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"When I Eat so Bad, my Pet Looks so Sad"
An Initial Test of the Persuasive Effect of Feedback from a Mobile Phone Virtual Pet on Adolescent Breakfast Intake

Sahara Byrne, Ph.D.
Assistant Professor, Communication

Geri Gay, Ph.D.
Professor and Chair, Communication
Faculty of Computer and Information Science

J. P. Pollak, M.S.
Doctoral Candidate, Computer and Information Science

Daniela Retelny
Research Assistant, Computer and Information Science

Amy Gonzales, M.S.
Doctoral Candidate, Communication

Brian Wansink, Ph.D.
Professor, Applied Economics and Marketing

Cornell University

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Abstract

A randomized field experiment with 53 adolescents tests the effects of a virtual pet game on likelihood to eat breakfast. Manipulations included varying positive and negative feedback from the virtual pet as it responded to photos of participants' breakfast meals. Additional tests compared the pet game to isolated formal features of the game such as sending in photos of breakfast consumed. Results indicate that participants with a Virtual Pet enabled to become sad (positive and negative feedback) were twice as likely to eat breakfast than those with a pet that was programmed to remain, at worst, in a visually neutral state (positive feedback only) and participants assigned to a condition that did not involve care for a pet but required breakfast photos. Additionally, participants exposed to negative feedback were more attached to their pet, worked harder for their pet, and enjoyed participating more than their peers. When participants did eat breakfast, there were no differences across conditions in how healthy the breakfasts was rated. Participants who never saw a sad pet appeared to develop the idea that breakfast is not important when compared to teens in all other conditions, including a true control. Overall, pets that can respond to participants' health behaviors with a range of expressions, from positive to negative, appear to elicit behavior change in the desired direction.

"When I Eat so Bad, my Pet Looks so Sad"
An Initial test of the Persuasive Effect of Feedback from a Mobile Phone Virtual Pet on Adolescent's Healthy Breakfast Intake

Persuading adolescents to modify their nutritional health behaviors presents a unique developmental challenge. Teens often tend to fail to make nutritional decisions appropriately (Story, Neumark-Sztainer & French, 2002), most likely because they are dependent on environmental resources at home and school (Ball et al., 2009; Richards et al., 2007), and have all but cemented lifelong eating preferences (Larson et al, 2006). At the same time, this age group may not be fully armed to make decisions for themselves. Adolescents are developmentally geared toward independent thinking and resistance to authority (Jessor, 1992). This combination of autonomy-seeking and resistance leads to problematic reactions to adult interventions, especially when it comes to the adoption of behaviors that are supposed to be "good for you". Teens are especially likely to resist messages that threaten their freedoms, such as the freedom to eat what you want (Brehm, 1966; Dillard & Shen, 2005). Unfortunately, if these adolescents perceive that a behavior they enjoy is under threat, health messages may cause an increase in the unhealthy behaviors targeted for change (Brehm, S. S., & Brehm, J. W., 1981).

The aim of this study is to come to adolescents on their turf by delivering a communicative message that prevents a negative response to adult intervention by increasing motivation and reducing reactance. To this end, we test the persuasive efficacy of a mobile phone based virtual-pet game to alter the nutritional behaviors of adolescents. We seek to know if caring for oneself through care for a virtual pet can result in behavior change through several mechanisms uniquely deliverable through mobile technology. While virtual care may apply to a multitude of behaviors, the

behavior under investigation here is increasing the likelihood of adolescent breakfast intake.

Breakfast and Adolescents

Skipping breakfast is becoming a common behavior in the United States population (Siega-Riz et al., 1996). Breakfast skipping has been linked to health-compromising behaviors and lifestyles among adolescents (Rahkonen et al., 2002) such as poor overall diet (Nicklas et al., 1993; Sampson et al., 1995), smoking (Sjoberg et al., 2003; Yorulmaz et al., 2002), infrequent exercise (Aarnio et al., 2002; Keski et al., 2003), and dieting or concerns about body weight (Brugman et al., 1997; Cohen et al., 2003). Unfortunately, as children and adolescents get older, they tend to skip breakfast more than any other meal (Siega-Riz et al., 2005).

There is a great deal of evidence suggesting that breakfast as part of a healthful diet and lifestyle can positively impact children's health and well-being. Rampersaud et al. (2005) summarized the results of 47 studies examining the association of breakfast consumption with nutritional adequacy, body weight, and academic performance in children and adolescents. The researchers concluded that even though the quality of the breakfast consumed varied within and between participants, children who report eating breakfast regularly tend to have superior nutritional profiles, be less overweight, have improved cognitive function, and demonstrate higher academic performance than their breakfast-skipping peers (Rampersaud et al., 2005). These findings suggest that it is better for adolescents to eat something for breakfast rather than skipping breakfast all together.

Armed with evidence that eating breakfast is important, researchers are beginning to investigate how to promote breakfast eating among adolescents. In order to intervene

and promote healthy eating behaviors, researchers have looked at why some individuals regularly eat breakfast while others do not. Moore et al. (2009) found that an individual's attitude and norms towards breakfast to be the strongest correlate of breakfast skipping – adolescents tend to eat breakfast when they report that it is easy for them to do so, and when they perceive that their friends or parents usually eat breakfast (Moore). These findings suggest that we can encourage students to consume breakfast by developing systems that change the way they feel about their breakfast routines.

Teens and their phones

Adolescents regard mobile phones as an indispensible communication device. Evidence suggests that many teens will even sleep with their mobile phones (Pew, 2009). In fact, 79% percent of teens with parents earning above $75,000 a year own a cell phone (Lehart et al., 2008). However, many teens in households with lower incomes own a cell phone, with 63% of teens with parents earning under $50,000 possessing mobile phones (Lenhart et al.). Adolescents use the mobile phone for much more than making phone calls. They increasingly view their phones as an immediate and entertaining link to their entire social network and an essential partner in the construction and organization of their social identity. Between 6th and 9th grade, cell phone ownership jumps 37%, with nearly 60% of teens owning a phone by the time they are 17, and these numbers are growing (Lehhart, 2005). This is no surprise, because these media-savvy teens still have one thing in common with teens of previous generations, they rely less on their parents and more on their peers during this developmental transition into adulthood (Berndt, 1996).

