Modeling Gender Differences in Healthy Eating Determinants for Persuasive Intervention Design

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Abstract. The onset of many health conditions, such as obesity and type 2 diabetes, can be prevented or at least delayed by adequate changes in diet. Various determinants of healthy eating – such as *Weight Concern, Nutrition Knowledge, Concern for Disease, Social Influence,* and *Food Choice Motive* – have been manipulated by persuasive technologies to motivate healthy eating behavior. However, the relative importance and the dynamic of interaction between the determinants of healthy behavior for males and females are still unknown. Understanding how the determinants vary across user groups is important, as it will help persuasive technology designers personalize their interventions to the target demographics, thereby increasing the effectiveness of the intervention. To investigate for possible variations in healthy eating determinants, we developed separate models of healthy eating determinants for males and females. The models, which are based on a quantitative study of 228 (124 males and 104 females) participants, reveal some similarities and differences in the interactions between the determinants of healthy eating behavior. Based on the result from our models, we highlight some gender-inclusive and gender-specific approaches to persuasive intervention design.

1 Introduction

Research has shown that good eating behavior can prevent or at least reduce the risk of obesity, cardiovascular disease, certain types of diabetes, and cancer [1]. It is, therefore, not surprising that behavior change interventions aimed at modifying dietary behavior have been identified as the cornerstone treatment for these conditions [2]. Persuasive Technology (PT) is a promising approach to tackle obesity by motivating healthy behavior change using technologies. Several frameworks exist for designing and evaluating PT interventions [3]; however, these frameworks assume a one-size-fits-all approach, providing little or no information on how these strategies can be tailored to various user groups. The realization that the one-size-fits-all approach may not be sufficient for motivating healthy behavioral change has led to a growing interest in ways of tailoring interventions to various user groups and individual users. For example, previous work has shown that a user's personality is an important determinant of motivation and persuadability [4]. Further work showed a relationship between the user's personality and the success of different PT strategies [6].

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The success of different PT strategies can be explained in part by how an individual or user group is influenced by different determinants of healthy eating. If we can understand how users are influenced by different determinants, we can effectively tailor interventions. Recent work identified *concern for weight, nutrition knowledge, concern for disease, social influence,* and *food choice motive* as determinants of healthy eating [7]; however, how the influence of these determinants varies across user groups is still unknown. For example, researchers have identified gender differences in dietary behavior [8]; however, whether or not these gender differences in eating behavior vary differentially with the determinants of healthy eating remains unclear. Understanding how the determinants vary across gender groups is important; it will help PT designers personalize their interventions to target demographics, thereby increasing the effectiveness of the PT intervention. To investigate this, we developed separate models of healthy eating determinants for males and females. The models, which are based on a quantitative study of 228 (124 males and 104 female) participants, show some similarities and differences in the relationships between the determinants of healthy eating behavior for males and females. These gender differences partially explain why males and females differ in their healthy eating behavior and suggest the need to make PT interventions gender-sensitive. We conclude by proposing ways of designing PT that are gender-inclusive (targeting both genders) and gender-specific (tailored for each group). We also shed light on the decision process in fast food eating behavior for both males and females and the need for persuasive approaches suitable for each decision process to motivate change.

2 Related Work

PT designers aim to manipulate certain behavior determinants to steer the user towards a target behavior. One way of increasing the effectiveness of a PT is to tailor it to individual users or certain user groups (based on determinants that are shown to be important for the individual or the group). The gender of a user is an important consideration for intervention tailoring. We present some gender considerations in technology design and determinants of healthy eating that has been used in PT design.

