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Secondary data analysis from a randomized trial examining the effects of small financial incentives on intrinsic and extrinsic motivation for weight loss

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Abstract

Objectives: To examine whether (a) an obesity treatment involving financial incentives yields higher levels of extrinsic motivation for weight management compared to an identical intervention without incentives, (b) extrinsic motivation for weight management mediates, or accounts for, the difference in weight loss outcomes between the two interventions, and (c) there is any evidence that financial incentives and associated extrinsic motivation "crowd out" intrinsic motivation for weight control.

Methods: Participants (N=153, 80.4% Female; BMI = 33.2 ± 5.9) were randomly assigned to a 3-month Web-based behavioral weight loss program (WBWL) or the same program plus small financial incentives delivered consistent with behavioral economics and behavior change theories (WBWL+$). Weight was objectively assessed at baseline, post-treatment (month 3), and after a 9-month no-treatment follow-up phase (month 12). Intrinsic and extrinsic motivation for weight management were assessed at months 3 and 12 using a modified version of the Treatment Self-Regulation Questionnaire, with questions added to specifically target extrinsic motivation related to incentives.

Results: Compared to WBWL alone, WBWL+$ had better weight loss and higher levels of both extrinsic *and* intrinsic motivation for weight management (p's≤.02). Moreover, during the no-

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treatment follow-up phase, the trajectories of weight regain did not significantly differ between WBWL and WBWL+$ (p=.58). Extrinsic motivation was not a significant mediator of treatment outcomes.

Conclusions: Modest financial incentives delivered consistent with behavioral economics and behavior change theories do not undermine intrinsic motivation for weight management during obesity treatment; in fact, they yield higher levels of both extrinsic and intrinsic motivation. Additional research is needed to better understand the mechanisms by which incentives improve outcomes in health behavior change interventions.

Keywords

weight loss; financial incentives; extrinsic motivation; intrinsic motivation; autonomous motivation

1. Introduction

Consistent with behavioral economics theories (Bickel, 2000; Kessler, 2009), financial incentives have been shown to promote health behavior change. Higgins and colleagues have consistently found that delivering financial incentives contingent upon smoking cessation or opioid abstinence improves abstinence rates relative to interventions without incentives (Higgins et al., 2012; Sigmon et al., 2015). Financial rewards also promote physical activity engagement (Pope & Harvey, 2014). In the area of obesity treatment, adding financial rewards contingent upon weight loss has been shown to improve overall weight loss outcomes (Jeffery, Bjornson-Benson, Rosenthal, Lindquist, & Johnson, 1984; John et al., 2011; Volpp et al., 2008).

Despite the success of financial incentive interventions for health behavior change, concerns are often raised about their potentially adverse effects on intrinsic motivation. Self-determination theory posits that while incentives may improve extrinsic motivation (i.e., the desire to engage in a behavior for an external reward) they may “crowd out,” or reduce, intrinsic motivation (i.e., the drive to engage in a behavior because it is inherently reinforcing) (Deci & Ryan, 2002; Teixeira, Silva, Mata, Palmeira, & Markland, 2012). In the psychology literature, evidence for the “crowding out” effect is thought to be present when one group receives an extrinsic reward and, upon removal of the reward, there are differential changes in the targeted behavior (Promberger & Marteau, 2013). For example, within the context of weight loss, “crowding out” would be present if, upon removal of an incentive, the incentivized group regains more weight than the non-incentivized group that otherwise received an identical intervention sans reward. While there is some support for “crowding out” in laboratory paradigms (Deci, Koestner, & Ryan, 1999), few studies have examined this effect in health behavior change interventions involving financial rewards (Promberger & Marteau, 2013). Moreover, to our knowledge, only one previous incentive trial (Crane, Tate, Finkelstein, & Linnan, 2012) examined the variables of interest – namely, intrinsic and extrinsic motivation – with validated measures. Results showed that financial rewards did not adversely impact intrinsic motivation for weight management. Interestingly, results also showed that incentives had no impact on extrinsic motivation for weight control. The latter effect may be explained by a measurement issue; the measure used to assess extrinsic motivation (Treatment Self-Regulation Questionnaire; Williams, Grow, Freedman,

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Ryan, & Deci, 1996) does not include any extrinsic motivation items specific to financial incentives. Instead, the extrinsic motivation subscale includes only items that focus on one type of extrinsic motivation: extrinsic *social* motivation (e.g., "other people would be mad at me if I didn't"), and does not include items assessing extrinsic motivation as it relates to financial incentives. To our knowledge, no previous incentive trial has assessed the impact of a financial incentive intervention on extrinsic motivation using a measure that includes incentive motivation items. Moreover, no financial incentive intervention has examined whether extrinsic motivation is in fact the mechanism by which financial incentives exert their treatment effect. Thus, in light of these findings and the limited available data, there have been several calls for research to actually assess and thus further understand how motivational processes operate within financial incentive health behavior change interventions (Hagger et al., 2014; Lynagh, Sanson-Fisher, & Bonevski, 2013; Promberger & Marteau, 2013).

