery. Here, we do not aim to investigate the impact of the intervention (diet) itself on participants, but rather the possible roles of the individual and their interactions with the technology through which the intervention is delivered, i.e. the online site. To this end, we concentrate our analysis on the results of the

Example Behavioural Questions

Perceived Behavioural Control:
I intend to stick to the TWD for the next 12 weeks
It's up to me whether or not I stick to the TWD for the next 12 weeks

Proactive Coping:
I am a 'take charge' person
I try to let things work out on their own

Intention to complete:
I intend to stick to the TWD for the next 12 weeks
I will try to stick to the TWD for the next 12 weeks

Weight Efficacy:
I can resist eating when I am anxious
I can resist eating even when I have to say "no" to others

Internet Usage:
How often per week do you use the internet?
What activities you regularly participate in when on the internet (Email, browsing/surfing, shopping, working/studying, playing games)?

behavioural questionnaire and the usage logs of the system and their relationships to the retention of participants with the online intervention.

The behavioral questionnaire that participants completed was designed to measure their feelings of intention and control associated with staying on the diet, level of proactive coping, body dissatisfaction, and weight-loss self-efficacy.

In addition to collecting basic demographic information, e.g., age, gender, weight, and height, the questionnaire asked 58 questions relating to Perceived Behavioural Control, Intention to Complete, Proactive Coping, and Weight Efficacy, responses for which were gathered on either a 4 or 7 point Likert scale. Intention and Perceived Behavioural Control are based on the Theory of Planned Behaviour and represent dietary intentions and control [1]. The intention to complete questions are modelled on work by [3]. Sample questions are listed in the left margin. The usage logs gathered data on the interactions with each of the site's features (blog, forum, meal planner, message board, content, and others) by each user for the duration of the study. Given the high attrition observed in the initial weeks, we focus the analysis on predicting attrition between weeks 1 and 2 of the study. That is, we examine the usage logs and the questionnaire responses in order to determine the relationships between usage and responses, and returning on week 2 or dropping out of the study.

The analysis concerning the questionnaire is straightforward. A logistic linear regression model with binomial errors was used to estimate the probability that a user will return after the first week of the study. Two predictive features were selected using the Bayes Information Criterion for model selection [6]: *Age* and *Gender*. Using a probability of 0.5 as a threshold, the combined predictor is only 55% accurate in predicting dropout and predicting return. Thus the demographics and the responses to the behavioural questionnaire proved not to be strong predictors of retention beyond the first week of the study.

We counted the number of days in which a user interacted with each site feature [3] in *week 1* in order to estimate the probability that a user will return in *week 2* and used logistic linear regression model to identify five predictive features: *Add Profile Image*, *Friending*, *View Blogs*, *Plan Meals*, and *View Content*[4] (p=0.01). Using a probability of 0.5 as a threshold, their combined predictor is 74% accurate in predicting dropout and 76% accurate in predicting return. Thus, the observed participants' interactions with the site are stronger predictors of retention than the demographics and questionnaire responses. The selected predictors are a mix of diet based features (Plan Meals, View Content) and networking features (Add Profile Image, Friending, and View Blogs) showing that continued participation is not reliant on engagement with either component, but rather on both components of the portal.

We examined the usage rates of each of the five predictive features and their correlation with users' return or drop out. As expected, most users (92%) browsed content on at least one day. Uptake of the other features however varies with 44% of users planning meals, 23% viewing blogs, only 6% making friends, and another 6% adding

[3] View Content, View profiles of others, View own profile, Add Profile Image, Add Profile Text, View Blogs, View Discussion Forum, Contribute to Discussion Forum, Contribute to Blogs, Write Wall Comment, Friending, Plan Meals, Check Diet Compliance, Click on News Feed, Record Weight

[4] We also measured interaction levels using raw counts of actions for each feature and obtained similar results.

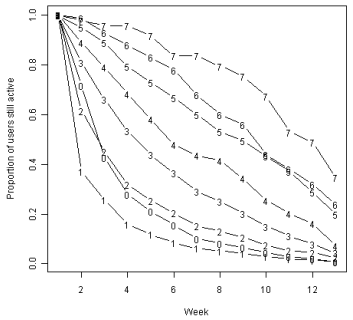

Figure 6: Content Viewing retention.

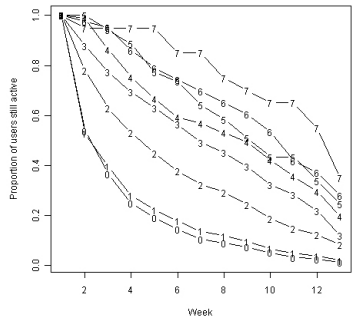

Figure 7: Meal Planning retention.

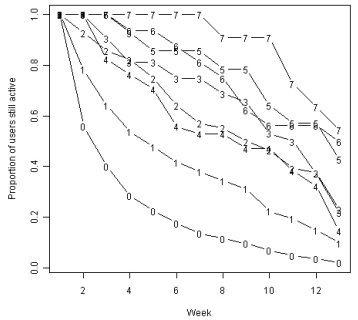

Figure 8: Friending retention.

profile image. Note that the distribution of users for the key dietary actions of viewing content and planning meals is spread across the seven days, while the distribution for the social actions is rather binary in nature.