Teens today, however, are driving the use of new mobile technologies built into their phones. Services such as text-messaging, camera phones, and multimedia messaging systems (MMS) are used by over half of teens with cell phones (Ernest-Jones,

2004). With the busy lives of teens today, the cell phone provides a parent-approved instrument with which teens can textually and visually connect to similarly busy peers, construct identity and be entertained. Teens consider the phone a fashion statement as well as a tool for achieving personal independence (Ito, 2003). Some have argued that mobile phones can even provide compensation for human companionship (Humphreys, 2005).

Mobile technology and health

A decade ago, health behavior change was identified as the second most significant domain for persuasive technologies, next to marketing (King & Tester, 1999). Mobile phones in particular have recently fascinated scholars of persuasion for the ability to deliver the perfect message at the perfect time (Fogg, 2002). Given the wealth of knowledge a mobile phone possesses about its owner and the fact that it is almost always switched on, persuasive messages can be personalized based on individual traits and habits, and these messages can be delivered at just the right moment based on current location, time, and even the users' stored schedule. The fact that the mobile phone is always connected and often equipped with access to the Internet gives the user confidence that the quality and relevancy of the information received in these messages is very high (Gay, 2009). With this being the case, information received from the device is deemed to be not only of a high quality but also trustworthy and supportive (Fogg, 2002). Given that people view their phones as highly supportive of their social life and activities, we propose to examine how interaction with a virtual pet on a mobile phone can help young people maintain healthy eating and exercise routines.

Though mobile phones may be ideally suited for the delivery of messages that will motivate an individual to change—individuals must first be receptive to the source of the message before they will make any changes to their attitude or behavior.

Pets as persuaders

In reality, the human-pet bond has been established as having multiple health benefits to the human caregivers (Baker & Wolen, 2008; Friedmann & Son, 2009). In order to maximize the benefits of caring for a pet, albeit a virtual one, we looked to related research in avatars. Avatars digitally represent human behaviors, usually in real time (Bailenson & Blascovich, 2004), but they need not always be replications of the human user. In fact, young people are more likely to enjoy and relate to animated characters that appeal to them by being cute or attractive (Sheth, 2003). Avatars, such as virtual pets, can effectively stand in for a human 'teacher,' especially in e-learning situations that aim to initiate healthy behaviors. The ultimate goal of avatars in the health context is to instigate tailored, personalized, interactive learning that functions to cover areas of user weakness without appearing critical or singling out a user publically (Sheth, 2003). A message coming from a likeable, dependent pet that interacts with adolescents may encounter less resistance than a message from an authority figure (Altschuter, 2007).

One such way to realize the benefits of virtual interaction is through mobile phone gaming. Recently, several studies have established that both video games and mobile phones, independently, can be effective mechanisms for changing health behaviors. For example, because mobile phones are ubiquitous, studies have shown these personal devices can help people quit smoking (Rodgers, et al, 2005), exercise more (Consolvo, et al, 2009), and be more mindful of healthy eating (Grimes, et al, 2008). Both desktop video games and, more recently, mobile phone games have been viewed as positive

mechanisms for health behavior change, such as improving diet (Peng, 2009), increasing exercise (Warburton, et al, 2007), and managing chronic diseases such as diabetes (Brown, et al, 1997).

Therefore, our goal is to provide the participants with feedback that comes directly from the user's personally chosen pet, which will indicate the rewards and consequences of the user's unique eating behaviors.

Motivating Behavior Change

One of the most frustrating outcomes of persuasive intentions is that the target does not always comply with the message. Social cognitive theory (Bandura 1986; 2004) offers guidance in how to effectively design and deliver messages that motivate change in adolescent eating behavior. According to Bandura, humans possess a unique ability to observe and mentally retain behaviors modeled by others but, when presented with a behavioral decision, must be independently motivated to engage in a similar behavior. Factors such as the observation of associated rewards and punishment provide a form of feedback that, together with sufficient self-efficacy, can motivate behavior change.

Feedback

Identifying the persuasive value of positive feedback versus negative feedback is a point subject to inconsistent findings in the literature to date (see, for example, Fox & Bailenson, 2009). In a recent meta-analysis of studies on vicarious punishment, a form of negative feedback, participants exposed to such interventions consistently demonstrated effective behavior change (d =.58), (Malouff, Thorsteinsson, Schutte, & Rooke, 2009). On the other hand, research has also shown that positive feedback is a stronger mechanism for affecting long-term adaptation of new behavior than negative feedback. Ilies and Judge (2005) have shown that when given feedback across time, individuals

constantly adjusted their goals to close the goal-outcome gap. Positive feedback indicating goal attainment led individuals to set higher subsequent goals, and negative feedback indicating goal nonattainment led them to adjust subsequent goals downward. Therefore, positive feedback can encourage people to strive for better performance, while negative feedback causes people to lower their expectations. Consolvo, McDonald, & Landay (2009) have developed a design schema for providing feedback to a user based on his or her physical activity as measured by an accelerometer and various activity sensing algorithms. In their design, users were given only positive feedback. Feedback was presented to the user in the form of an ever-changing image of a garden, displayed on the mobile phone's home screen. While these researchers argue that the lack of negative feedback was integral to the game's success, they did not directly compare participants who received positive feedback against those in a condition that received negative feedback.

