Incentive Design to Enhance the Reach of Weight Loss Programs

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1. Introduction

The obesity epidemic in the U.S. contributes to substantial economic, social, and personal losses (Mokdad et al., 1999; Wellman and Friedberg, 2002). Its rapid and consistent growth is accompanied by a host of chronic diseases (e.g., asthma, atherosclerosis, depression, hyperinsulinaemia, hypertension, sleep apnea, and Type 2 diabetes) (Must et al., 1999). The resulting direct medical expenditures are 9% of U.S. annual medical expenditures (Finkelstein et al., 2003) and 27% of the rise in per capita health care expenditures between 1987 and 2001 (inflation adjusted) can be attributed to obesity (Thorpe et al., 2004). Obese adults on average spend 48% more inpatient days per year than normal-weight adults (Thompson et al., 2001), are more vulnerable to short-term disability (Arena et al., 2006), experience more absenteeism from work (Aldana and Pronk, 2001; Tsai et al., 2005), and exhibit decreased productivity (presenteeism) in the workplace (Burton et al., 2005; Ricci and Chee, 2005). In the U.S., the aggregate annual costs attributable to obesity alone are estimated to be $73.1 billion (Finkelstein et al., 2010).

These undesirable health and economic consequences have motivated the federal government and employers to invest in weight control programs. However, the participation rate (i.e., the reach of these programs) is consistently low (generally around 10% to 15% eligible employees participated) which causes limited public health impacts (Zamosky, 2010). Even when the program participation fees, food and exercise expenses are paid by a third party, weight control program participants still face substantial time and psychological costs (Kane et al., 2004a; Kane et al., 2004b). A sizable personal time investment is needed to learn about and then implement successful weight loss strategies.

Foods and activities that were once enjoyed (e.g., watching TV or eating fast food) must be limited or eliminated to achieve weight control goals. Offering financial incentive is the most common way to encourage weight control program participation and adherence (see reviews such as Kane et al., 2004a; Kane et al., 2004b; Paul-Ebhohimhen and Avenell, 2008; Wall et al., 2006).

Different aspects of incentives have been investigated in the preventive care literature such as the forms of incentives (e.g., insurance co-pay, coupon, gift or cash) (Cherkin et al., 1990; Kenkel, 1994; Lillard et al., 1986); the amount of monetary value of the incentives (Doody et al., 2003; Helpern et al., 2002); the certainty of the payment (Volpp et al., 2008); the contingency conditions (i.e., whether the payment is tied to participation or to outcomes) (Curry et al., 1991; Donatelle et al., 2000; Higgins et al., 2004); and the timing of the incentive payment (Finkelstein et al., 2007). The consensus is that financial incentives are consistently positively related to initial program participation rates.

However there is a dearth of research on answering how well financial incentives work in enhancing program reach since no systematic analysis has been undertaken to understand the interaction between the different aspects of incentives and people's program participation decisions. A practice uniformly absent in previous studies of incentive-based programs is the rational justification of the incentive designs including the choices of incentive amount, type and timing.

This study takes a key step to advance the literature on financial incentives in weight loss programs by formally evaluating the effects of the magnitude, type, and timing of financial incentives in stimulating participation in a weight loss program among overweight and obese adults.

2. Related Literature

Financial incentives have been one of the common tools used to encourage desirable behaviors and induce better decision-making. In the context of weight control programs, the examination of incentive effectiveness began as early as the 1970s (e.g., Jeffery (1978). However, most studies were randomized control trials and therefore were limited in the ability of comparing a full range of incentive attributes and levels. Furthermore, most studies did not test the direct incentive effects independent of intensive weight control program structures.[1] Therefore the direct effect of financial incentives may be masked (i.e., the influence of financial incentives may be redundant rather than additive to, or interactive with, intensive programs) (Finkelstein et al., 2007; Kane et al., 2004a; Kane et al., 2004b; Paul-Ebhohimhen and Avenell, 2008).

Finkelstein et al. (2007) conducted a pilot study to examine stand-alone financial incentives in the absence of a structured weight loss program. They found that financial incentives resulted in short-term weight loss (3 months), but long-term maintenance was not assessed. Similarly, Volpp et al. (2008) demonstrated the short-term effectiveness (over 4 months) of incentives used in conjunction with an initial dietitian-directed counseling session and frequent self-monitoring. Both studies could only explore limited variations of incentive structures and results and inferences were bounded within the sample of program participants. Both papers called for future research to assess financial incentive effects on program reach and long-term weight loss outcome maintenance.

[1] Intensive programs are those programs that have frequent person contacts, program monitoring and group meetings etc.

Economists have been working on modeling, testing and constructing effective incentive structures especially in the cases of smoking cessation, substance abuse control and education promotion (e.g., Dallery and Glenn, 2005; Gine et al., 2010; Kremer et al., 2009). In the context of weight loss programs, although economic intuition suggests the potential positive effect of financial incentives in motivating program participation and promoting better outcomes, limited economic research has addressed this topic. There have been calls for more active role uptakes by economists in effective utilization of financial incentives to shape individuals' health behaviors through rigorous economic analytic methods (Sindelar, 2008). Recent experimental economic work has shown that paying students who did not exercise often to go to the gym regularly can reinforce the exercise habit which can then be maintained even after the incentives are withdrawn (Charness and Gneezy, 2009). Burger and Lynham (2010) examined data from the weight loss betting industry and found that gender heterogeneity needs to be considered in the design of weight loss incentive. However to our knowledge there currently does not exit research which simultaneously examines the influence of different financial incentive attributes and multiple associated attribute levels on individuals' weight loss program participation decisions.

An important step towards making large impacts on public health through weight loss programs is to understand how different aspects of financial incentives can work together to help reach more people (through participation). This study employs stated-preference methods to systematically investigate this question. Our results provide much needed information for the appropriate design of incentives for different population subgroups to stimulate participation in weight loss programs. Results will further inform full-scale

randomized control trials through calibrating the incentive components which is the crucial step recommended by Stevens et al.(2007).