2.1 Motivations for Healthy Eating and Gender-Relevant Design

Persuasive technology that aims to bring about desirable change in attitude and behavior [9] can be effective if based on various determinants of healthy behavior. As a result research attention has focused on identifying determinants of healthy behavior, including both domain-specific and generic determinants. Recent work identified *Weight Concern, Concern for Disease, Nutrition Knowledge, Social Influence,* and *Food Choice Motive* as determinants of healthy eating [7]. These determinants can be classified into two groups: *intrinsic* and *extrinsic* determinants. In line with self-determination theory [10], intrinsic determinants, such as health optimization, involve rewards that are internal to the individual. *Weight concern,*

concern for disease, nutrition knowledge, and *food choice motive* can be classified as intrinsic determinants. Extrinsic determinants, such as approval or disapproval of others, involve external rewards or punishments [11]. *Social influence* belongs to this category. Generally speaking, each determinant might have both intrinsic and extrinsic attributes. This classification is therefore based on dominant attribute. Previous research has shown that both intrinsic and extrinsic determinants impact healthy eating behavior [7]. Consequently, various persuasive technology applications have been informed by these determinants. *Escape from Diab* [12] is a persuasive application that uses a game-based approach to motivate healthy eating and exercise. *Escape from Diab* manipulates the *weight concern* and *nutrition knowledge* to bring about desirable change. Similarly, *LunchTime* manipulates the user's *nutrition knowledge* in order to motivate healthy eating [13]. The impact of various healthy eating determinants in motivating healthy eating has been established; however, whether these determinants impact on differently males and females is unknown.

Recently, technology developers have begun to consider gender differences in their interface design decisions. For example, Moss et al. [14] reveal differences on how males and females perceive and rate websites. Their studies show that people tend to rate websites higher if designed by people of the same gender. By default (without any gender-inclusive or gender-specific design guide), male developers tend to design for male aesthetic and female developers for female aesthetics [14]. Persuasive research has also shown some gender differences in perceived credibility [15] and the moderating effect of gender on perceived persuasiveness [16]. Therefore, PT for motivating behavior change can appeal to target gender groups by employing gender specific design strategies. Therefore, examining the influence of various determinants on healthy behavior for males and females will be useful in guiding PT designers on the important determinants to focus when designing gender-tailored or gender-inclusive PT intervention.

3 Study Design and Methods

The data reported in this paper is part of a project aimed at designing technological interventions for promoting healthy eating.

We employed both quantitative and qualitative methods to examine factors affecting participants' healthy eating behavior as applied to the decision to eat fast food. We elicited participants' responses to surveys that were used to assign weightings to the five determinants of healthy behavior – *weight concern, concern for disease, nutrition knowledge, social influence,* and *food choice motive*. We were specifically interested in the relationship between the five healthy eating determinants and *health behavior* as they inform decisions making. We supplemented the survey with a 5-minute interview with 15 participants aged 18 to 36 (7 females and 8 males) aimed to elucidate the reasons behind the behaviors, and to clarify responses from the survey. In this section, we first describe how we developed the research instrument; this is followed by a description of the data collection methods used and the validation of our analysis.

3.1 Measurement Instrument

To collect data for our model, we developed a survey to collect responses from customers from a set of fast food restaurants in Canada. "Fast food" is defined here as convenience foods obtained in self-service or 'take away' restaurants / eateries with minimal waiting. These foods are characterized with high energy density, low levels of micronutrients and fiber, high levels of simple sugars and salt; they are usually sold in larger portion sizes than conventional home-cooked or restaurant foods [17]. The survey was developed after a detailed review and pilot tested (n=10) for refinement.

The survey instrument consisted of questions assessing participants' (1) demographics (gender, age group, education); (2) health concern (weight concern and concern for diseases); (3) nutrition knowledge; (4) fast food motives; (5) healthy eating attitude; (6) frequency of purchase; (7) purchase decision type, and (8) social influence. We adapted the 10 questions from Kahkonen [18] to measure the health concern variable. The scale has been validated by several studies [18, 19]. The health related concern measures the participants' degree of concern about food and health related issues using 5-point Likert scale ranging from "1 = Not Concerned at all" to "5 = Very Concerned". Typical questions in this variable ask the participants to evaluate their degree of concern for "getting a lot of calories in food". The present study separated concern for health into two variables: Weight Concern (WC) and Concern for Disease (DC). This is based on the factor loadings and suggestions by previous studies [7, 19], that WC and DC might impact health attitude/behavior differently. Food choice motive measures several factors and their relative importance to the participants in making daily meal choices. The factors refer to health and non-health related food characteristics that might be taken into account when choosing what to eat. We adapted the 36 food choice motives questions developed by Steptoe et al. [20]. Some examples include "It is convenient", "It is healthy", and "It is cheap". Our survey allowed the participants to select from a list of factors that motivate their fast food consumption, which were mostly non-health related. We measured attitude towards healthy eating using a 3-item scale adapted from Kearney et al. [21]. An example of a question in this category is "I make a conscious effort to eat healthy". The participants state their level of agreement using a 5-point Likert scale, ranging from "1 = strongly agree" to "5 = strongly disagree". To assess nutrition knowledge, we adapted the questions developed by Alexander [22] and used a 5-point Likert scale ranging from "1 = worst quality" to "5 = best quality". The questions were designed to solicit participants' knowledge about fast food meals by allowing them to rate the subjective nutrition quality of some selected fast food meals. A typical question is "Can you rate how nutritious and healthy you feel that French fries are?" The social influence variable was included to determine the influence of others on purchase decisions. To do this, participants were presented with questions of the type: "Which of the following influence your decision to purchase fast food (you can select more than one): family, friends, colleagues, restaurant attendants, and self-decision". This particular question was deemed necessary because, although several researches have shown the important role that others play in motivating certain behaviors, the degree of social influence and its relationships with other variables are still unclear. Also, the