There is also some evidence that negative feedback can be harmful. For example, Lin et al. (2006) demonstrated that feedback is important for individuals interacting with a virtual pet in their work with the pedometer-based game Fish'n'Steps. In Fish'n'Steps, the user is given a virtual fish that resides on their computer whose state is determined by the number of steps the user takes on a daily basis, as recorded by a simple pedometer. The fish increasing in size is positive feedback and the fish decreasing in size is negative feedback. Lin et al. did not directly examine the nature of feedback experimentally, but their findings suggested that a number of subjects who received negative feedback stopped playing the game altogether. We cannot know with certainty if they stopped playing to avoid negative interactions with their fish.

To better understand the role of negative feedback in motivating behavior change we ask the following research questions:

RQ1: Will users who receive positive feedback only from their pet eat breakfast more regularly than users who receive both positive and negative feedback?

RQ2: Will users who receive positive feedback only from their pet eat healthier breakfasts than users who receive both positive and negative feedback?

RQ3: Will users who receive positive feedback only from their pet report enjoying the game more than users who receive both positive and negative feedback?

Attachment

The concept of feedback may also influence how attached teens are to their pet. Including both negative and positive feedback may serve to increase participants' pet attachment. Participants that receive negative feedback in the form of a sad pet may find their pets more believable, as appropriate emotional responses enhances the realism of virtual characters (Shapiro, Pena-Herborn, & Hancock, 2006). A pet that becomes sad and happy is more representative of a real animal then a pet that never becomes sad. Having a sad pet may thus more strongly activate the "human-pet" attachment bond, which is based on role that humans play as the caregiver by providing for the needs of the animal (Archer, 1997). However, seeing a pet become sad may result in participants distancing themselves from the virtual creature in order to reduce dissonance and feelings of failure (Lin et al., 2006). Similarly, a pet that never becomes sad might result in greater attachment because that pet is fun, and easy to care for. Given these arguments, we ask:

RQ4: Will users who receive positive feedback only from their pet report greater attachment and motivation to help the pet than users who receive both positive

and negative feedback?

Self-Efficacy

Because feedback occurs as a direct result of behavior, it is closely related to the concept of self-efficacy. Bandura (1977) posited that efficacy expectations are based in part on performance accomplishments and vicarious experiences. Negative and positive feedback from the pet (vicarious responses) may impact one's eating behaviors (performance) in a pro-social way if that feedback leads to an increase in self-efficacy. However, as stated above, while one can argue that exposure to positive feedback only will charge self-efficacy, it is also possible that negative feedback to unhealthy behaviors will motivate the targeted behavior in an effort to obtain positive feedback and thus increase self-efficacy when successful.

RQ5: Will users who receive only positive feedback from their pet report greater self-efficacy for eating behaviors than users who receive both positive and negative feedback?

Alternative motivational factors

It is also possible that having a virtual pet that responds to one's recorded behaviors functions to instigate behavior change simply because the user knows he or she is being observed as they perform the behavior. The concept of social facilitation asserts that individuals are more likely to perform simple or well-learned behaviors if they believe that their behavior is being watched (O'Keefe, 2002). Bandura and Walters (1963) were among the early researchers of social facilitation, and through their studies, found that behavioral imitation and response patterns could be acquired through observation. Some researchers believe that an individual simply perceiving that their behavior is being monitored, even by a computer system or device, will improve

performance or behavior (O'Keefe, 2002). In a persuasive technology context, social facilitation can be supported through message boards, buddy lists, and other simple representations that let users know that others are logged in and participating and that participation in the interaction is being observed. In the nutritional context, food diaries that can potentially be observed by support groups or nutritionists have been seen as effective ways to increase healthy behaviors. Similarly, taking photos of meals and submitting the photos to an unidentified 'other' may be enough to create social facilitation. To test the effect of the pet game over and above social facilitation, we aim to compare participants who play the pet game to participants without pets, but who perform behaviors built into the game that might promote breakfast eating independent of the pet. These features include receiving reminder email, taking a photo of breakfast, and submitting photographic evidence of breakfast to the experimenters.

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RQ6: Will users in either Virtual Pet condition demonstrate healthier breakfast behaviors than users who submit pictures without Virtual pets?

RQ7: Will users in either Virtual Pet condition self-report healthier breakfast behaviors, more positive attitudes toward their assigned task, and/or greater self-efficacy compared to users who send pictures without Virtual pets and those in the control group?

Reactance

One of the major theoretical advantages to the persuasive technology being investigated in this study is that the virtual pet game may function to deliver a pro-social message to adolescents without initiating resistance the message. Often, individuals will reject the ideas being communicated in a persuasive message (Cho & Salmon, 2007;

Byrne & Hart, 2009). For example, if teens perceive that an authority figure is attempting to threaten their valued eating habits, they may become angry and behave the in the opposite direction of what is being asked of them, a process known as psychological reactance (Brehm, 1966; Brehm & Brehm, 1981; Burgoon et al., 2002). Reactance is a motivational state generally associated with negative cognitions and feelings of anger toward the entity threatening a freedom, such as a teacher or parent (Dillard & Shen, 2005). This state of reactance may motivate teens to reject a message (Brehm & Brehm, 1981). The virtual pet game delivers persuasive messages through a source that the user considers likeable. Because the participants in our study choose their pet and give it a name, he or she may consider the pet to be a likable, non-threatening source. Because the message is not coming directly from an authority figure, reactance may be minimized.

RQ8: Will participants in either Virtual Pet condition report more reactance to the research team compared to those who do not have a pet?

RQ9: Will participants with a pet providing negative feedback report a higher level of reactance than participants assigned to pets that do not give negative feedback?

Method

Participants

Fifty-three adolescents in 7th and 8th grade (M = 13.1 years) participated in an experiment designed to test the effectiveness of a mobile phone virtual pet on breakfast eating behavior. The teens resided in a suburban agricultural community in the northeastern United States. 84% of the sample was Caucasian, 6% identified themselves as bi-racial or of mixed race, less than 3 children identified themselves as Native American, African American, or other. A parental consent form was signed for each

participant. The gender distribution was nearly even (males = 29; females = 24). All participants were given an iPhone for the intervention phase of the experiment. During the course of the study, 2 phones were lost and 4 were taken away by the school or by parents and returned to us, rendering those children unable to participate. Those losses were distributed across conditions.