This study examined whether the "crowding out effect" occurs within the context of a financial incentive weight loss intervention. Crowding out was assessed two ways: with the use of an objective behavioral outcome (weight change following incentive removal) and, for the first time, by actually measuring intrinsic and extrinsic motivation for weight management by using a measure that includes items specific to incentives and examining whether the use of financial incentives yields high extrinsic motivation at the cost of intrinsic motivation. In addition, although extrinsic motivation is thought to be the primary mechanism by which incentive interventions exert their effect, mediational analyses testing this hypothesis have never been conducted; thus, we will assess whether extrinsic motivation does in fact mediate treatment outcomes in a financial incentive trial. These questions were examined within the context of a randomized controlled trial involving financial incentives for obesity treatment (Leahey et al.,2015). In the trial, participants were randomly assigned to a 3-month Web-based behavioral weight loss intervention that included financial incentives (WBWL+$) or an identical Web-based behavioral weight loss intervention without financial rewards (WBWL). At post-treatment (month 3), weight change was objectively assessed and participants completed measures of intrinsic and extrinsic motivation for weight management. A no treatment follow-up assessment was also conducted at month 12, during which participant weight was measured and motivation reassessed. Based on self-determination theory (namely, the notion that external rewards will enhance extrinsic motivation, which could impact treatment outcomes; Deci & Ryan, 2002; Teixeira et al., 2012), our specific month 3 (post-treatment) hypotheses were: (a) WBWL+$ would have higher levels of extrinsic motivation for weight management than WBWL alone and (b) extrinsic motivation would mediate treatment outcomes between the two arms. Given that evidence for "crowding out" in financial incentive interventions is inconclusive (Promberger & Marteau, 2013), we *explored* whether WBWL+$ undermined intrinsic motivation for weight control, defined as WBWL+$ having less intrinsic motivation than WBWL alone at months 3 and 12 and WBWL+$ experiencing greater weight regain after the incentive was removed (i.e. during the no treatment follow-up period from month 3 to 12) (Promberger & Marteau, 2013).

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2. Methods

2.1. Design overview.

Data reported herein were collected from a parallel design randomized trial examining the effects of adding modest financial incentives or optional group sessions to an Internet-based behavioral weight loss program (Leahey et al.,2015) (clinicaltrials.gov number NCT01560130). In February of 2012, the first 676 participants who enrolled in an annual wellness campaign and agreed to participate in a research study were screened for eligibility. Exclusion criteria were age <18 or >70; BMI≤25kg/m^2; current pregnancy or planned pregnancy during the study period; uncontrolled medical problem (e.g., heart condition); previous study participation; unreliable Internet access; planned relocation outside the study area; and non-English speaking. Those who were eligible attended an in-person orientation. Following informed consent, all participants were randomly assigned by the study statistician to a 3-month Web-based Behavioral Weight Loss program alone (WBWL), the same Web-based Behavioral Weight Loss program plus modest financial incentives (WBWL +$), or the Web-based Behavioral Weight Loss program plus optional group sessions. A simple, 1:1 computerized randomization scheme was used. Given that the conceptual and theoretical focus of the current study is on financial incentives and not group / social support, all methodology and data presented hereafter will focus on the WBWL and WBWL +$ treatment arms only (see Figure 1 for participant flow). All participants completed a post-treatment assessment at month 3. Whereas treatment stopped at month 3, there was a no treatment follow-up assessment at month 12. Primary outcome results from the trial showed that WBWL+$ yielded significantly greater weight loss than WBWL alone at post-treatment (month 3), and that both WBWL and WBWL+$ had similar magnitudes of weight regain between 3 and 12 months, with no differences between groups (Leahey et al., 2015). The focus of the present study is on secondary outcomes. Specifically, to examine the effects of the two interventions on intrinsic and extrinsic motivation for weight management at month 3, whether extrinsic motivation mediates treatment outcomes between the two arms at month 3, and whether there is any evidence of “crowding out” of intrinsic motivation for weight control over time. All procedures occurred at a research center in Providence, Rhode Island and were approved by the local Institutional Review Board.