purchase decision question was added to examine if decision to eat fast food is an impulsive or a planned decision. This is important because decision on suitable persuasive approach might differ depending on whether target behavior involves an impulsive or a planned decision.

3.2 Participants

The participants consisted of 228 restaurant visitors sampled at selected fast food restaurants within a Canadian University. The data were gathered over a period of 30 days. The only eligibility criterion required was that the participants were at least 18 years old at the time of data collection, in compliance with the study ethics approval and also to ensure that the participants were of legal age to make decisions independently (including decisions on what to eat). There was a relatively even distribution of females (46%: 104 participants) and males (54%: 124 participants). The ages of the participants were unevenly distributed: 18-25 (155, 68%), 26-35 (59, 26%), 36-45 (11, 5%), and only 3 (1%) over 45. Similarly, most of the participants in this study were high school graduates who are presently pursuing their first degrees 104 (46%); 5 (2%) held a diploma degree, 53 (23%) held a bachelor's degree, 57 (25%) were master's degree holders, 7 (3%) were doctorate degree holders and, 2 (1%) held other forms of certificates. Regarding the frequency of visits to fast food restaurants, more than 60% of the participants visited fast food restaurants at least 2 times a week (every day: 8, 4%; 3 times a week: 62, 27%; once a week: 73, 32%; 3 times a month: 32, 14%; once a month: 39, 17%; never: 14, 6%). It is important to highlight that the exact frequency of visits might be greater as the interviewed participants revealed that fast food bought as take away or home delivered were not counted. A significant number of females (66: 63%) make an impulsive decision to buy fast food, while 85 (69%) males indicated that their fast food consumption is often a planned decision.

3.3 Measurement Validation

To determine the validity of our survey instrument we conducted an Exploratory Factor Analysis (EFA) in SPSS 19 using Principal Component Analysis (PCA).

Confirmatory Factor Analysis

We identified five determinants of healthy eating from the literature – *weight concern, disease concern, nutrition knowledge, social influence,* and *food choice motive*. To verify that our data replicated the five factors in healthy eating behavior, we conducted Confirmatory Factor Analysis (CFA – a statistical procedure that compares the fit of the data with the factor being modeled) using Partial Least Square (PLS) Structural Equation Modeling (SEM). PLS is especially recommended for theory formation and verification [24]. Moreover, PLS-SEM has less stringent requirements concerning data distribution assumptions [24]. In the CFA, the five factors were included as latent (independent) variables, and each was hypothesized to have a direct effect on healthy eating attitude – the dependent variable. We report the

recommended set of indices for model validity and reliability in PLS. We used SmartPLS 2 [25] to analyze the model.

Indicator reliability can be assumed because Cronbach's α and the composite reliability that analyze the strength of each indicator's correlation with their variables are all higher than their threshold value of 0.7 and 0.6 respectively [26]. Convergent and discriminate validity can be assumed as all constructs have an Average Variance Extracted (AVE) – which represents the variance extracted by the variables from its indicator items – above the recommended threshold of 0.5 and greater than the variance shared with other variables [26]. The models yield acceptable values of all indices for PLS model validity or reliability. Again, prior to comparing our two models, we established measurement invariance between males and females samples. The psychometric properties from our two groups demonstrate that the two groups have the same structure; therefore our data is suitable to conduct group comparison. Measurement Invariance was assessed using component-based CFA via SmartPLS [25].