Experimental Design

Participants were individually assigned randomly to one of four conditions in the experiment. Adolescents assigned to Conditions 1, 2, and 3 were sent daily reminder emails to their phone by 7am. The emails requested that conditions 1 and 2 send the photo to their pet, which was in the participants' phone book and preset to send to a designated email address. Condition 3 received the same email but it came from a designated email address and asked the participant to send the photo to that same email address.

Participants assigned to conditions 1 and 2 were given the additional task of chosing and interacting with a pet of their choice (described in detail below). Half of those adolescents were provided both *negative* and positive feedback on their breakfast behaviors directly from their pet, meaning that their pet could vary across 5 visual depictions from ecstatic to distraught (Condition 1, $n = 12$)[1]. The remaining participants who were assigned pets were only provided with positive or neutral feedback (Condition 2). That is, at worst, the program held their pet in a visually neutral state ($n = 13$).

Participants in the 3rd condition ($n = 14$) received the same daily emails as conditions 1 and 2, requesting that they take a photo of their breakfast and email the

[1] Because of the costs associated with conducting mobile phone research (over $1200 per participant), randomized, controlled field experiments with children are non-existent. We made the choice to split our sample across 4 conditions, including control, which resulted in relatively small sample size per condition.

photo to a designated email. However, participants in this condition did not choose a pet or interact with a pet in any way, nor did they receive any feedback. These teens simply took photos of breakfast and sent the photo in. They were never sent any requests to eat healthy or any explicit suggestion that it is healthy to eat breakfast at all.

The fourth condition (n = 14) served as a control group. These adolescents were emailed and asked to send pictures of unrelated duties such as taking a picture of an object that was important to them, people they liked, or activities that they took part in during the day.

Design of game

The game, called *Time to Eat*, is a virtual pet care game in the style of the popular *Tamagotchi* or *Nintendogs*, designed to run over the internet on smart phones and other mobile devices with web-browsing capabilities. In the game, the player first adopts and names a pet, choosing from a variety of possibilities including a dog, dinosaur, penguin, potato, stapler, robot, tree, worm, and hippo. Once the player has adopted a pet, they can "visit" the pet at any time by launching Time to Eat from an icon on their phone's home screen. During game-play, the user receives an email from their pet each morning, prompting the child to eat breakfast. For the purpose of this study, prompts included messages such as "don't forget to eat breakfast this morning!" Each morning, the player is expected to take a photograph (using their phone's built in camera) that documents the breakfast or snack that they will consume. The photo is then sent to a server, where it awaits judging.

Scoring. Responses were provided by a trained undergraduate researcher majoring in nutrition and information science. Responses were sent to the phones of participants with pets within 1 hour of the photo being received. With few exceptions, nutritionists

consider most breakfast choices to be healthier than eating no breakfast at all. For example, eating what many might consider a "sugary cereal" is not always as unhealthy as one might think (CRH, 2008). Therefore, our main interest was in determining if we could promote eating breakfast more often (Rampersaud et al., 2005)). However, we also judged the photos based on a rubric created based on the healthfulness of the food consumed. A score ranging from -2 (no photo submitted) to +2 (a healthy meal) was awarded to each breakfast that was submitted to us. Scores were based on (CHR, 2008). Based on the score, the player's pet responds to an algorithm that causes the users pet to appear very unhappy, mildly unhappy, neutral, mildly happy, or very happy (See Figure XX). Once the meal is judged, the player receives email feedback from their pet and is prompted to once again "visit" their pet to see the outcome. As will be described in the measures section below, the system was programmed such that participants assigned to receive positive feedback only (condition 2) never saw their pet appear below the neutral state, no matter how poorly they ate, and those that did not have a pet (condition 3) did not receive any score or feedback of any type to the pictures they submitted to us.

Procedure

One month before the experimental intervention the participants were asked by their classroom teacher to compete a three-day food diary as a pre-test measure of breakfast habits as part of a future classroom project on nutritional awareness. There were no differences between conditions on likelihood to eat breakfast on the written food diaries (M = .71, SD = .40) or the healthiness ratings of the breakfast (M = *.92,* SD = .40). Two weeks before intervention our research team visited the school to introduce the project and collect pre-test self-report measures. Participants were removed from class and completed a short paper and pencil questionnaire. The questionnaire included an

eating disorder diagnostic tool (Garner, D.M., Olmstead, M.P., & Polivy, 1983), but none of the participants were deemed to be at-risk of having an eating disorder.

Two weeks later, all of the participants were given an iPhone and trained on how to use the basic features. They were told that the phones were not allowed out during school hours. They were also informed that by the end of the project, they would all participate in every part of the game and that it was important not to talk to their friends about the part of the game they were currently playing at any time. Then, participants were individually trained in a quiet space on their specific 'job' as per their assigned condition. The adolescents performed their 'job' according to their assigned experimental conditions for 10 days total. At the end of ten days, children were given the post-test (self-report questionnaire) collected on laptop computers via MEDIALAB software. After all participants had completed the post-test, those in the photo only condition (3) and control group (4) were trained on the pet game and given the opportunity to play for 5 days in order to fulfill the promise that everyone would eventually do so.

Measures

Behavioral measures of breakfast intake

Based on the pictures of breakfast foods that participants (except control) were ask to send through the email system, two scores were established on breakfast intake. The first variable measured our main outcome of interest, the likelihood of eating breakfast at all during the experiment (M = .33, SD = .30). This variable was calculated by dividing the number of breakfasts eaten during the experiment by the number of days. An additional variable was created to measure the healthiness of the breakfasts overall,

for those teens that did eat, by calculating an average of the score of each day (M = 1.15, SD = .36).