3. Conceptual Framework and Model Specification

An individual's utility associated with a weight loss program is assumed to be comprised of systematic (observed) and random (unobserved) elements. The observed component is specified in terms of the program attributes. Specifically, individual *i*'s utility associated with weight loss program *j* is:

$$U_{ij} = \beta' X_j + \varepsilon_{ij}, \qquad j = 1, 2, ..., J \qquad (1)^2$$

where X_j is a vector of the relevant incentive attributes for the program option *j* (e.g., magnitude, type and timing), β is a vector of associated preference parameters and ε_{ij} is the random error term. If program *j* is chosen it is assumed that this program yields the maximum utility among available weight loss program options ($j \in J$). In its current form equation (1) assumes that the utility a person receives from engaging in a weight loss program (*X*) is separable from the utility brought by other goods and services (*Y*). That is:

$$\partial U(X, Y) / \partial X \partial Y = 0 \qquad (2).$$

This assumption may or may not be reasonable, but as empirical observers we do not know which elements of *Y* would affect (interact with) characteristics of a weight loss program (*X*). To address this potential issue we consider two personal characteristics, sex and weight status (i.e., normal weight, overweight or obese), that might proxy for these other variables and influence people's evaluation of weight-loss program characteristics. Thus, equation (1) is rewritten as:

$$U_{ij} = \beta' X_j + \gamma s_i + \rho w_i + \varepsilon_{ij}, \qquad j = 1, 2, 3, ..., J \qquad (3)$$

[2] The utility associated with not participating in the weight loss program is set to be zero.

where *s* denotes subject sex, *w* is a vector of weight categories, and γ and ρ are effect parameters.

Preferences for weight loss programs were elicited through choice questions where each question asked subjects to choose between two weight loss programs and a third option of not participating in any one of the programs. The conceptual framework for analyzing responses to choice questions is based on the random utility model of utility differences (Hanemann, 1984; McFadden, 1974; Swait, 2006; Train, 2003). The probability that program *j* is chosen is:

$$\begin{aligned}\Pr(j) &= \Pr[\beta' X_j + (\gamma s + \rho w) ASC_j + \varepsilon_{ij} > \beta' X_k + (\gamma s + \rho W) ASC_k + \varepsilon_{ik}], \forall\, j \neq k, K \in J \\ &= \Pr[\beta'(X_j - X_k) + (\gamma s + \rho w)(ASC_j - ASC_k) + (\varepsilon_{ij} - \varepsilon_{ik})] \\ &= \Pr[\beta'(X_j - X_k) + (\gamma s + \rho w)(ASC) + \upsilon_{jk}] \qquad (4)\end{aligned}$$

Note, we have interacted sex (*s*) and (*w*) with an alternative specific constant (*ASC*) that indicates if a weight loss program is chosen (=1) or not (=0). The interaction prevents the demographic characteristics from cancelling out in the utility difference. This simple specification assumes that *s* and *w* affect the probability that a person will choose any weight loss program over no weight loss program.

Assuming an extreme value distribution for the errors (υ_{jk}), the probability of choosing program option *j* is the standard conditional logit model (Greene, 2000). However, the conditional logit model contains restrictive assumptions that are questionable: a) choices made by an individual are not correlated over the *S* repeated choice scenarios even though subjects were each asked to answer four choice questions, and b) parameters are assumed to be fixed which implies that all individuals have identical preferences across the weight loss program characteristics. A random-parameters logit model) relaxes these assumptions by allowing some preference parameters (elements of β) to vary randomly over individuals (Revelt and Train, 1998;

Train, 1998, 2003). The preference parameters are drawn from a density $f(\beta \mid \theta)$ with unknown parameters θ (typically a mean and a variance).

Conditional on the unknown individual-specific parameters, β_i, the probability of individual *i* making a given sequence of choices over *S* choice scenarios is the product of conventional logit formulas:

$$L_{is}(\beta_i)=\prod_{s=1}^{S}\frac{e^{\beta_i' x_{js}}}{\sum_{j=1}^{J} e^{\beta_i' x_{js}}} \qquad (5)$$

In our case, *S* equals 4 and *J* equals 3. By specifying a distribution for $f(\bullet)$, θ can be estimated using a simulated maximum likelihood procedure (Train, 2003). Here, we assume the parameters are distributed normally.

This conceptual specification of the weight loss program allows two forms of heterogeneity to enter the analysis. First, the proclivity to participate in any weight loss program may be affected by subjects' sex (*s*) and current weight categorization (*w*); Second, each subject is allowed to respond to the program characteristics (*X*) differently. Allowing for such heterogeneity has the potential to provide insights to the development of more effective recruitment protocols for weight loss programs.

4. Study Design

Choice questions (sometimes referred to as conjoint analysis, choice modeling or attribute-based choice questions) are a derivate of stated-preference methods, which are a family of survey-research methods used to systematically investigate preferences for programs (e.g., weight loss interventions) through program attributes (e.g., financial incentive). The merit of stated-preference methods is their ability to use carefully

constructed program scenarios to elicit preference information for new programs where revealed-preference data are not available. Stated-preference techniques have been widely used in marketing, transportation and environmental economics (Hensher et al., 2005; Holmes and Adamowicz, 2003; Louviere et al., 2000). In recent years stated-preference methods, including choice questions, have been increasingly popular in the field of health economics. Studies have used stated-preference methods to model choice of health plans (Booske et al., 1995; Cunningham et al., 1999; Harris et al., 2002) and choice of medication (Bingham et al., 2001), to estimate patient preferences for different aspects of health care services (Chakraborty et al., 1994; Chakraborty et al., 1993; Moayyedi et al., 2002), to assess preferences in doctor-patient relationship (Vick and Scott, 1998) and to establish general practitioner preference for different practice jobs (Wordsworth et al., 2004).