4 Results and Discussion

To examine the differences and similarities between males and females (in terms of their healthy eating determinants), we systematically examined the interactions and the influences of the five determinants (*weight concern, concern for disease, nutrition knowledge,* and *social influence*) on healthy eating behavior using SEM in SmartPLS.

4.1 The Structural Model

The structural model determines the interactions between determinants – specifically, the relationship between the determinants and healthy eating attitude. Figures 1 and 2 show the structural models of healthy eating determinants for males and females respectively. An important criterion to measure the strength of the relationship between variables in structural models is the level of the path coefficient (β) and the significance of the path coefficient (p) [27]. Path coefficients measure the influence of one variable on another. The individual path coefficients and their corresponding level of significance obtained from the two models are shown in Figures 1 and 2.

4.2 Comparison of Eating Determinants for Females and Males

The results from our models show that males and females differ with regards to the influence of the determinants (*weight concern, concern for disease, nutrition knowledge,* and *social influence*) on their healthy eating behavior (see Figures 1 and 2). Females show a more holistic approach to healthy eating behavior in relation to the influence of the determinants. A pairwise comparison of multi-group differences reveals some significant differences ($p<0.05$) in the interaction between the determinants and healthy eating attitude in the two groups. We discuss and compare the influence of the determinants on males and females.

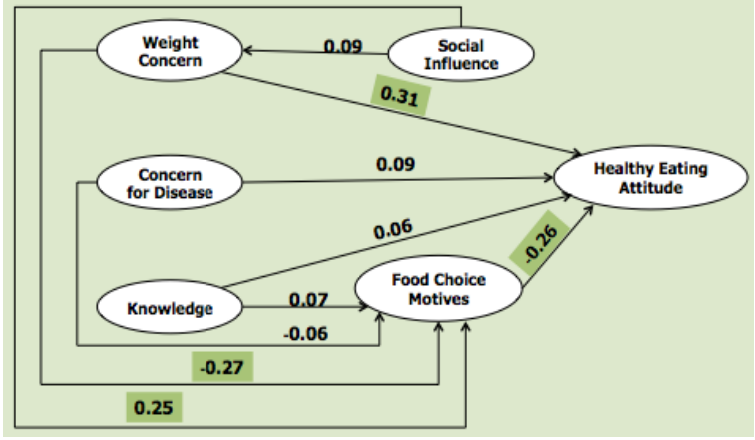

Fig. 1. A model of healthy eating attitude and associated determinants' interactions for males. Significant coefficients are highlighted

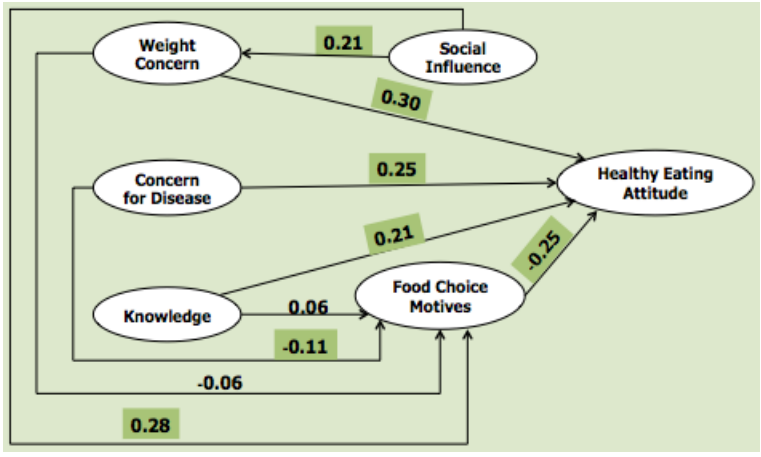

Fig. 2. A model of healthy eating attitude and associated determinants' interactions for females. Significant coefficients are highlighted