Self-reported perceptions of personal health and eating behaviors

As a measure of comparison with the control group, who's members did not take photos of breakfast, one self-reported item measured how often the participant felt that his or her own eating behaviors would be considered healthy. The item asked if the specific "job" the participant was asked to do made them eat healthier. Participants responded on a 5-point scale with 1 being *not at all* and 5 being *definitely!* (M [healthy1] = 2.60 , SD = 1.29). Participants were also asked to report judgments of their physical self (Marsh, Richards, Johnson, Roche, & Tremayne, 1994). The scale asked participants to indicate how agreement with 6 statements such as *I am satisfied with my body, I am happy about how my body feels,* and *I feel good about the way I look*. Reverse coded items were recoded such that higher scores were indicative of more positive judgments of one's physical self [physSCALE: phys1-phys6] (α= .94, M = 3.76, SD = 1.00).

Self-efficacy

General self-efficacy was measured on a 10-item scale of self-esteem (Rosenburg, 1965). The scale assessed agreement on 7 points with statements such as *I feel useless, I am just as important as others, I sometimes feel like a failure, and I am able to do things as well as most other people*. Reverse coded items were recoded such that higher scores were indicative higher self-esteem for all items [esteemSCALE: esteem1-esteem10 (2,5,6,8,9RC)] α= .81, M = 5.17, SD = 1.14).

Participants were asked *how hard it is to eat breakfast in the morning* to measure self-efficacy of eating breakfast specifically. The item was measured on a 7-point scale with 1 anchored at *easy* and 7 at *hard* (misc1, M = 3.19, SD = 2.06).

Personal efficacy to eat healthy was measured with 10 items modified from the Project EAT Survey (Neumark-Sztainer, Story, Hannan, Perry, & Irving, 2002) [diffhealth 1-diffealth10] α= .77, *M* = 2.96, *SD* = .63). The scale included such questions as *for the past two weeks, how difficult would it be to eat healthy if you were with friends, if you were at a food restaurant, if you were alone*. Higher scores indicated agreement with statements, with 5 indicating *very hard* and 1 indicating *very easy*.

In the two conditions of the experiment where participants were assigned to play the Virtual Pet game (negative or positive feedback), participants responded to one item directly measuring self-efficacy in regards to caring for their pet. Higher scores indicated higher self-efficacy, with 1 being indicating strong agreement and 5 indicating strong disagreement. The item read: *it was hard to keep my pet happy* (pet14RC, *M* = 3.20, *SD* = 1.32).

Attitudes toward eating healthy

Perceived value of eating healthy in general was assessed by asking participants to rate how much they care about eating healthy (Neumark-Sztainer et al., 2002). A higher score on the indicated *caring a lot* while a lower score indicated *not caring at all* ([care1] *M* = 3.60, *SD* = 1.13).

Attitudes toward pet

Attachment to pet. All participants who played the pet game rated the degree to which the pet comforted them by completing a version of the Comfort from Animals Companion Scale (Zasloff, 1996) that had been slightly modified to reference the virtual-pet (petattachSCALE [pet1-pet11] α = .98, *M* = 3.29, *SD* = 1.29). The 11-item scale included such questions as *my pet is fun*, *my pet makes me feel needed*, and *my pet is always there for me*. Higher scores indicated agreement with statements, with 5

indicating strong agreement and 1 indicating strong disagreement. One additional item asked participants how much they agree with the statement *I am going to miss my pet* (*M* [pet18] =3.40 , *SD* = 1.53), with higher scores indicating higher agreement and therefore stronger attachment.

Two items measured how motivated participants were to help their pet when it was in distress. Items were measured on a 5-point scale; *when my pet looked sad, I wanted to make it happy* (*M* [pet12] = 3.72, *SD* = 1.46), and *when my pet looked sad, it made me sad* (*M* [pet 13] =3.20 , *SD* = 1.53). The items were highly correlated and therefore combined to form one variable of *motivation to help pet*, with higher scores indicating more motivation to help (motivepetSCALE *r* = .84 , *M* = 3.46, *SD* = 1.38).

Attitudes toward intervention

Recall that the adolescents in this study were told during training that they would complete a specific 'job' for a certain amount of time. This idea of a 'job' translates directly to the experimental manipulation associated with the assigned condition, our main independent variable. We measured attitudes toward the specific activity, or job, that was assigned to that child. Enjoyment was measured on an 8-item scale (jobfunSCALE [job1,2,5,6,7,24 & job3rc, 4rc] α = .92 , *M* = 3.22, *SD* =1.01). Effort expended toward succeeding at job was measured on a 6-item scale (jobeffortSCALE [job14-16-17, job15rc, 18rc] α = .83 , *M* = 3.42 , *SD* = 1.02). Perceptions of how skilled one judged oneself at the job were measured on a 6-item scale (jobskillSCALE [job8-job12, job13rc] α = .88, *M* = 3.22, *SD* = 1.01). Sustained interest in job was measured with one statement asking if the participant had lost interest in his or her job after a few days and was reverse coded to indicate sustained interest [Mjob22rc] = 3.38, SD = 1.42).

Reactance

Post-test measures of state or situational reactance were adapted from Silva (2006) for adolescents (α= .74 , M = 2.40 , SD = .91). Items were measured on a 7 point scale where 1 = *not at all* and 7 = *very much*. Items included such statements as *I agree with the emails sent to me from the iPhone project (reverse coded)*, the *people from the iPhone project are trying to pressure me into agreeing with them*, and *the people from the iPhone project are trying to pressure to keep me from making up my own mind about eating healthy* [react1rc,2rc,3rc,5rc-react4,6,7,8,9,10].

Results

To test our research questions a series of one-way Analysis of Variance and *t*-tests were conducted on our main dependent variables of interest.

