Gender Differences in Response to a Mobile Health Game

Theodore Lee
Sahara Byrne
Geri Gay
Cornell University
Ithaca, NY 14850, USA
theodore.lee@cornell.edu
seb272@cornell.edu
gkg1@cornell.edu

John Pollak
Cornell Tech
New York, NY 10011, USA
jpp9@cornell.edu

Daniela Retelny
Stanford University
Stanford, CA 94305, USA
dretelny@stanford.edu

Amy Gonzales
Indiana University
Bloomington, IN 47405, USA
gonzaamy@indiana.edu

Abstract
This work demonstrates how gender may be an important consideration in the design of a mobile phone application designed to encourage adolescents to engage in healthy eating. In this randomized field experiment, fifty-seven U.S. high school freshmen (13-14 years old) were given Apple iPhones for 10 days. The goal was to test if caring for a virtual pet would encourage participants to eat breakfast more frequently and with greater healthiness. Boys and girls responded differently to the treatments. Boys who could see others' pets ate significantly healthier than boys who could only see their own pet. However, girls who could only see their pet ate healthier than boys in the same condition. Girls did not respond as well as boys to being able to see peers' pets. Results are partially explained by competition and social pressure. Implications of gender and treatment differences for design are discussed.

Author Keywords
Adolescents, breakfast, eating, gender, mobile.

ACM Classification Keywords
H.5.3. Group and Organization Interfaces; Asynchronous interaction; Theory and models; Web-based interaction.

Figure 1. Sample iPhone screen of social viewing condition (1). Participants are able to view the healthiness status and breakfast history of group mates.

Introduction

As the national obesity percentage continues to increase past two-thirds, solutions are desperately needed to reduce the loss of productivity and life [5]. We concentrate on encouraging healthy breakfast eating from childhood using a mobile health game. First, one implication of encapsulation 47 studies is that while eating a healthy breakfast is ideal, eating almost any traditional breakfast food is better for young people than not eating at all [9]. Second, mobile games have successfully demonstrated the ability to promote healthy behaviors in youth [7,10,12]. Third, although work has been done assessing the impact of different player types on health games [3,14], there has not been a game that specifically tests the impact of gender in socially-oriented pro-health games. Our study draws on past mobile game research as well as classic gender literature to discuss gender implications for health games.

Social support is positively associated with readiness for healthy dietary change [1]. Therefore, positive social interactions can lead to healthier eating:

H1a: Individuals assigned to a condition allowing social interaction will eat breakfast more often than those (without social interaction) in the individual condition.

H1b: Individuals assigned to a condition allowing social interaction will eat healthier breakfasts than those (without social interaction) in the individual condition.

However, while social support may help individuals make healthy choices, theory and research on gender differences gives us reason to pause. Boys and girls may react differently to social interactions because of gender differences in social support [11], social norms [1], and competition [15]. Therefore, we propose:

H2: Across conditions, there will be a main effect for gender such that girls will eat breakfast less frequently than boys.

H3a: Girls will eat breakfast less frequently in the social condition than in the individual condition.

H3b: Girls who do eat will eat more healthy breakfasts in the social condition than in the individual condition.

H4a: Boys will eat breakfast more frequently in the social condition than in the individual condition.

H4b: Boys who do eat will eat healthier breakfasts in the social condition than in the individual condition.

RQ1: Can social pressure explain observed differences?

RQ2: Can competition explain observed differences?

METHODS

This study adds on the utility of the mobile game "Time to Eat" to elicit healthy breakfast eating in adolescents by adding a social component to the base application [4]. The base design has has successfully increased

Feedback included phrases, e.g.:

(2) "YUM! That was a great breakfast. I loved the toast, orange juice and apples you ate."

(1) "Good job eating breakfast, but tomorrow I might need something a little healthier."

Figure 2. Sample text feedback to users based on healthiness.

breakfast eating in a sample of younger youth [4,10]. For brevity's sake, please consult references for details of the original design.

Twenty-one males and 31 females drawn from three 9th-grade English honors U.S. high school classrooms participated in this experiment (n = 52). Subjects were assigned randomly to one of three conditions in groups of seven. All groups had both boys and girls. Furthermore, all conditions had access to a chat interface from which they could chat with other participants.