Table 1 shows number of users who interacted with each social feature at least once in week 1 (uptake users) and the proportion of these users who returned in week 2 (return week 2). It also shows the number of users who did not use the feature in week 1 (others) and the proportion of those users who returned in week 2. We concentrate first on the least popular, yet predictive features of Friending and Adding Profile Image. For these, we note particularly high return rates (85% and 72%, respectively) in week 2 for users who made friends or added a profile image in week 1. Conversely, the return rates for those who did not carry out these actions is 36% only. We note similar findings for the blog viewing, with those who viewed blogs having a return rate of 64% in contrast to 31% of those who did not.

	uptake users	return week 2	others	return week 2
Add Profile Image	289	72%	4449	36%
Friending	308	85%	4430	36%
View Blogs	1097	64%	3641	31%

Table 1: Binary Predictive Features

	0	1	2	3	4	5	6	7
View Content (%)	28	38	65	83	92	98	95	95
Plan Meals (%)	19	21	45	66	80	92	97	98

Table 2: Distributive Predictive Features

The counts of feature usage for viewing content and planning meals in week 1 are shown in Table 2, ranging from 0 (no interaction) to 7 (interaction every day). For users who viewed no content we observe a return rate of only 28%. We see a clear upward trend as the number of content viewing days increases: 65% of users who viewed content on two days in week 1 returned in week 2 and 95% of those who viewed content every day in week 1 returned in week 2. When examining the meal planning data, we do not observe much difference between those who did not plan at all and those who only planned one day. However, we observe marked improvement in the return rate if two or more days were planned.

In addition to investigating the return rates from week 1 to week 2, we also examined the long term effect of carrying out these predictive actions in week 1. Figure 6 shows the proportion of users still active in each of the 12 weeks of the study out of those users who viewed content on 0 to 7 days in week 1. It can be seen that the more days users viewed content in week 1, the longer they remained engaged with the site. We observed similar results the other predictive actions. Figures 7 and 8 show similar trends observed for meal planning and friending.

Discussion

We have shown that fixed factors and initial interactions with the key site features are highly correlated with user retention on our weight loss portal. Women were more likely to remain on the website and older people. Surprisingly we did not observe patterns of retention when examining self reported weight efficacy, proactive coping or intention measures. In terms of site interactions, in cases, where users uploaded a profile image during their first week, they were twice as likely to return as those that did not. These users made an effort to represent

themselves visually, marking themselves as approachable and identifiable by other users. In the case of making friends online, 85% of those who made connections with others returned. We hypothesize that the friendships are the key to social interactions on the site, the connections provided motivation for regular site visits to communicate and keep up with the progress of others, strengthening the sense of community belonging, support and influence. Those who read the blogs benefited from the shared experiences of others: they see how others feel and behave, and can relate to their experiences. Finally, those who view the diet content have the knowledge to proceed on the diet and those who plan for the first week took control of their diet.

Continuing Work

This paper reported on a large scale user study on the predictive power of early interactions on short and long term user engagement in a diet related support site. While we noted no correlation between the behavioural questionnaire responses and general retention it is possible that individuals could be predisposed to certain behaviors on the site. For example, individuals of a certain age, or stage of readiness, or with certain coping strategies may approach the site in a way that makes them more likely to carry out particular tasks. We propose that it is often the repercussions of the action, and not the action itself, which influences retention. Uploading a photo could make you more approachable by others, which could enable you to make more friends; these friends are likely to write on your wall, comment on your blogs, share their experiences, and in general provide you with a sense of support, belonging and influence. Our next steps are to investigate thoroughly these issues by conducting further analysis on the data gathered in our behavioral questionnaire, in order to determine predictors for these key actions and explore persuasive ways of increasing interactions with these features to influence retention.

Our work suggests that when designing a web site or a social networking site, the designers should consider the actions (features) that users are encouraged to carry out (address) in order to increase the chances of returning to the site, therefore, increasing user engagement and the success of the site.

Acknowledgements

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References

[1] J. Francis, M. Eccles, M. Johnston, A. Walker, J. Grimshaw, R. Foy, E. Kaner, L. Smith, and D. Bonetti. Constructing questionnaires based on the theory of planned behaviour. *A manual for health services researchers*, 2004.

[2] J. Freyne, S. Berkovsky, N. Baghaei, S. Kimani, and G. Smith. Personalized techniques for lifestyle change. In *Proceedings Artificial Intelligence in Medicine, AIME 2011, Slovenia*, pages 139–148, 2011.

[3] E. Greenglass. Proactive coping and quality of life management. 2002.

[4] D. Martin. Twitter Quitters Post Roadblock to Long-Term Growth. http://blog.nielsen.com/nielsenwire/online_mobile/twitter-quitters-post-roadblock-to-long-term-growth.

[5] F. Reichheld and P. Schefter. E-loyalty: your secret weapon on the web. *Harvard business review*, 78(4):105–113, 2000.

[6] G. Schwarz. Estimating the dimension of a model. *The annals of statistics*, pages 461–464, 1978.