Likelihood to eat breakfast. The main goal of our study was to determine if participating in the Virtual Pet game, or certain versions of the game that varied the nature of feedback, would increase the likelihood to eat breakfast compared to participants who simply took pictures of what they ate and submitted the photos[2]. A one-way Analysis of Variance revealed differences between conditions on the likelihood of eating breakfast F (2,36) = .4.52, $p < .05$, $\eta_p^2 = .20$. Participants with pets that responded with both negative and positive feedback were about twice as likely to eat breakfast (M = .52, SD = .20), than both participants with pets that responded with positive only (M = .27, SD = .28, $p < .05$) and participants who sent pictures in but did not have pets (M = .20, SD = .31, $p < .01$).

Healthiness of breakfast when eaten. In examining the healthiness of the breakfasts eaten by those teens who did eat breakfast, a one-way Analysis of Variance

[2] Participants in the control condition did not report daily breakfast habits and were therefore not included in this analysis. However, control participants were included in analyses of non-pet related self-report measures conducted below.

revealed no differences between conditions on how healthy the breakfasts were judged to be F (2,24) = .11, p = .89, η_p^2 = .009. When children did eat breakfast, participants with pets that responded with both negative and positive feedback were no more likely to eat a healthy breakfast (n = 12, M = 1. 12, SD = .46), than participants with pets that responded with positive only (n = 9, M = 1. 19, SD = .27) or participants who sent pictures in but did not have pets (n = 6, M = 1. 15, SD = .46).

Self-reported healthy eating. A one-way Analysis of Variance was conducted to detect differences between all 4 conditions on perceptions of how much the participants' "job" helped them eat healthier [healthy1, F (3,49) = 4.42, p < .01, η_p^2 = .21. Post-hoc tests reveled that those with pets giving negative and positive feedback (M = 3.33, SD = .99) and those that sent pictures without a pet (M = 3.07, SD = 1.49) reported eating healthier than participants in the control group (M = 2.14, SD = 1.49) and participants with pets that responded with positive only (M = 1.92, SD = 1.11).

Importance of eating healthy. A one-way Analysis of Variance was conducted to detect differences between conditions on perceptions of how much the participants care about eating healthy [care1], F (3,49) = 3.49, p < .05, η_p^2 = .18. Post-hoc tests reveled that participants with pets that responded with positive feedback only (M = 2.85, SD = 1.41) reported caring less about eating healthy than participants in the other three conditions, that is, those with pets giving negative and positive feedback (M = 4.17, SD = .58, p < .01), those that sent pictures without a pet (M = 3.79, SD = 1.41, p< .05) and participants in the control group (M = 3.64, SD = 1.08, p = .05).

Perceptions of physical self. A one-way Analysis of variance revealed no differences between experimental conditions on reports of positive perceptions of physical self [physSCALE] F (3,49) = 1.61, p = .20, η_p^2 = .09.

Eating self-efficacy. Comparing across all 4 conditions, there were no differences on participant reports of general self efficacy [Esteemscale] F (3,49) = .29, p =.84, η_p^2 = .02. There were also no differences between conditions on personal efficacy to eat healthy [diffhealthSCALE] F (3,49) = .54, p = .66, η_p^2 = .03.

Attitudes toward job

Enjoyment. A one-way Analysis of Variance was conducted to detect differences between conditions on perceptions of how much the participants enjoyed their assigned 'job' [jobfunSCALE]. The result approached, but did not reach, significance, F (3,49) = 2.23, p = .09, η_p^2 = .12. Post-hoc tests reveled that participants with pets that responded with positive feedback only (M = 2.63, SD = 1.00) reported that they enjoyment their job less than participants in any of the other conditions, that is, those with pets giving negative and positive feedback (M = 3.55, SD = .86, p < .05), those that sent pictures without a pet (M = 3.37, SD = .84, p = .06) and participants in the control group (M = 3.36, SD = 1.15, p = .06).

Effort. A one-way Analysis of Variance was conducted to detect differences between conditions on perceptions of how much the participants enjoyed their assigned 'job' [jobeffortSCALE]. The analysis approached, but did not reach, significance, F (3,49) = 2.70, p = .06, η_p^2 = .14. Post-hoc tests reveled that participants with pets that responded with positive feedback only (M = 2.82, SD = .93) reported expending less effort toward their job than participants with pets giving negative and positive feedback (M = 3.85, SD = .80, p < .05), and those that sent pictures without a pet (M = 3.63, SD = .95, p < .05), though they reported no significant difference in effort when compared to those in the control group (M = 3.37, SD = 1.16, p = .14).

Skill. A one-way Analysis of Variance revealed differences between conditions on perceptions of the degree to which the participants felt they became skilled at their assigned 'job' [jobfunSCALE] F (3,49) = 3.06, $p < .05$, $\eta_p^2 = .16$. Post-hoc tests reveled that participants with pets that responded with positive feedback only ($M = 2.58$, $SD = 1.06$) reported that they were less skilled at their job than participants in any of the other conditions, that is, those with pets giving negative and positive feedback ($M = 3.70$, $SD = .77$, $p = .057$), those that sent pictures without a pet (M = 3.30, SD = .1.05, $p < .01$) and participants in the control group ($M = 3.36$, $SD = 1.15$, $p < .05$).

Sustained Interest. A one-way Analysis of Variance revealed differences between conditions on perceptions of the degree to which the participants reported maintaining interest in their 'job' after a few days [job22rc] F (3,49) = 4.56, $p < .01$, $\eta_p^2 = .22$. Post-hoc tests reveled that participants with pets that responded with positive feedback only ($M = 2.31$, $SD = 1.32$) reported that they were less able to hold interest in their job than participants in any of the other conditions, that is, those with pets giving negative and positive feedback ($M = 3.83$, $SD = .83$, $p < .01$), those that sent pictures without a pet (M = 4.00, SD = 1.30, $p < .01$) and participants in the control group ($M = 3.36$, $SD = 1.55$, $p < .05$).

