Tagliatelle: Social Tagging to Encourage Healthier Eating

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Abstract

This paper describes the design and initial evaluation of *Tag-liatelle*, a collaborative tagging application for encouraging healthier eating. Users photograph their own meals and upload these photos to a website, where fellow users anonymously tag them for content. Initial results suggest that tagging of food content is a popular activity. However, further work must be done to automate the extraction of valid nutritional information from the tags generated.

Keywords

Games for health, image tagging, photographic food diaries, nutrition, ubichomp.

ACM Classification Keywords

J.3 [Life and medical sciences]: *health,* H.5.3 [Group and Organization Interfaces]: *collaborative computing.*

General Terms

Design, Human Factors, Experimentation.

Introduction

The reduction of obesity is a major public health challenge [4]. Obesity in both children and adults has

increased substantially over the last decade in the UK, affecting 15% of children aged 2-10, and around a quarter of men and women, in 2007 [1]. Furthermore, excess weight can lead to a number of debilitating conditions for the sufferer including cancer, type 2 diabetes, cardiovascular disease, and stroke.

Studies have identified that high energy density, low-fibre, diets are major risk factors in the development of obesity [6]. Indeed, recent research indicates that diet alone can explain the observed trend of increasing obesity [9]. It cannot be overstated, therefore, that the development of new and innovative methodologies aimed at helping people determine the nutritional content of their own food intake and motivating them to choose healthier options is an urgent goal.

Technology for Encouraging Healthier Eating
In recent years there has been a growing interest in dietary interventions that utilise digital media and the Internet [5, 7, 14]. These tools allow for tailored behaviour change programs to be delivered to users on a large scale, as well as providing the means to monitor participants' engagement with the programmes and the delivery of timely and specific feedback to participants [7].

Measuring Nutritional Intake
A major challenge for applications that aim to help users make healthier eating choices is that of objectively measuring nutritional intake (see [10] for review). Food diaries, the most popular current method of doing so, (see [13]) are personal logbooks for recording daily food intake, which are used under the guidance of a professional dietitian. Whilst food diaries are a valuable component of small-scale interventions,

rolling out similar interventions to change eating behaviour to the general population as a preventative measure would be unfeasible, due the labour-intensive process of consultation and guidance with dietitians. Additionally, food diaries suffer problems of reliability commonly associated with self-reporting.

Photographic Food Diaries
Recent research shows that photographic food diaries, which encourage participants to capture photos or digital images of their meals, can be used to mitigate some of the drawbacks to paper-based food diaries [14]. Such approaches are less dependent on participants' memory and honesty, and therefore can more accurately record portion sizes and food quality. Photographic diaries also have the advantage that they encourage participants to reflect upon food eaten at the time of eating, rather than afterwards, a process that has been attributed to improved dietary intake [14]. However, existing photo-based interventions such as *myfoodphone.com* (see [5]), still require the intervention of a trained dietician, or else rely on relatively simple, reflective prompting.

Social Tagging Applications
Recent developments in game-like tagging applications, commonly referred to as 'Games with a Purpose (GWAPs), offer the possibility of generating highly scalable tools for the analysis of participants dietary intake. *The ESP Game* and *Peekaboom* [11] have utilised users in order to perform a task that remains beyond the state-of-the-art in image processing; the tagging of digital images with relevant content labels that can later be used in text-based image retrieval. In effect, the players of these games function as a data analysis tool [12].

Figure 1. Examples of some images uploaded by participants.

We propose that a similar model of data analysis may be ideal for augmenting photographic food diaries. Specifically, users may tag uploaded food image content in the same way that players of The ESP Game and Peekaboom tag image content. This model is both novel within dietary interventions and is highly scalable, since additional users necessarily provide the system with additional processing power.

In addition, this project aims to exploit the persuasive power of social media as a means of facilitating behaviour change. Specifically, we propose that exposing participants' eating habits to each other may act as triggers [2] for motivating both healthier food choice and the maintenance of those choices over an extended time.

Tag-liatelle

Tag-liatelle is a web-based application that enables users to upload digital photos of meals that they have eaten to a server, which anonymously distributes these photos to other users for tagging. Each user is required to tag one photo that has been previously uploaded by another user before they can upload a photo of their own. In addition, users are free to visit the Tag-liatelle website at any time in order to tag randomly selected images. Thus, each photo uploaded is tagged a number of times, generating a rich history of tags for each photograph uploaded. A basic prototype of this application, which included only these essential elements and no further design embellishments, was evaluated in the current study.

Evaluation

The current study examines whether participants were motivated by the Tag-liatelle application to regularly

photograph their meals and to upload these photographs to a website. It also examines participants' willingness to tag the photos uploaded by fellow users.

As a secondary goal, the study examines the feasibility of retrieving nutritional information about the food in the uploaded photograph from tags generated by users. The current study will analyse to what extent the tags generated by participants using Tag-liatelle appear in the United States Department of Agricultures (USDA) Food and Nutrient Database for Dietary Studies, a database containing full nutritional information for over 13,000 different foods [8]. The USDA database was chosen for this initial feasibility study due to its comprehensiveness and the fact that it was free-to-use and available online.

Methodology

Fourteen participants were recruited from staff in the Media, Humanities and Technology faculty in the University of Lincoln. The evaluation focused on two areas that appear to be most critical in the development of social tagging tools for dietary analysis; whether participants will use the system regularly and whether the tags generated can be used to provide useful nutritional information.