In practice, two types of choice questions have been employed, binary choices and multi-program choices. Binary-choice questions typically ask subjects if they will or will not participate in a program (Kjaer et al., 2006; Kvamme et al., 2010; Ryan et al., 2006). Multi-program questions typically ask subjects to choose between two or more alternative programs and an additional option of not participating (Brown et al., 2009; Ozdemir et al., 2009; Paterson et al., 2008). The key similarity between all of these applications is that choice questions are used to elicit individuals' preferences for different treatment and prevention programs by asking respondents to choose their preferred program that is defined by a set of treatment or outcome attributes. In fact, the Brown et al. (2009) study is similar to our study in that subjects would be paid an incentive to participate in a program to improve their health (a walking program for older

adults) and subjects are asked to consider other attributes of the program that might induce participation. The estimation results from choice-question data enable researchers to determine the relative importance of the different attributes in influencing statements of program-participation decisions.

4.1. Survey Design − Program Description and Incentive Attributes

Survey participants were asked to indicate their willingness to participate in a 3-month weight loss program. The program included an initial face-to-face consultation with a dietitian, personalized eating and exercising plans and tracking tools, and weekly telephone support calls, monthly program weigh-in visits (1^{st}, 2^{nd}, and 3^{rd} months), two follow-up weigh-in visits to monitor maintenance of weight loss after the active 3-month program is completed (6^{th} and 12^{th} months) (See appendix for details). We chose this minimal weight loss program as the platform for evaluation instead of the intensive ones in order to avoid potentially masking the effectiveness of financial incentives. Survey participants were informed that losing 5% of body weight for overweight and obese individuals would greatly reduce the risk of chronic diseases. This condition was used as the basis for a monetary incentive: if program participants achieved and maintained at least 5% weight loss when compared to their initial weight at each weigh-in visit, they would receive a financial incentive.

The program scenarios are defined in terms of different combinations of financial incentive attributes. These attributes (Table 1) include:

a. monetary value of the incentive ($),

b. form of incentive (cash, prepaid grocery card, pre-paid gym pass, and healthcare co-pay waiver), and
c. timing of incentive payment (at each weigh-in, at the end of the 3-month program, or at the end of the last follow-up at 12th month).

Each choice questions presented subjects with two weight loss programs to choose between which were differentiated by varying levels of at least one of the financial incentive attributes described above (Figure 1). Subjects were asked to indicate the program they would choose or to not choose either program. Each subject was asked to answer four choice questions. The survey also included questions to collect information about the individuals' socio-economic characteristics, physical activity level, healthy eating behavior, intrinsic and extrinsic motivations, weight and height, and general health status.

Before the survey was implemented two focus groups were conducted with participants from the targeted population. The focus group results were used to refine survey content with a specific focus on the description of the weight loss program and the framing of the choice questions.

4.2. Attribute Design

One might want to consider a design where subjects collectively have a chance to consider all binary pairings of attributes in the choice question, e.g., $5 in Program A and $24 in Program B, then $5 in Program A and $55 in Program B. The same would follow for the payment type and payment timing attribute levels. For our study, we have three attributes, resulting in 20 pairings for the monetary incentive amount, 12 pairings for

payment type, and 6 pairings for payment timing. Trying to include all of these possible pairings in every combination would lead to a prohibitively large design (20×12×6). We opted to use a simpler design that results in a slight amount of correlation among attribute differences, but it keeps the design a manageable size (12×6). All possible parings for payment type and timing are included and then one of the monetary incentive amounts is randomly assigned to each pairing.

The pairings for each attribute are combined to form choice sets that become Programs A and B in the choice questions. To minimize attribute correlation, a 12 × 6 fractional factorial matrix was used. We developed the 72-line matrix using Kuhfeld's on-line design catalog (SAS, 2009). We then assigned monetary incentive amounts randomly to each of the alternatives in each choice set. The final design of choice questions is comprised of 72 choice sets (Program A/B combinations). The 72 program pairings were divided into 18 survey versions with four choice questions in each survey. These 18 survey versions were then randomly assigned to participants.

4.3. Survey Implementation

We administered a mail survey to 1,500 adults. Survey participants were recruited throughout the Commonwealth of Virginia via random digital dialing. The phone recruitment and survey mailing were conducted by the Virginia Tech Center for Survey Research.

Survey participants were screened over the phone to ensure recruitment eligibility (i.e., at least 18 yrs old). Individuals provided self-reported weight and height over the phone and research staffs used this information to calculate Body Mass Index (BMI) and

screened them further: the recruitment goal is to have ~300 normal weight adults and ~1,200 overweight or obese adults agree to participate in the survey over the phone.[3] A total of 1,500 surveys were mailed out in three rounds over the months of October and November 2009, and February 2010.[4] No follow-up calls or secondary mailings were used. We received 863 complete and usable surveys leading to a 60% completion rate.[5] The surveys were then coded by trained research staff and the data were double-entered.

5. Results

5.1. Data Description

Table 2 reports summary statistics of survey respondents' characteristics. There were more women than men in our sample (67% vs. 33%). Over 80% of respondents are Caucasian and about 10% are African American. The average age is 55. A majority of the respondents have at least some college education. Approximately half (48%) of female respondents were not working at the time of the survey either because they were retired, unemployed, students or unpaid home workers. This ratio is lowered to 40% in the male subsample. Male respondents earn more than female respondents. Nearly half of all male respondents (49%) were overweight and 35% were obese. In contrast, in the female subsample fewer are overweight and more are obese.

[3] The normal weight survey participants were told to complete the survey as if they actually need a weight loss program.
[4] The final sample of 1,500 is comprised of 277 normal weight individuals, 577 overweight individuals and 646 obese individuals.
[5] Out of the 1,500 mail-outs, we have about 60 non-deliverable addresses.