Reactance. Comparing across all 4 conditions, there were no differences in participant reports of psychological reactance [preactSCALE] F (3,49) = .59, $p = .62$, $\eta_p^2 = .04$.

Comparisons between Pet Conditions

The following analyses were designed to assess attitudes toward pet-specific concepts (test items inquired about the pet specifically) and were therefore performed as paired-comparisons between participants in the two conditions with pets only.

Pet care efficacy. A *t*-test was conducted on participants with pets to determine differences in perceptions of how difficult it was to care for their pet (pet14rc). The analysis revealed that participants assigned to pets responding only with happy or neutral states only found it easier to care for their pet ($M = 3.70$, $SD = 1.32$) then those with pets enabled to become sad ($M = 2.67$, $SD = 1.15$) $t = 2.06$, df = 23, $p < .05$, $d = .83$.

Motivation to help pet. A *t*-test was conducted on participants with pets to determine differences in motivation to help the Virtual Pet (motivepetSCALE). The analysis revealed that participants assigned to pets enabled to become sad reported being more motivated to help their pet when it was in distress ($M = 4.08$, $SD = .85$) than were those with pets responding only with happy or neutral states ($M = 2.88$, $SD = 1.55$), *t*(unequal variances)= 2.42, df = 18.84, $p < .05$, $d = .95$.

Attachment to pet. A *t*-test was conducted on participants with pets to determine differences in attachment to their pet (petattachSCALE). The analysis revealed that participants with pets enabled to become sad were more attached to their pets ($M = 3.81$, $SD = .92$) then were those with pets responding only with happy or neutral states ($M = 2.80$, $SD = 1.41$) $t= 2.11$, df = 23, $p < .05$, $d = .86$.

A *t*-test was conducted on participants with pets to determine how much they will miss the pet when the phone is returned (pet18). The analysis, which approached significance, revealed that participants assigned to pets enabled to become sad reported that they will miss the pet more ($M = 4.00$, $SD = .95$) then were those with pets responding only with happy or neutral states ($M = 2.85$, $SD = 1.77$), *t*(unequal variances)= 2.05, df = 18.70, p =.05, $d = .81$.

Mediation Analyses

To check for potential mediators between exposure to negative feedback and likelihood to eat breakfast, we ran preliminary mediation tests on the following intervening variables: pet attachment, motivation to help pet, enjoyment of job, effort toward job, skill at job, sustained interest in job and pet care efficacy. We first checked for a correlation between exposure to negative feedback and likelihood to eat breakfast (r = .45, p <.05). Then we ran a correlation between exposure to negative feedback and attachment (r = .40, p <.05). Finally, we ran the correlation between attachment and likelihood to eat breakfast, which was not significant (r = .09, p =. 70). Thus, we determined participants exposed to negative feedback became attachment to pet, but attachment was not necessarily driving them to eat breakfast more often. This pattern of results was similar for all other variables proposed above as mediators except pet care efficacy. For that variable, we found a negative correlation between having negative feedback and how easy it was to care for the pet, meaning that participants exposed to negative feedback found it harder to care for the pet (r = -.40, p <.05) and a negative correlation between how easy it was to care for pet and likelihood to eat breakfast, meaning that participants who found it hard to care for the pet tended to eat breakfast more often (r = -.40, p <.05). However, we ran a Sobel (CITE) test of mediation that was not significant (*sobel* = 1.43, p = .15) and a one-way analysis of variance in which pet care efficacy did not emerge as a significant covariate between negative feedback and likelihood to eat breakfast.

Discussion

In this project, we investigated the effects of a mobile phone based 'virtual pet' game in a randomized field experiment. The design of the technology was derived from the principles of persuasion described above. For this initial study, we focused on effects

of varying feedback. Our primary dependent variable of interest was likelihood to eat breakfast, with an aim to increase baseline breakfast eating in adolescents. These results should provide future researchers and designers of mobile health games with a better understanding of how constructs of persuasion work in mobile games.

The Importance of Negative Feedback

Because the extant research on the topic is not definitive, our primary research questions were specifically looking at the difference between receiving virtual-pet feedback that ranged from positive to negative compared to the effects of having no exposure to negative feedback, that is, seeing positive or neutral feedback only. We discovered that, when comparing the two experimental groups with pets, those who received negative feedback from their pet were twice as likely to eat breakfast compared to their peers who never saw their pet become sad. This pattern was replicated across several other dependent variables. Specifically, teens with pets enabled to become sad were more motivated to help their pet, were more attached to their pet, enjoyed the game more, reported expending more effort toward the game, thought they were more skilled at the game, maintained a higher level of sustained interest in the game, and felt that eating healthy was more important when compared to those in the positive feedback only condition. All of these results appeared in spite of the fact that teens with sad pets reported that caring for their pet was more difficult than those with pets held, at worst, in a neutral state, and there were no differences between conditions on reports of general or eating-related self-efficacy. Therefore, participants with sad pets did not necessarily perceive that it was any easier to eat breakfast – but they did so anyway.

Although we were primarily concerned with an increase of likelihood to eat breakfast, we also judged each breakfast for "healthiness" when the teens did eat. There

were no differences between conditions on the healthiness of the breakfast sent in the photographs. However, teens with a pet enabled to become sad perceived that they ate healthier, based on a self-report measure, than did those in the positive-feedback only group. This is due perhaps to the degree of perceived effort expended at doing the job well.

Pet or no pet?