Weight Concern: People may adopt healthy behaviors for reasons that are unrelated to health [7]. Being overweight has many negative health-related implications; however, the post survey interviews revealed that the participants were mostly concerned about their weight because they want to maintain an attractive appearance. Our model shows that *weight concern* is a significant positive determinant of healthy eating behavior for both males and females ($\beta = .31$ and $\beta = .30$, respectively, $p<.01$) as shown in Figures 1 and 2. This is in line with the previous finding that *weight concern* is an important consideration in people's decision to adopt a healthy eating behavior [7]. A possible explanation of this finding is the fact that calories (a major source of weight) can only be obtained by consuming food. Therefore, people who are concerned about their weight can easily be persuaded to adopt a healthy eating

behavior to control their weight. A female participant in our post survey related how important it was for her to maintain an 'ideal' weight because it served as a basis for her self-esteem.

Also noteworthy is the fact that, although, *weight concern* affected healthy eating attitude positively for both males and females, its effect on *food choice motive* is only significant for males (β = -.27, p<.01). This suggests that males that are concerned about gaining weight from consuming unhealthy food not only adopt a healthier eating attitude, but also show more resistance to the barriers on healthy eating imposed by *food choice motive*. Therefore, an effective way of overcoming the inhibiting effect of barrier to healthy eating posed by *food choice motive* is to design interventions to increase the perceived relationship between unhealthy eating and weight gain especially for males. Overall, the relationship between *weight concern* and healthy eating attitude implies that persuasive intervention designers aiming at developing gender-inclusive applications for motivating healthy eating attitude can emphasize and make obvious the relationship between unhealthy eating and weight gain to motivate both genders. For instance, a tracking and monitoring application can portray the outcome of healthy behavior in terms of the amount of weight lost (or gained in case of unhealthy behavior) to motivate both males and females to adopt healthy behavior.

Concern for Disease: Previous research on the influence of *concern for disease* on healthy eating attitude has generated contradicting views and results. Sun [19] showed that most individuals expressed concern about unhealthy eating and developing food-related chronic diseases while Orji et al. [7] shows that *concern for disease* is not a significant determinant of a healthy eating attitude. These mixed findings are not surprising considering that none of the studies have considered other moderating factors that might alter the relationship between *concern for disease* and eating attitude. Our models show that the influence of *concern for disease* on attitude is in fact influenced differently by gender. *Concern for disease* is a significant motivator of healthy eating attitude for females (β = .25, p<.01) but not for males as shown in Figures 1 and 2. A possible explanation why *concern for disease* is not as strong a motivator as *weight concern* for both males and females is that there are so many other factors that can cause diseases other than unhealthy eating. Similarly, research has shown that people differ in their beliefs about diet-disease relationship and attributions of illness (its causes, cures, treatments, and symptoms) [28]. Our results suggest that males do not consider the relationship between one's dietary behavior and diseases, while females do. This is in line with a previous study that shows that Canadian male students engage in more risky health-related behaviors to show strength, fearlessness, and manliness [8]. Men perceive their health status as excellent because they tend to consider themselves invulnerable to a number of potential health threats [8]. This implies that persuasive interventions attempting to motivate healthy behavior by manipulating the relationship between (un)healthy eating and diseases might not be effective for males, whereas they are likely to motivate a positive behavior change in females. The mediating role played by *food choice motive* on *concern for disease* for females is worth noting. The negative influence of disease concern on *food choice motive* (β = -.11, p<.01) implies that designing persuasive technology to increase an individual's consciousness of acquiring diseases from

unhealthy eating is a promising way of reducing the inhibiting effect of *food choice motive* on healthy eating attitude for females.

Nutrition Knowledge: Previous research has shown that knowledge influences healthy eating attitude positively [7]. Similarly, research examining the relationship between *nutrition knowledge* and gender shows that females possess a higher level of *nutrition knowledge* than males [29]. Consequently, several PT interventions have been designed based on the idea that providing *nutrition knowledge* will go a long way towards promoting healthy eating behavior [13]. Our model, however, reveals that knowledge is only a significant determinant of healthy eating attitude for females ($\beta = .21$, $p<.01$). In fact designing persuasive interventions to impact *nutrition knowledge* on males might have no direct or indirect influence on their healthy eating attitude. This supports previous research that shows that knowledge alone might not be sufficient to cause a desired behavior change [30]. Persuasive interventions targeting males might not focus on any strategy that impact *nutrition knowledge* as a key motivator of change.