5.2. Random Parameters Logit Estimates

Similar to Paterson et al. (2008) we specify utility for individual *i* associated with program *j* in choice scenario *s* in additive form as:

$$U_{ijs} = \beta_{iA} A_i + \beta_M M_j + \beta_{iF} F_j + \beta_{iT} T_j + \varepsilon_{ijs} \qquad (6)$$

where A_i is a alternative-specific constant (ASC) indicating a program was chosen and equals 1 when either program was chosen (0 otherwise), *M* is the monetary amount of the incentive, *F* is vector of binary variables capturing the form of the incentive payment and *T* is a vector of binary variables capturing the timing of the incentive payment. The omitted category from *F* is the insurance co-pay waiver and for *T* it is the payment at 12 months. Each of the *F* and *T* variables' coefficients are allowed to be normally distributed when estimating the random parameters logit model and the marginal utility of money (β_M) is assumed to be constant across subjects. This is the same analytical framework used by Özdemir (2009) and Paterson (2008). The Özdemir study did not include a monetary incentive. The Paterson study did include a monetary incentive, but similar to what is done here, they allowed each of the monetary attribute variables preference parameters to be randomly distrubted except the monetary amount variable.

We report two models in Table 3. Model 1 estimates equation (6) including only the ASC and attributes of the financial incentive. Model 2 appends interactions between the ASC and subjects' sex and current weight status. Both models indicate that individuals are more likely to participate if they receive a higher monetary incentive, and the coefficient on this variable is robust to the inclusion/exclusion of the sex and weight status interaction effects. Cash and grocery card payments are preferred to default payment type, which is the insurance co-pay waiver, and a gym pass payment's effect on

the probability of participating in a given program is not significantly different from the insurance co-pay waiver. The effect of both cash and grocery card are about 10 times larger than that of a gym pass. Thus, individuals respond favorably to financial incentives, provided the interface (form of payment) is appropriate. A test that the parameter estimates for the cash and grocery card forms of payment are statistically equal cannot be reject in either model (p= 0.8836 and p= 0.9851, respectively).

The standard deviation estimates generated by the random parameter logit models enable us to investigate heterogeneity or differences in preferences for attributes. The estimated standard deviations are significant for all three payment forms which suggests there is heterogeneity in subjects' preferences for payment forms. Given the normal distribution assumption imposed, the estimated mean (1.214) and standard deviation (0.798) associated with the cash coefficient in Model 1 indicates that a small percentage of respondents, about 6%, prefer a co-pay waiver to cash payment, i.e., the coefficient on the cash variable is negative (this is intuitive if we consider that some potential participants visit the doctor more than others). For the grocery card option, about 13% of subjects prefer a co-pay waiver to the grocery card. These percentages increases to 31% and 34%, respectively, when gender and weight status variables are added to the equation (Model 2). It is interesting to note the mean parameter estimates for the cash and grocery card variables are stable when sex and weight status are added to the model, but their standard deviations increase. This increased variation could result from an over-specification of our model of random utility given that we have relatively few observations in each cell (male/female, normal/overweight/obese). However, our key results pertaining to program participation are nearly identical across the two models.

The payment timing variables are significant in both models, indicating that monthly payments (payment at each weigh-in) and one cumulative payment at 12 months (the base) are preferred to a single payment at the end of the 3-month active portion of the weight-loss program. The single payment at the end of the 3-month program only rewards the result of one weigh-in and no additional incentives are associated with the other two follow-up weigh-ins while the other two timing options (pay at each weigh-in and pay at 12-month) attach incentives to all three weigh-ins. Thus, results indicate that individuals would prefer to be paid more often in the program which may reflect the desire to be recognized during the process. Unlike the form of payment parameters, both the means and standard deviations of the timing variables are affected by the inclusion of sex and weight status in the equation; the mean for the 3-month payment becomes larger, the mean for payment at each weigh-in becomes smaller, and the standard deviations of both increase and become significant.

All interaction terms in model 2 are statistically significant which shows considerable sex and BMI status heterogeneity in participation preference. The inclusion of two-way and three-way interactions enables the comparison between sex and weight status groups (a total of 6 groups). Table 4 presents the magnitudes and p-values for the participation preference differences among these groups. It shows clearly that participation preference is statistically significantly different when comparing females from any weight status to normal weight males. In general, a female, regardless of her weight, is statistically more likely to participate in the weight loss program than normal weight male. Furthermore, obese males are more likely to participate compared to overweight male. No further

significant preference heterogeneity is found through interaction models after controlling for the program incentive attributes.

To further investigate the relationship among the financial incentive attributes, we calculate how much is needed to offset the "cost" of participating in the weight loss program (the minimal dollar amount threshold) under different incentive frameworks. This cost of participation is determined for each attribute, holding the remaining attributes constant (i.e., type and timing), by calculating the necessary amount of the incentive per weigh-in that gives the same utility level as though the person elected not to participate. Table 5 presents the minimum payments per weigh-in calculated using results from the model with sex and weight status interactions. Given the fact that our models have random parameters, we set the preference coefficients at their estimated means so our participation costs can be interpreted as average participation costs. In order to provide enough motivation to an overweight male, the weight loss program needs to offer more than $59.46 per weigh-in in cash if the payment is at the end of the 3-month program. The per weigh-in amount decreases to $10.23 if the payment happens at each weigh-in. Furthermore, the amount needs to increase to $116.00 if it is in the form of a gym pass instead. For an overweight female, a similar trend exists: the program needs to offer more than $60.31 per weigh-in in gym pass if the payment happens at each weigh-in to attract her. This amount decreases to $3.77 if it is in cash and increases to $109.54 if it is paid at the end of the 3-month program.

Our results show differences in coefficient estimates across sex. However, these estimated coefficient differences may occur as the result of scale differences in the random component of the utility (i.e., variance differences). Therefore, we adopt the

procedure of Swait and Louviere (1993), to test whether the observed differences in our coefficient estimates are due to actually heterogeneity across sex or simply differences in scale between the two groups. Specifically, we tested whether the parameter estimates are equal after accounting for differences in scale factors across gender groups. The likelihood ratio test gives us a statistics of 127.03 with a p-value of 0.000. Therefore, we reject the null hypothesis and confirm that preference heterogeneity exists beyond differences in scale across sex and our minimal weight-loss program will be more effective in reach if the program can customize the incentive component by gender.