Results

Nine of the fourteen participants recruited regularly uploaded and tagged food photographs over the course of the seven-day trial. Thus, there was a 64% uptake rate. The remaining five participants did not produce any activity and have been excluded from the following analysis.
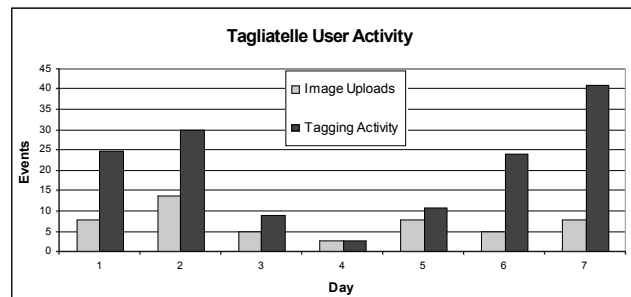
Tagliatelle User Activity

Figure 2. User activity over the course of the seven day trial.

Figure 1 displays a log of user activity over the course of the study. Forty-nine photos were uploaded in total by the 9 participants, an average of 5.44 photos per participant, or less than one photo per participant, per day of the study. Users generated 249 tags in total over the course of the study, an average of 27.6 tags per participant. Thus, while participants did not upload photographs with great regularity, they did produce a large number of tags.

In order to evaluate whether the tags generated by participants were useful for retrieving nutritional information about the food in the uploaded photographs, each of the 249 tags generated by users were entered into the USDA Food and Nutrient Database for Dietary Studies[1]. It was noted whether each tag matched any entries in the database and whether or not that tag found one exact match in the database. It was also noted whether tags included portion information such as size, weight or numbers and whether tags were evaluative rather than

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[1] The search function used is available at http://www.nal.usda.gov/fnic/foodcomp/search/index.html

descriptive. Evaluative tags (e.g. tags like "unhealthy") are less useful in analysing food content than descriptive tags (e.g. tags like "chips").

Table 1. Analysis of user generated tags

	Appears in database	One Exact match in database	Portion information	Evaluative tags
Number	161	6	46	38
Percentage of Total	64.65%	2.4%	18.47%	15.26%

Table 1 presents descriptive statistics that detail the composition of tags generated by participants in the current study. 64.65% (or 161) of the total 249 tags generated by participants matched entries in the Food and Nutrient database. Not shown in Table 1, those 161 tags each matched an average of 105.77 entries. Only 2.4% of tags generated matched a single entry in the database and only 18.47% of all tags contained portion information. Thus, it does not appear that participant-generated tags were specific enough in order to easily derive nutritional information about the food content of the uploaded photographs from the USDA database.

15.26% of tags generated were evaluative rather than descriptive in nature. The other 84.74% of tags did describe the food in the uploaded photograph to some extent. So, while the method devised for translating tags into nutritional information in the current study

was not useful, it does appear that most tags generated did contain useful descriptive information.

DISCUSSION

The current paper describes an initial evaluation of a social tagging application designed to encourage users to make healthier food choices. The evaluation focused on two areas; whether participants were motivated to engage regularly with this very basic tagging application and whether the tags generated could provide useable nutritional information. It should be noted that the 7-day trial used to evaluate the system was far from ideal in terms of evaluating long-term usefulness of social tagging activities. Specifically, new technology often experiences a novelty effect upon introduction, which wears off after a short period of time. As the ambition is to create long-term behaviour change, a longer-term trial must be implemented as this project progresses.

The uptake rate in the current study is lower than expected, with 36% of recruited participants not engaging with the application. However, it must be noted that the current study evaluated a very basic and sparse experimental prototype of the application. It is envisioned that the inclusion of more explicit social and gaming elements to future versions will improve the level of uptake.

The number of photos uploaded by each user was low, with an average of less than one photo uploaded per day, per participant. Hence, it was not possible to form a comprehensive judgement about the eating habits of the trial participants from the data gathered in this study. It is possible that the social nature of the Tag-liatelle system may create an incentive not only for

eating more healthily, but also for failing to report any meals that the player feels would be met with disapproval from fellow users of the application. Evidently, in order for the system to record user diet more accurately, there needs to be clearer incentives for players to fully disclose their entire diet than were available in this initial study. In future work, we will investigate the use of online games and social networking websites for precisely this purpose.

While the number of photo uploads recorded per participant was very low, the activity of tagging images provided by others did prove popular. Participants were only required to tag one photo per each photo they uploaded themselves. However, the majority of participants tagged far more photos than they uploaded. This finding supports the suggestion that social tagging of food photographs may be an attractive activity for users and is promising for future work in this area.

The majority of tags added to food photographs were not sufficiently detailed to match entries in a standardised nutrition database. Thus, the goal of eliminating the requirement for a dietitian within photographic food diaries was not achieved in this initial study. However, findings of the current study will guide the direction of future research towards that goal. Specifically, perhaps due to the playful nature of the application, participants in the current study commonly tagged photographs with colloquial terms for food that had a more formal name within the database. Cultural differences between the location where the trial was carried out (UK) and the origin of the database (USA) also seem to have affected results. Thus, in addition to sourcing a UK-based food database, it

appears that the development of a tool that is capable of translating colloquial and regional-specific terms into those found in a standardised database is an essential requirement as this project progresses.

CONCLUSIONS

Despite the rudimentary nature of the prototype application evaluated in the current study, the number of tags generated by participants demonstrates that social tagging systems represent a promising method of designing scalable healthier-eating interventions. Further work must be conducted to improve the motivation of users to record all food intake, and to automate the extraction of nutritional information from the tags generated. We also see potential to use social tagging analysis of food imagery to support initiatives such as sustainable food culture [3] whereby nutritional tags could be substituted with ethical ones.

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