2.2. Interventions.

Web-based Behavioral Weight Loss (WBWL).—Participants in WBWL attended a one-time, 1.5 hour, in-person group session and then received a 3-month behavioral weight loss program delivered via an interactive Web platform. During the one-time group meeting, participants were given their weight loss goal (1–2 pounds/week; ≥5% of initial body weight at program end), dietary goals (<250lbs: 1200–1500 kcals/day, 30–40g fat/day; ≥250lbs: 1500–1800kcals/day, 40–50g fat/day), and activity goals (gradually increase to 250min/week). They were also taught how to accurately monitor their intake, activity, and weight each day and were oriented to the intervention Website. The Website included weekly multimedia lessons based on the Diabetes Prevention Program (DPP; DPP Research Group, 2002) and a self-monitoring platform where participants submitted their daily diet, activity, and weight data. At the end of each week, participants received tailored, automated feedback messages based on their reported calorie, activity, and weight information.

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**Web-based Behavioral Weight Loss plus Incentives (WBWL+$).—**Participants in WBWL+$ received the WBWL program as described above. In addition, given that self-monitoring and Website use is associated with better weight loss outcomes (Leahey et al., 2014; Wing & Hill, 2001), participants in WBWL+$ were incentivized for engaging in self-monitoring behaviors and reporting self-monitoring data into the study Website. Specifically, each week participants submitted at least 5 days of diet, activity, and weight information into the study Website, they received a small financial incentive that ranged from $1 to $10. Incentives were delivered consistent with principles from learning theory (Bandura, 1969; Thaler, 1981); specifically, they were delivered frequently (weekly), they varied in size ($1 to $10 per week), and participants were not informed of the incentive reinforcement schedule in advance. That is, each week participants submitted at least 5 days of self-monitoring information (weight, calorie, and physical activity data) into the study website, they earned anywhere from $1 to $10. To engage participants at the outset, larger incentives were delivered in the beginning of treatment (Week 1: $8, Week 2: $10) and incentive size varied thereafter ($1, $2, $7, etc.). If participants reported all self-monitoring information into the Website, they earned a total of $45 during the entire program. The WBWL+$ homepage included a display of the participant's earnings. In addition to incentivizing self-monitoring, participants also had the opportunity to receive an incentive for achieving clinically significant weight loss. Those who lost 5–10% of initial body weight at treatment end (month 3) were entered into a $50 raffle. Those who lost ≥10% were entered into a $100 raffle. Ten winners were chosen from each raffle. Payouts were distributed immediately following the 3 month assessment either in person or via mail. No treatment-related incentives were delivered during the no treatment follow-up period (i.e. month 3 through month 12).

2.3. Assessments.

Assessors were blind to intervention allocation. The following measures were collected.

Demographics.—Participants reported basic demographic information at baseline.

Motivation for weight management.—A modified version of the Treatment Self-Regulation Questionnaire (TSRQ; Williams, Grow, Freedman, Ryan, & Deci, 1996) was administered to measure intrinsic and extrinsic motivation for weight management involving financial rewards (see Appendix for questionnaire). The original TSRQ assesses extrinsic motivation as it relates to social contingencies (e.g., I'm involved in weight management because other people would be mad at me if I wasn't), but does not include items focused on other types of external or controlled motivation. Thus, in order to investigate whether a financial incentive intervention impacts extrinsic motivation as theorized (due to *incentive* contingencies), adding items to the TSRQ that actually assessed extrinsic motivation as it relates to external reward (i.e., incentives) was necessary. Four face-valid items were added to the extrinsic motivation subscale (e.g., "I tried to lose weight or control my weight because I knew that I could win money;" "I counted calories, fat grams, and exercise minutes because I knew that I would win money;" response options ranged from "not at all true," coded 0 to "very true," coded 6). With these additional items, internal consistency was maintained at good to excellent levels (extrinsic α=.79; intrinsic α=.83). This measure was

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administered at month 3 and month 12. Please note, this measure was administered after treatment because participants had to experience the weight loss program in order to accurately answer the questions (e.g., “I counted calories, fat grams, and exercise minutes because…”).

Weight and height—Weight was measured to the nearest 0.1kg using a digital scale at baseline, 3, and 12 months. Height was measured using a wall-mounted stadiometer. Body Mass Index (BMI) was calculated using the formula weight in kg / height in m^2.