5.3. The Incentivized Minimal Weight-Loss Program Reach Prediction

Table 6 presented average predicted probabilities of participation in the weight loss program for each attribute combination, conditioned on sex and weight status. The results are calculated based on the estimation of Model 2. To help the reader sift through the array of predictions, we bolded the attribute combinations where the estimated model predicts that more than 50% of the subjects will participate.

Several interesting insights can be gained from Table 6. Comparing the upper part of the table with the lower part, the preference heterogeneity that exists across sex can be readily seen. Normal weight men are unlikely to participate but normal weight women are likely to participate. Overweight men are somewhat less likely to participate than overweight women and the opposite relationship holds for obese men and women. These differences are relatively small in practical terms, generally less than 5% for overweight people and generally less than 10% for obese people. Normal weight or overweight females in general can accept any payment timing of any form at a lower dollar amount

compared to normal weight or overweight males. This trend is reversed when the comparison is made between obese females and obese males. Figure 2 provides a visual example to show the extant gender heterogeneity: fixing the payment form in cash and timing at each weigh-in, the predicted participation rate exhibits a wide range for males of different weight status (i.e., the participation prediction curves exhibit a wide spread), while the predicted participation rate are pretty similar for females of different weight status (i.e., the participation prediction curves are clustered together).

Examining preference heterogeneity within gender but across weight status (i.e., comparing rows within either the upper or lower part of Table 6), we can see that males generally show more interest in the program as their weight status elevates. However, this trend is not clear when we look at females. Furthermore, normal weight females even exhibit a higher preference towards program participation compared to overweight and obese females. Figure 3 provides a visual example of this within gender preference heterogeneity towards payment forms. The two predicted participation curves when the incentives are in the form of cash and gift card essentially overlapped. The copay waiver is preferred to gym pass when the amount is greater or equal to $24.00.

Overall, the predicted participation rates for a payment at the end of 12 months are about 10% lower than the pay at each weigh-in scheme. A payment at each weigh-in with cash or grocery card obtains the highest participation at the lowest cost: over 50% of overweight men will participate at a $24 incentive; over 50% of overweight women will participate at a $5 incentive; and over 50% of obese men and women will participate at a $5 incentive. Furthermore, at this preferred payment timing, an incentive of $98 results in a predicted participation rate of over 90% among overweight or obese men and women.

Finally, there is no difference in the predicted probabilities for the cash and grocery card forms of payment.

These results collectively suggest that weight loss programs with immediate incentive payments (i.e., pay at each weigh-in) are likely to enlist higher participation than programs with deferred payments. Payment forms that give people more usage flexibility in their daily lives (i.e., cash or grocery card) are also likely to enlist higher participation.

6. Discussion

Participation rates (i.e., reach) of weight loss programs have been relatively low, limiting the potential for public health impacts. Financial incentives are common tools employed in weight loss programs to increase program reach and adherence. However no known study has simultaneously examined wide ranges of incentive attributes and levels in terms of their influence on weight loss program participation. Our study employed stated-preference methods to elicit individuals' program participation preference towards different financial incentive attributes.

The results of this study show promise for the use of carefully designed incentive programs enlisting greater participation in weight loss programs. The observed heterogeneity, both in subject responses to program attributes and in terms of subject characteristics, indicates that a weight loss program with a one-size-fits-all financial incentive component will not maximize participation. For example, while most subjects preferred the idea of a cash payment or a grocery card payment, small percentages of our subjects did not prefer these methods of payment.

It might be surprising at first view that cash and grocery cards are preferred forms of payment relative to gym passes and insurance co-pay waivers. Physical activity is a key to any successful weight loss program. Overweight and obese people generally require more health care than normal weight people. The main cause rests in the liquidity of the payment. A gym pass is a single use payment form that has a pre-determined usage while cash has full usage flexibility and a grocery card frees up individuals' cash that is normally allocated to grocery spending for other uses. Thus, a fungible payment form is important for the incentive to be effective in reach. In addition, some people may already have gym memberships or may not have insurance co-pays. Future studies should look at subject characteristics and why they do not choose these incentive attributes more closely.

Overall our results indicate that immediate payments that are easily fungible in peoples' daily lives will engender the highest participation rates. These results can be used to develop an understanding of what financial incentives attributes will be most successful in ensuring high participation (reach) of weight-loss programs, but one should interpret the absolute magnitudes of the predictions with caution. These predictions are based on subjects' statements of willingness to participate and the results say nothing about whether subjects will actually complete a weight loss program and maintain their weight loss. These concerns can be addressed through a full-scale clinical trial where the results of this study provide a basis for designing and calibrating the specific financial incentive components in the trial.

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Figure 1. Sample Attribute-Based Choice Question in the Survey

9. Please consider the following two weight loss programs.

	Program A	Program B
Monetary value of incentive received per weigh-in	$24	$55
Form of incentive	Gym passes	Waivers of copays for doctor visits
Timing of incentive payment	Pay at the last booster weigh-in (12-month)	Pay at the end of the program weigh-in (3-month) and no rewards for the other two booster weigh-ins
Total Maximum Amount Earned	$24 + $24 + $24 = $72 worth of gym passes	$55 + $0 + $0 = $55 worth of copay waivers

Which weight-loss program would you choose to participate in?
(PLEASE CHECK ONE BOX)

☐$_1$ I would choose Program A.

☐$_2$ I would choose Program B.

☐$_3$ I would not choose either program.