CONDITION 1

Subjects chose and named one of 9 pets. When subjects opened the game, they saw a screen that featured their pet in the middle and their group mates' pets on the sides (Figure 1). Participants were asked to email a picture of their breakfast every morning from their iPhones. Based on their responses, they received visual and textual feedback. The pet's status was indicative of their current healthiness score; they did not see their score numerically nor were they told of the scoring. Users could not only see their peers' pet status, but could also click on the pets of others in their group to see their peers' breakfast picture history.

CONDITION 2

In the second condition (pet-only), subjects played the same game as condition 1, but they only saw their own pet and own breakfast history. They could not see the pets of their peers nor their peers' breakfast history.

CONDITION 3 (CONTROL)

There was no pet interface of any kind in the control. Instead, they were merely asked to take a picture of their breakfast every morning and send it to our email address. This served to control for the novelty of the iPhone, the priming of taking breakfast pictures, and participation in the study.

Measures

The primary behavioral measure used in this study is based on the breakfast pictures emailed daily by all participants. A pair of trained undergraduate research assistants collaboratively processed photos within an hour of submission. The rubric is identical to the one previously developed [4], coincides with USDA guidelines [13], and is consistent with classic cognitive theories in that positive and negative feedback is provided (Figure 2, 3) [2]. Breakfast scores ranged from -2 to 2 based on healthiness (M = 1.33, SD = .41). We treated non-submission (112 of 520 total possible responses; 21%) as not eating breakfast.

Figure 3. Range of visual feedback for a pet. Pets are most unhappy when subjects repeatedly do not eat breakfast and happiest when they eat a balanced one.

We measured variables using 7-point Likert scales (*Disagree strongly* to *agree strongly*). Participants self-reported responses to the item *I was aware that people would know if I didn't eat breakfast* (M = 4.66, SD = 1.59) in order to confirm that the social condition was actually different from the pet-only condition.

Feedback included phrases, e.g.:

(0) "It is good that you are eating breakfast in the morning, but it could be better. How about trying some oatmeal with fruit tomorrow instead of pancakes with whipped cream and syrup?"

(-1) "I didn't get breakfast this morning so I don't have much energy today."

(-2) "You didn't feed me breakfast. Starting tomorrow, try to have breakfast every day!"

Figure 2. Sample text feedback to users based on healthiness.

Since we described participants' duties as their "job", general pressure was measured via *I felt pressured to do my job* (M = 3.33, SD = 1.72). Competition to win was evaluated via subjects' agreement with *I did better at my job than others in my group* (M = 4.00, SD = 1.12), adapted from items on the Competitiveness Questionnaire [6].

RESULTS

Shapiro-Wilk tests reveal that distributions are normal, even within conditions. A Bonferroni correction is not necessary because we only perform one analysis per dependent variable and the correction may result in Type II errors [8]. A 2 (condition: social/individual) X 2 (gender) UNIANOVA confirmed a successful manipulation, $F(3, 31) = 2.68$, $p = .06$, $\eta p2 = .21$.

A 3 (condition) X 2 (gender) analysis of variance was conducted on breakfast frequency. Results indicated no main effect for condition or gender, and there was no significant gender X condition interaction. Thus, H1a, H2, H3a, H4a are not confirmed. That said, this finding is readily explained by a possible ceiling effect - across all three conditions, participants ate breakfast 79% of the time (Range = 0-10, M = 7.85, SD = 2.31).

A separate 3 (condition) X 2 (gender) analysis of variance was conducted on breakfast healthiness. Results, illustrated in Figure 4, indicated no main effect for condition or gender; rather, a significant gender X condition interaction emerged, $F(2, 46) = 3.41$, $p < .05$, $\eta p2 = .13$. Specifically, pairwise comparisons indicated that males and females in the pet-only condition 2 ate differently, $F(1, 46) = 4.57$, $p < .05$, $\eta p2 = .09$. Girls in the individual condition (M = 1.49, SD = 0.41) ate healthier than boys in the individual condition (M = 1.06, SD = 0.57). Second, males who could see each other's pets ate significantly healthier (M = 1.59, SD = 0.19) than boys who could not see others' pets (M = 1.06, SD = .57), $F(2, 46) = 3.13$, $p < .05$, $\eta p2 = .12$. Females who could see others' pets did not eat significantly healthier (M = 1.31, SD = 0.33) than girls who could not (M = 1.49, SD = 0.41), $F(2, 46) = 0.83$, $p = .44$, $\eta p2 = .04$).