Social Influence: In line with previous research [7], *social influence* has no direct influence on healthy eating attitude for both males and females. However it strengthens the influence of *food choice motive* for both males and females ($\beta = .25$ and $\beta = .28$, respectively, both $p<.01$). This implies that the hindering effect of *food choice motive* on healthy attitude is amplified by related others (e.g., peers). Also noteworthy is the fact that *social influence* increases the effectiveness of *weight concern* for females. This is in line with previous findings that social support provided by friends and family members can enhance both weight loss and maintenance [31]. This result can be explained by the fact that friends eat together as a way to form social bonding. As noted in previous work [7], fast food restaurants are convenient, fast, and inexpensive places for group eating. Our model results also suggest that *social influence* can facilitate or hinder healthy behavior. *Social influence* can hinder the tendency of healthy eating by strengthening the negative influence of *food choice motive* on healthy eating attitude; however, it also amplified concern for gaining weight from unhealthy eating for females. The findings show that *social influence* may not be used as a key motivator of behavior change in a persuasive intervention but can be used to amplify the effect of other motivators like *weight concern*.

Food Choice Motive: *Food choice motive* is the only determinant that influences healthy eating attitude negatively for both males and females ($\beta = -.26$ and $\beta = -.25$, respectively, $p<.01$). This is as expected as most of the motives behind fast food consumption are non-health related (e.g., cheap, convenient, time saving). PT designers should therefore plan to deal with the inhibiting effect of *food choice motive* on healthy eating attitude in their design. From our model, one way to reduce the negative effect of *food choice motive* is to increase *weight concern* (for males) by making obvious the diet-weight relationship. For females, however, decreasing the negative effect of *food choice motive* can be achieved by increasing *concern for disease*, which can be achieved by portraying diet-disease relationships.

Impulsive and Planning Decision: Another important discovery that emerged from our study is that the decision to eat fast food is more an impulsive decision for females (63% of females make impulsive decisions to eat fast food) and a planned

decision for males (69% of males make planned decision to eat fast food). Impulsive decisions to purchase occur when an individual makes an unintended, unreflective, and immediate purchase [32]. This result is in line with a previous study that shows that men possess goal-oriented characteristics, such as decisiveness, whereas women show more emotive qualities, such as emotional responsiveness [33]. This implies that different persuasive approaches maybe employed for males and females to cause an effective change in healthy behavior especially in relation to fast food consumption. For example, persuasive approaches that appeal to an individual's emotion (rather than his/her sense of reasoning) might be more effective for women at changing behaviors associated with impulsiveness and shallow processing of information. Logical strategies (e.g., goal setting) that appeals to a person's sense of reasoning might be more effective at causing behavior change in males.

4.3 Gender-Inclusive PT Design

Our findings can be applied to design persuasive intervention targeting both males and females (gender-inclusive) without demotivating anyone. Our results show that *weight concern* influences both males and females positively. Therefore, to appeal to a broader audience, persuasive intervention designers should include persuasive strategies that manipulate *weight concern.* For example, self-monitoring technologies can be used to track a user's behavior and the outcome can be projected in terms of weight gain or loss. Similarly *concerns for disease and nutrition knowledge* are significant motivators for females, but do not influence males negatively. Including these determinants in PT intervention design will motivate a positive behavior change for females without hindering behavior performance for males. *Social Influence* has no direct influence on attitude; however, it influences *weight concern* positively for females and therefore can also be employed. *Food choice motive* impacts on attitude negatively for both males and females. To deal with this, PT designers can increase the perceived *weight concern* and *concern for disease* in a gender-inclusive design.

4.4 Gender-Specific PT Design

Although designing gender-inclusive PT intervention is possible, personalizing persuasive interventions is advocated to increase the effectiveness of interventions and to keep the intervention simple – focusing on only determinants that are of significant to each group.