Table 1. Attribute Levels

Attribute	Level	Value
Monetary value	1	$5
	2	$24
	3	$55
	4	$72
	5	$98
Form of incentive	1	Cash
	2	Grocery cards
	3	Gym pass
	4	Co-pay waiver for doctor visits
Timing of payment	1	Pay at the last follow-up weigh-in (12-month)
	2	Pay at the end of active program weigh-in (3-month)
	3	Pay at each weigh-in

Table 2. Summary Statistics

Variables	Male (n=273) (%)	Female (n=581) (%)	Full Sample (n=863) (%)
Race			
Caucasian	87	83	84
African American	7	13	11
other	6	4	5
Age (in years)			
18-29	4	5	5
30-39	4	11	9
40-49	19	20	20
50-59	31	25	27
> 60	42	38	39
Education			
high school and less	27	28	28
some college	24	32	29
college graduate	25	22	23
postgrad degree	24	18	20
Employment status			
full-time employed	55	39	44
part-time employed	5	13	10
unemployed	5	4	5
retired	32	23	26
student	1	1	1
unpaid homemaker	0	15	10
on disability	2	5	4
Income			
30k or less	15	22	20
30k-75k	30	42	38
75k-120k	32	22	25
120k or more	22	14	17
BMI			
normal	16	25	22
overweight	49	35	39
obese	35	41	39

Table 3. Random Parameter Logit Model Results

	(1)		(2)	
	mean	sd	mean	sd
ASC	-0.089	4.816***	-3.339***	
	(0.280)	(0.313)	(0.351)	
Monetary value	0.022***		0.026***	
	(0.002)		(0.002)	
Pay form (Base: Copay waiver)				
Cash	1.214***	0.798***	1.246***	2.586***
	(0.113)	(0.253)	(0.150)	(0.243)
Grocery card	1.230***	1.075***	1.242***	2.974***
	(0.116)	(0.224)	(0.168)	(0.260)
Gym pass	-0.116	1.912***	-0.224	2.876***
	(0.138)	(0.225)	(0.176)	(0.278)
Timing of payment (Base: payment at 12 month)				
Payment at 3-months	-0.462***	0.576***	-0.789***	2.005***
	(0.095)	(0.203)	(0.148)	(0.213)
Payment at each weigh-in	0.649***	0.191	0.491***	1.721***
	(0.092)	(0.344)	(0.124)	(0.167)
Gender Interaction				
ASC × female			1.697***	
			(0.356)	
BMI interaction (Base: Normal individuals)				
ASC × overweight			1.336***	
			(0.358)	
ASC × obese			1.892***	
			(0.371)	
ASC × overweight × female			-1.529***	
			(0.421)	
ASC × obese × female			-2.024***	
			(0.430)	
Log likelihood	-2,562		-2,984	
Observations	9,726		9,726	

Robust standard errors in parentheses
* p < 0.1.
** p < 0.05.
*** p < 0.01.

Table 4. Participation Preference Heterogeneity across Age and Weight Status

		Normal Weight		Overweight		Obese	
		Male	Female	Male	Female	Male	Female
Normal Weight	Male		1.70***	1.34***	1.50***	1.89***	1.57***
			(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
	Female			-0.36	-0.19	0.20	-0.13
				(0.130)	(0.367)	(0.443)	(0.534)
Overweight	Male				0.17	0.56**	0.23
					(0.450)	(0.034)	(0.294)
	Female					0.39	0.06
						(0.106)	(0.746)
Obese	Male						-0.33
							(0.169)
	Female						

Note: The upper triangular of this table presents the differences between column group and the row group. For example, the first cell in the first row value of 0.745 is the differences in participation probability between normal weight female and normal weight male. p-values are in the parenthesis.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Table 5. The Minimum Payment Dollar Amounts per Weigh-in

	Timing of payment		
	12-month	3-month	Each weigh-in
Normal male			
cash	$80.50	$110.85	$61.62
gift-card	$80.65	$111.00	$61.77
copay waiver	$128.42	$158.77	$109.54
gym-pass	$137.04	$167.38	$118.15
Overweight male			
cash	$29.12	$59.46	$10.23
gift-card	$29.27	$59.62	$10.38
copay waiver	$77.04	$107.38	$58.15
gym-pass	$85.65	$116.00	$66.77
Obese male			
cash	$7.73	$38.08	$0.00
gift-card	$7.88	$38.23	$0.00
copay waiver	$55.65	$86.00	$36.77
gym-pass	$64.27	$94.62	$45.38
Normal female			
cash	$15.23	$45.58	$0.00
gift-card	$15.38	$45.73	$0.00
copay waiver	$63.15	$93.50	$44.27
gym-pass	$71.77	$102.12	$52.88
Overweight female			
cash	$22.65	$53.00	$3.77
gift-card	$22.81	$53.15	$3.92
copay waiver	$70.58	$100.92	$51.69
gym-pass	$79.19	$109.54	$60.31
Obese female			
cash	$20.31	$50.65	$1.42
gift-card	$20.46	$50.81	$1.58
copay waiver	$68.23	$98.58	$49.35
gym-pass	$76.85	$107.19	$57.96

Table 6. Average Predicted Weight-Loss Program Participation (Reach) by Attribute Combinations (% Participation)

	Incentive amount	Pay at 12-months				Pay at 3-months				Pay at each weigh-in			
		Cash	Grocery card	Gym pass	Co-pay waiver	Cash	Grocery card	Gym pass	Co-pay waiver	Cash	Grocery card	Gym pass	Co-pay waiver
						Male							
Normal Weight	$5	12	12	3	4	6	6	0	2	19	19	5	0
	$24	19	19	5	6	9	9	2	3	27	27	8	10
	$55	34	34	11	13	19	19	5	6	46	45	16	19
	$72	44	44	15	19	27	26	8	9	**57**	**56**	23	27
	$98	**61**	**61**	26	31	41	41	14	17	**72**	**72**	37	42
Over-weight	$5	35	35	11	13	20	19	0	7	47	46	17	0
	$24	47	47	17	20	28	28	8	10	**59**	**59**	25	29
	$55	**66**	**66**	31	36	47	47	17	20	**76**	**76**	42	48
	$72	**75**	**75**	41	47	**58**	**58**	24	28	**83**	**83**	**53**	**59**
	$98	**86**	**86**	**58**	**63**	**73**	**73**	38	44	**91**	**91**	**69**	**74**
Obese	$5	48	48	18	21	30	30	0	11	**60**	**60**	26	0
	$24	**60**	**60**	26	30	41	41	14	17	**71**	**71**	36	42
	$55	**77**	**77**	44	49	**61**	**61**	26	31	**85**	**85**	**56**	**62**
	$72	**84**	**84**	**55**	**60**	**71**	**71**	36	41	**90**	**90**	**66**	**71**
	$98	**91**	**91**	**70**	**75**	**82**	**82**	**52**	**58**	**94**	**94**	**80**	**83**