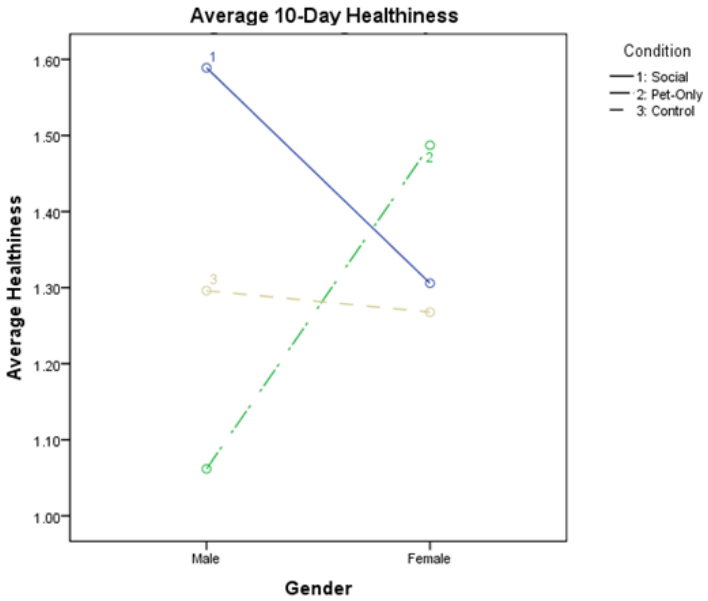

Figure 4. Gender*Condition Interaction in Breakfast Healthiness. Males in the social condition eat particularly healthily.

Although H1b and H3b are not supported, these results lend support to H4b since there is a significant difference such that the boys in the social condition ate

healthier (M = 1.59, SD = 0.19) than the boys in the pet-only condition (M = 1.06, SD = 0.57, $p < .02$).

Addressing Research Questions

Our data suggests that social pressure likely played a role in these results. In a significant 2 (condition: social/individual) X 2 (gender) generalized linear model ($F(3, 32) = 8.99$, $p = .03$), gender ($\chi 2 = 4.24$, $p = .04$) and condition ($\chi 2 = 4.02$, $p < .05$) both had significant main effects on subjects' pressure to do their job. Specifically, participants in the social viewing condition felt more pressure (M = 4.00, SD = 1.70) than those in the pet-only condition (M = 2.81, SD = 1.28). Additionally, across conditions, girls reported feeling more general pressure (M = 3.61, SD = 1.73) than boys (M = 2.90, SD = 1.67).

Similarly, competition explains some differences. A significant 2 (condition: social/individual) X 2 (gender) generalized linear model ($F(3, 32) = 10.00$, $p = .02$) revealed a significant main effect for condition ($\chi 2 = 5.66$, $p = .01$). Specifically, participants in the social viewing condition reported feeling that they did better than others in their group (M = 4.58, SD = .77) compared to those in the individual condition (M = 3.81, SD = 1.28) and control (M = 3.53, SD = 1.07). Thus, it appears that competition may be a factor in predicting breakfast healthiness, particularly for boys in social environments.

DISCUSSION & IMPLICATIONS

The results from this study demonstrate that gender plays a complicated role in social situations, particularly in situations where food is involved. Although main effects of gender and condition were not observed, there is a significant interaction between the two. Boys in this study may have reacted strongly (by eating healthier) to competitive pressures in a social environment while girls did not. Instead, girls ate healthier when they played the game alone rather than in a social environment. These findings indicate that gender and competitive pressures are important design considerations.

First, this experiment effectively rendered a previously private eating behavior (breakfast) into a semi-public behavior; unfamiliarity with this privacy change might have contributed to the "weird" feelings reported. These findings call into question the recent propensity towards socially-based interventions and whether they are always appropriate.

Second, gender is an important consideration when designing mobile health applications. Since boys and girls differ in their competitive tendencies, different approaches should be made (e.g. girls competing alongside others, boys competing against others). While not always mutually exclusive, the two paths might be best implemented separately. Alternatively, measuring users' competitive nature prior to an intervention and tailoring their experience appropriately could also prove effective.

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