To design persuasive interventions targeting males, PT designers should employ any persuasive strategies that emphasize *weight concern* to directly impact positive attitude change. *Concern for disease* could also be employed to reduce the inhibiting effect of *food choice motive* on attitude. On the other hand, to design for females, PT designers should employ strategies that emphasize *weight concern, concern for disease,* and *nutrition knowledge* to motivate a positive change in attitude. *Social influence* can be employed to strengthen the impact of *weight concern* on attitude. Similarly, *concern for disease* can be employed to reduce the negative effect of *food choice motive* on healthy eating attitude.

Our findings can be applied in designing both gender-inclusive and gender-specific PT interventions that manipulate only the determinants that are important to the users.

Limitations and Future Work: This research study has some limitations that must be acknowledged. One practical limitation for generalizability stems from younger participants from the university community, the majority of whom are students. We are careful not to generalize for a population older than 35. In the future, we hope to apply the findings from this study in designing both gender-inclusive and gender-specific PT interventions for motivating healthy eating behavior.

5 Conclusion

Several research findings have identified gender differences in healthy behavior especially healthy eating behavior; however, whether there are also differences in the underlying determinants of healthy eating behavior was not clear. Our study shows the existence of gender differences in the underlying determinants of healthy eating and their interactions. This finding established the need to tailor PT intervention based on gender – by targeting determinants that are significantly important to males and females. Our models show that females have a more realistic view of health behavior (in relation to its determinants). Finally, based on the results from our study, we highlighted approaches for designing both gender-inclusive and gender-specific interventions. Our study also shows that a rational persuasive approach may be more effective for males while emotional appeal may work better for females. We shed light on ways of designing gender-sensitive PT for increased effectiveness.

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References

1. Wansink, B.: Mindless Eating: Why We Eat More Than We Think. Bantam (2006)
2. Lau, et al.: 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children. CMAJ 176, S1–S13 (2007)
3. Oinas-Kukkonen, H., Harjumaa, M.: A Systematic Framework for Designing and Evaluating Persuasive Systems. In: Oinas-Kukkonen, H., Hasle, P., Harjumaa, M., Segerståhl, K., Øhrstrøm, P. (eds.) PERSUASIVE 2008. LNCS, vol. 5033, pp. 164–176. Springer, Heidelberg (2008)
4. Kaptein, M., Lacroix, J., Saini, P.: Individual Differences in Persuadability in the Health Promotion Domain. In: Ploug, T., Hasle, P., Oinas-Kukkonen, H. (eds.) PERSUASIVE 2010. LNCS, vol. 6137, pp. 94–105. Springer, Heidelberg (2010)
5. Hu, R., Pu, P.: Acceptance Issues of Personality-based Recommender Systems. In: Proc. ACM Conf. on Recommender Systems, pp. 221–224 (2009)
6. Halko, S., Kientz, J.A.: Personality and Persuasive Technology: An Exploratory Study on Health-Promoting Mobile Applications. In: Ploug, T., Hasle, P., Oinas-Kukkonen, H. (eds.) PERSUASIVE 2010. LNCS, vol. 6137, pp. 150–161. Springer, Heidelberg (2010)