		Female											
Normal Weight	$5	43	43	15	18	26	26	0	9	**56**	**55**	22	0
	$24	**56**	**56**	22	26	36	36	12	14	**67**	**67**	32	37
	$55	**74**	**74**	39	45	**56**	**56**	23	27	**82**	**82**	**51**	**57**
	$72	**81**	**81**	50	**56**	**66**	**66**	31	36	**88**	**88**	**62**	**67**
	$98	**89**	**89**	**66**	**71**	**79**	**79**	47	**53**	**93**	**93**	**76**	**80**
Over-weight	$5	39	39	13	15	22	22	0	8	**51**	**51**	19	0
	$24	**51**	**51**	19	23	32	32	10	12	**63**	**63**	28	33
	$55	**70**	**70**	35	40	**51**	**51**	19	23	**79**	**79**	46	**52**
	$72	**78**	**78**	45	**51**	**62**	**62**	27	32	**85**	**85**	**57**	**63**
	$98	**88**	**87**	**62**	**67**	**76**	**76**	42	48	**92**	**92**	**73**	**77**
Obese	$5	40	40	13	16	23	23	0	8	**52**	**52**	20	0
	$24	**52**	**52**	20	24	33	33	10	13	**64**	**64**	29	34
	$55	**71**	**71**	36	41	**53**	**53**	20	24	**80**	**80**	48	**54**
	$72	**79**	**79**	47	**52**	**63**	**63**	28	33	**86**	**86**	**59**	**64**
	$98	**88**	**88**	**63**	**68**	**77**	**77**	44	49	**92**	**92**	**74**	**78**

Note: This prediction table is calculated based on the random parameter logit model results. All values are in percentage.

Figure 2. Example of Gender Heterogeneity towards Cash Payments per Weigh-in

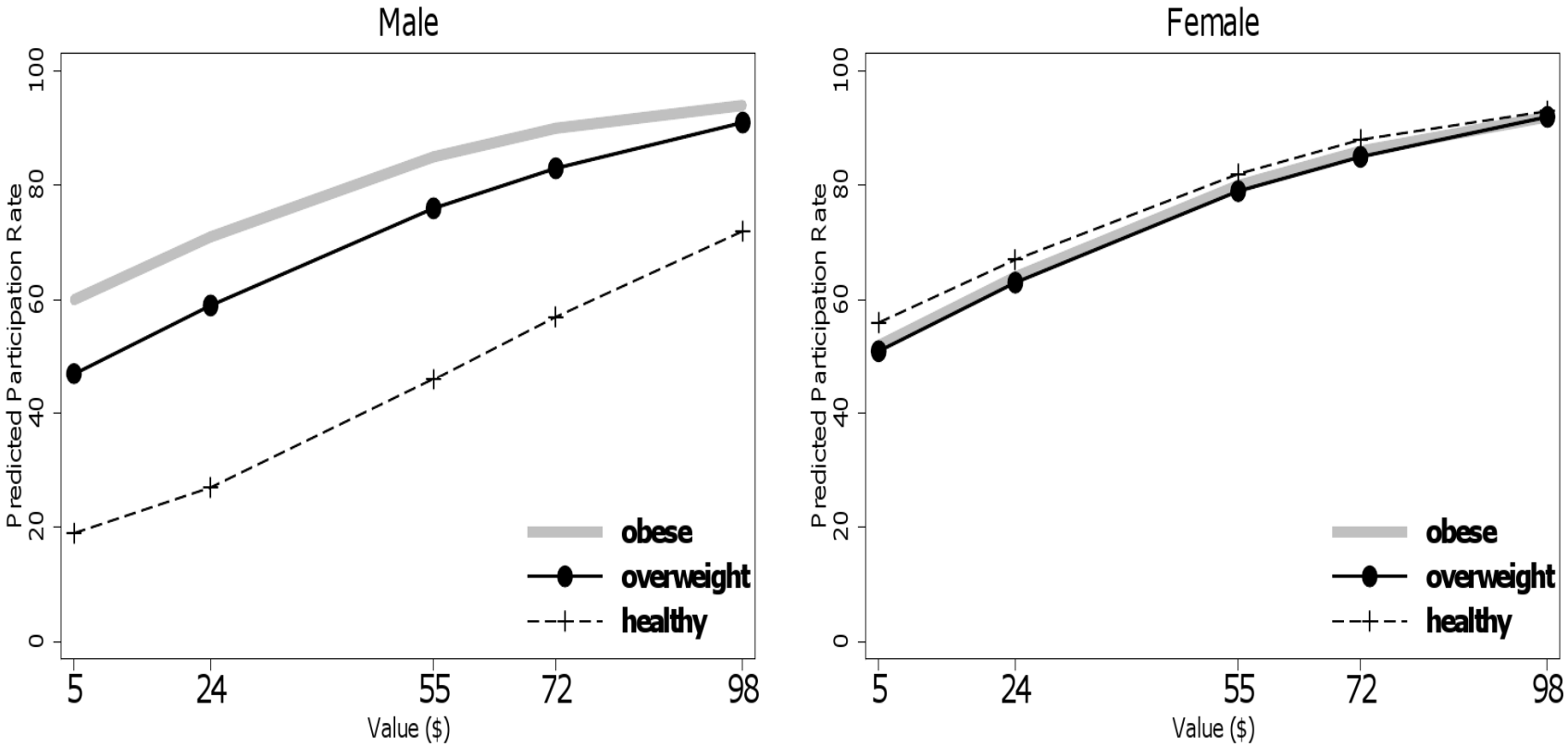
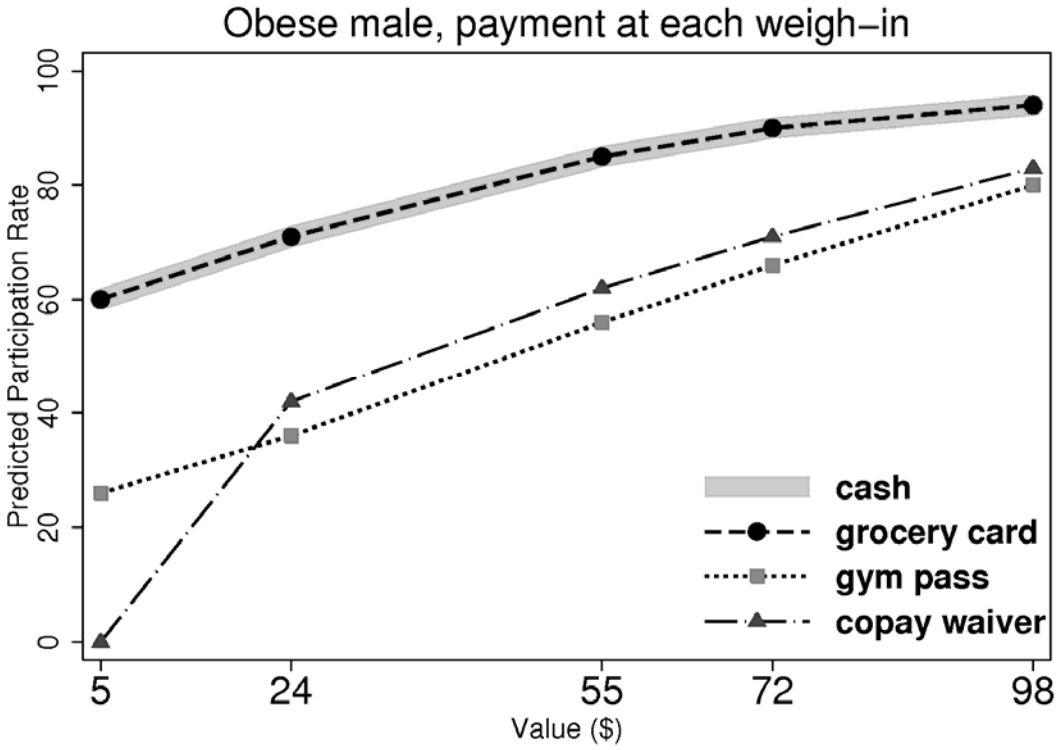