Because we desired to test the effects of our pet care game above and beyond some of the game's salient interactive features that might promote social facilitation, we tested if simply receiving reminders and sending in photos would be enough to motivate breakfast eating. To this end, we added a condition that required participants to receive identical reminder emails as those with pets and asked participants to send in pictures of what they ate – but these participants did not have a pet. The pattern of findings indicates that receiving reminder emails and sending in photos is not as effective as having a pet, *if* that pet is providing both positive and negative feedback. On our behavioral measures, based on the photographs of breakfast sent in to our lab, participants sending photos-only performed similarly to those in the happy-pet (positive feedback) condition. That is, they were less likely to eat breakfast than those in the negative feedback condition. This behavioral finding occurred in spite of self-report measures that fell more parallel to those in the negative feedback condition. Teens that simply sent in pictures were no different than those in the more effective negative feedback condition when reporting that eating a healthy breakfast is important, enjoyment of their job, expense of effort at their job, perceptions of how skilled they were at their job, and degree of sustained interest in the job. Yet, despite all of these similarities, teens in the negative pet condition outperformed both groups that sent in photos (positive-pet and photo-only) in the

likelihood that they would eat breakfast.

Teens in the photo-only condition reported eating equivalently healthy breakfasts compared to those in the negative feedback condition. But again, based on our own judgment of the actual food that was consumed, there were no differences between the three conditions on healthy the food actually was.

Implications for attachment

Of those teens that had pets, attachment to one's pet was greatest when participants received negative feedback, rather than positive feedback only. This may have occurred because participants perceived the pet as more realistic when it became sad in reaction to participants' poor eating habits. Findings from video game research indicate that people perceive a character as more realistic when the character expresses context appropriate emotions (see Shapiro, Pena-Herborn, & Hancock, 2006). Pets that provided both positive and negative feedback expressed a range of emotions that corresponded with participants eating behaviors. On the other hand, pets that only provided positive feedback never became unhappy, even when the participants ate poorly, or forgot to eat breakfast altogether. It almost appeared that the pet was not responding in the positive only condition. Given that human-pet attachment is sustained by the human instinct to provide for the needs of the animal (Archer, 1997), and that this relationship is often powerful enough to supersede other human-human relationships (Kurdek, 2009), it is not surprising that participants were more attached to the virtual pets when they were exposed to the negative consequences of their eating behaviors on their pets.

Implications for efficacy.

While we found no differences between all four conditions on the more general

efficacy and eating-related efficacy variables, we did discover that the participants with negative feedback found it more difficult to care for their pet than those without negative feedback. However, the perceived difficulty did not seem to hinder healthy behavior. These same participants reported being more likely to want to help their pet, and, as reported above, outperformed the positive feedback group on most dependent variables. Our data suggest that efficacy may not be as important as attachment in terms of increasing the desire to care for oneself for the purpose of caring for a virtual pet. On a positive note, we evidenced behavior change but, on the down side, we did not increase general efficacy in terms of eating nor did we see any positive change in perceptions of the importance of eating breakfast. In fact, in the positive-feedback condition, participants seemed to adopt the idea that breakfast eating was not important compared to the other three conditions, including the control – perhaps because there were no direct consequences to the pet when breakfast was missed. By not receiving negative feedback, the pet may have functioned to activate unintended constructs in the mind of the user, primarily the belief that skipping breakfast is just fine (Bandura, 1977; Byrne & Hart, 2009).

Social Facilitation

By including a group of teens that interacted with key features of the game without a pet, we were able to test the effect of the pet game above and beyond these features. We were particularly interested in teasing out effects from the pet from effects of the reminder emails and of taking photos and sending them into our lab. Teens in the condition that received emails and sent in pictures, with no pet or feedback, did not perform as well on the main behavioral measure of breakfast eating than those with a pet that gave both positive and negative feedback. Therefore, while we cannot claim that the

no-pet group outperformed the control (because the control did not send in pictures), we do know that the pet giving negative feedback was the most successful at promoting breakfast eating.

Implications for reactance.

There were no differences between conditions on psychological reactance toward the project or the 'job'. While no differences may be due to measurement error, our data suggest that it is possible to increase breakfast eating without increasing psychological reactance, at least in the form reactance is measured here. We duly note that this finding could be due to the overshadowing of perceived threat by actual gratitude toward the project for providing an iPhone.

Future research

Due to the extreme financial barriers to running this study, we were not able to conduct a longitudinal measure. That is, we did not have the resources to keep the phones active longer than the time suggested here. Therefore, we do not know if or when the group that was able to view a sad pet would lose interest in the game. New features, such as unlocking new games as a reward and earning accessories for the pet might promote sustained interest.

To cleanly test the impact of negative feedback and social facilitation, we did not examine features of the pet game that were not provided to this sample of participants. Certain additional features may lead to further compliance through both collaboration and competition. Features such as competition between individuals or teams, a chat function to facilitate social support, and access to view one another's pet might increase the efficacy of such technology. Previous studies indicate that public behaviors in digital media are more likely to become integrated into a person's way of thinking about the self

(Gonzales & Hancock, 2008). It may also be true the social visibility in the game would increase the likelihood that participants will take on the desired role of being a healthy eater.

Finally, future research should examine the efficiency of the pet game across health contexts and beyond. The virtual pet can respond to compliance with any 'documentable' behaviors such as energy conservation and completing homework assignments.

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Figure 1. All 5 Stages of feedback (Condition 1).

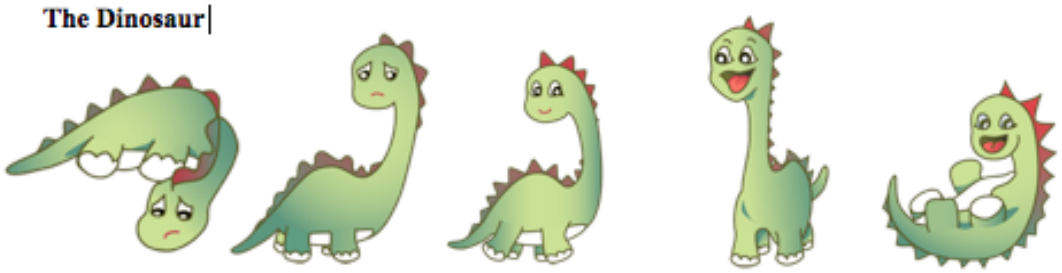

Figure 2. Screenshot of Feedback on screen