7. Orji, R., Mandryk, R.L., Vassileva, J.: Towards a Data-Driven Approach to Intervention Design: A Predictive Path Model of Healthy Eating Determinants. In: Bang, M., Ragnemalm, E.L. (eds.) PERSUASIVE 2012. LNCS, vol. 7284, pp. 203–214. Springer, Heidelberg (2012)
8. Dawson, et al.: Examining gender differences in the health behaviors of Canadian university students. J. of the Royal Society for the Promotion of Health 127, 38–44 (2007)
9. Fogg, B.J.: Persuasive Technology: Using Computers to Change What We Think and Do. M.K. Publishing (2003)
10. Deci, E.L., Ryan, R.M.: Intrinsic Motivation and Self-Determination in Human Behavior (Perspectives in Social Psychology). Plenum Press (1985)
11. Michaelidou, N., Christodoulides, G., Torova, K.: Determinants of healthy eating: a cross-national study on motives and barriers. J. of Consumer Studies 36, 17–22 (2012)
12. Thompson, D., et al.: Serious Video Games for Health How Behavioral Science Guided the Development of a Serious Video Game. Simulation & Gaming 41, 587–606 (2010)
13. Orji, R., Vassileva, J., Mandryk, R.L.: LunchTime: a slow-casual game for long-term dietary behavior change. J. of Personal and Ubiquitous Computing (2012), doi:10.1007/s00779-012-0590-6
14. Moss, et al.: Some men like it black, some women like it pink: consumer implications of differences in male and female website design. J. of Consumer Beh. 5, 328–341 (2006)
15. Ferebee, S.: The Influence of Gender and Involvement Level on the Perceived Credibility of Web Sites. In: Oinas-Kukkonen, H., Hasle, P., Harjumaa, M., Segerståhl, K., Øhrstrøm, P. (eds.) PERSUASIVE 2008. LNCS, vol. 5033, pp. 279–282. Springer, Heidelberg (2008)
16. Drozd, F., Lehto, T., Oinas-Kukkonen, H.: Exploring Perceived Persuasiveness of a Behavior Change Support System: A Structural Model. In: Bang, M., Ragnemalm, E.L. (eds.) PERSUASIVE 2012. LNCS, vol. 7284, pp. 157–168. Springer, Heidelberg (2012)
17. Feeley, A.B.B., Pettifor, J.M., Norris, S.: Fast food consumption among 17 year olds in the Birth to Twenty Cohort. South African J. of Clin Nutri. 22(3) (2009)
18. Steimann, F., Kahkonen, P., Tuorila, H., Rita, H.: How information enhances acceptability of a low-fat spread. J. Food Quality and Preference 7, 8 (1996)
19. Sun, Y.-H.C.: Health concern, food choice motives, and attitudes toward healthy eating: the mediating role of food choice motives. Appetite 51, 42–49 (2008)
20. Steptoe, A., Pollard, T.M., Wardle, J.: Development of a measure of the motives underlying the selection of food: the food choice questionnaire. Appetite 25, 267–284 (1995)
21. Kearney, et al.: Attitudes towards and beliefs about nutrition and health among a random sample of adults in the Republic of Ireland and Northern Ireland. PHN 4, 1117–1126 (2001)
22. Alexander, J.M.: Dieting strategies of college students: a study of behaviors, attitudes and goals, and the influence of restraint and gender. M.S. Thesis, Rutgers Univer (1992)
23. Hinton, R.H., Brownlow, C., McMurray, I., Cozens, B.: SPSS Explained. Routledge (2004)
24. Henseler, J., Ringle, C.M., Sinkovics, R.R.: The use of partial least squares path modeling in international marketing. J. Advances in Internl. Marketing 20, 277–319 (2009)
25. Ringle, C.M., Wende, S., Becker, J.: smartpls.de - next generation path modeling, `http://www.smartpls.de/forum/contact.php.hp` (accessed August 2012)
26. Chin, W.W.: The Partial Least Squares Approach to Structural Equation Modeling. Modern Methods for Business Research, 298–336 (1998)
27. Hair, et al.: PLS-SEM:Indeed a Silver Bullet. J. Markting Theory and Pract. 19,139–152 (2011)

28. Vaughn, et al.: Cultural Health Attributions, Beliefs, and Practices: Effects on Healthcare and Medical Education. J. Open Medical Education J. 2, 64–74 (2009)
29. Whitcombe, et al.: Relationship between Nutrition Knowledge and Gender, Ethnic Background, and Year in School in varsity athletes. J. Amer. Dietetic Ass. 96, A87 (1996)
30. Brown, K., McIlveen, H., Strugnell, C.: Nutritional awareness and food preferences of young consumers. J. Nutrition & Food Science 30, 230–235 (2000)
31. Wing, R.R., Jeffery, R.W.: Benefits of recruiting participants with friends and increasing social support for weight loss and maintenance. J. Consult. and Clini. Psy. 67, 132–138 (1999)
32. Rana, S., Tirthani, J.: Effect of Education, Income and Gender on Impulsive Buying Among Indian Consumer an Empirical Study of Readymade Garment Customers. J. Management 145–146 (2012)
33. Rosenkrantz, P., Bee, H., Vogel, S., Broverman, I.: Sex-role stereotypes and self-concepts in college students. J. of Consulting and Clinical Psych. 32, 287–295 (1968)