Figure 3. Example of Preference Heterogeneity towards Incentive Payment Form



Appendix

Section B. In this section we describe a weight loss program and we would like to learn your thoughts on the program.

We want you to consider a weight-loss program that has been shown to be effective and does not require a lot of time or meetings. This is a 3-month program to get people started on weight loss. The program, when followed closely, helps people lose 1 to 2 lbs per week, and successful participants can lose between 12 and 24 lbs over the 3-month period. The program components are:

One-on-one meeting with a dietitian: Participants have an initial 1-hour meeting with a registered dietitian to develop a plan for eating and exercising to help them lose weight and keep the weight off.

Eating Plan: Participants will receive a workbook that includes the detailed eating plan discussed with the dietitian. The eating plan will be tailored specifically to the participants' needs and will include recipes to help participants to achieve their goals. The program will include information on appropriate calorie intake and focus on balancing protein, fat, and carbohydrates.

Physical Activity Plan: Participants will receive a workbook that includes the detailed physical activity plan discussed with the dietitian. The physical activity plan will be tailored specifically to the participants' ability and needs. The program will include regular physical activity that could range from walking 5 or more days per week and simple strength exercises to more moderate and vigorous activity and weight training.

Tools to Keep track of eating: The program will include tracking tools (available online and in papers) for foods and calories eaten. Participants will be able to enter in the food they eat in a simple way and create meals. These tools will allow participants to review progress and plan for the future.

Tools to Keep track of physical activities: The program will include tracking tools for monitoring physical activity. Participants will be able to enter the amount and type of activities they do every day and get a record of the number of calories expended. These tools will allow participants to review progress and plan for the future and are available online and in papers.

Coaching Calls: During the 3-month program, participants will receive weekly coaching calls to help them keep up with their diet and exercise plans.

Program Weigh-ins: Participants will be asked to weigh-in at the program location (for example a local clinic) once a month during the 3-month program.

Booster Weigh-ins: After the program ends, participants will be asked to return for two follow-up weigh-ins (6-month and 12-month) with the goal of tracking the weight maintenance progress.

Section C. In this section we describe incentives for participating in the weight-loss program and would like to know your opinions on the incentives.

To encourage participation and motivate weight loss sometimes incentive packages are added to this type of program.

Losing 5% of body weight for overweight and obese individuals will greatly reduce the risk of chronic disease. For all of the examples we provide below, participants will receive incentives if they achieve or maintain **a 5% weight loss** (about 10 pounds for a 200 pound person) when compared to their **initial** weight. For example, a participant joins the program and weights 200 lbs in the initial weigh-in; this participant weighs 190 lbs in the 3-month weigh-in which means he/she achieves the 5% weight loss goal. If he/she weighs no more than 190 lbs in the two booster weigh-ins, he/she achieves the 5% weight loss maintenance goal.

In our examples that follow, we will ask you to consider several different incentives are being considered:

A. Monetary Value of Incentives: $5, $24, $55, $72, or $98.

B. Form of the Incentives: cash, pre-paid grocery gift cards, gym passes, or waivers of copays for doctor visits.

C. Timing of the Incentive Payments:

- received only at the end of the program weigh-in (3-month) and no incentives for the two booster weigh-ins (6-month and 12-month);
- earned and received at each of the 3-month, 6-month and 12-month weigh-ins; or
- earned at each of the 3-month, 6-month and 12-month weigh-ins but only received at the 12-month weigh-in.