2.4. Statistical Analyses.

Initial demographic and bivariate analyses were conducted using IBM SPSS Statistics for Windows, Release 20.0.0 (©IBM Corp., 2011, Armonk, NY, www.ibm.com). The WBWL and WBWL+$ groups were first examined for possible baseline group differences on demographic and weight characteristics using analysis of variance or chi-square tests for continuous or categorical variables, respectively.

We next compared WBWL+$ and WBWL on weight loss and levels of extrinsic and intrinsic motivation for weight management at post-treatment (3 months). Then, we examined three mediation models (Mathieu & Taylor, 2006), in which we first looked to determine whether extrinsic motivation mediated the relationship between the treatment and participants’ weight loss at 3 months. Next, we examined a model in which intrinsic motivation was a potential mediator between the treatment and participants’ weight loss at 3 months. Finally, we investigated a model in which both extrinsic and intrinsic motivation were simultaneously used as potential mediators of the relationship between treatment and participants’ weight loss at 3 months to better understand how extrinsic and intrinsic motivation might jointly influence weight loss, and if extrinsic motivation might ‘undermine’ intrinsic motivation by reducing any direct and indirect predictive effect of intrinsic motivation on weight loss outcomes. The full model-based mediation analyses were conducted via path analysis using the structural equation modeling software package Mplus, Version 7.3 (Muthen & Muthen, 2015). Evidence for mediation was met if the previously significant relationship between treatment and outcome was reduced or eliminated when the proposed mediator was added to the model, and if the indirect effect from treatment through the mediator to the outcome was also statistically significant (Preacher & Hayes, 2004). A bias-corrected percentile-based bootstrap approach (Hayes, 2009) with 5,000 draws was used to assess whether the proposed mediation effect was statistically significant.

Effects sizes are presented. To quantify proportions, means and correlations, Cohen’s *h*, Cohen’s *d* and r^2 were computed, respectively (Cohen, 1988). As recommended, for path analyses, the standardized indirect effect coefficient with confidence intervals derived from the bias-corrected percentile-based bootstrap approach is included to represent the measure of effect size (Cheung, 2009).

3. Results

A total of 85% of randomized participants (N=153) completed assessments of weight and weight management motivation at both 3- and 12-months. Retention did not significantly

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differ by treatment arm (WBWL: 81.3%, WBWL+$=88.8%, p=.16, Cohen's *h*=.22). Sample characteristics are presented in Table 1. There were no significant differences between treatment groups on any baseline demographic or anthropometric variables.

The WBWL+$ group experienced significantly greater weight loss than the WBWL group (6.3±5.2kg vs. 4.4±4.4kg, p=.02, d=.39) at month 3. The WBWL+$ group also had significantly greater levels of both extrinsic (2.5±1.0 vs. 1.5±0.5, p<0.001, d=1.26) and intrinsic (5.7±1.0 vs. 5.2±1.2, p=0.006, d=.45) motivation for weight management compared to the WBWL group at post-treatment (month 3). Both intrinsic and extrinsic motivation were significantly associated with weight loss outcomes (r's=.20-.37, p's<.02, r^2=.04-.14).

Given these results, we further explored whether extrinsic motivation for weight management mediated the relationship between treatment and weight loss at post-treatment (month 3). Within this model, the path between treatment and extrinsic motivation was significant (β = .532, p <.001), while the path between extrinsic motivation and weight loss at 3-months was not significant (β = −0.139, p = 0.13). The path parameter between treatment and weight loss was significant (β = −0.187, p =0.02) when examined as the sole predictor of weight loss at 3-months, but was not significant (β = −0.113, p = 0.22) when extrinsic motivation was added to the model as a potential mediator of weight loss. However, although the inclusion of extrinsic motivation in the model altered the effect of treatment on weight loss, the indirect effect from treatment to weight loss via extrinsic motivation was not significant (β = −0.074, 95%CI: −0.186, 0.038) and extrinsic motivation was shown to not be a mediator of the treatment effect on weight loss. See Figure 2 for the graphic representation of the standardized path effects for the full mediation model.

Given the significant differences in intrinsic motivation for weight management between the two arms, we conducted post-hoc exploratory analyses to examine whether intrinsic motivation mediated the relationship between treatment arm and weight loss at post-treatment (month 3). Results showed that the path between treatment and intrinsic motivation was significant (β = .220, p =.004), and that the path between intrinsic motivation and weight loss at 3-months was also significant (β = −0.342, p < 0.001). In this model, the path parameter between treatment and weight loss, when examined as the sole predictor of weight loss at 3-months, was also reduced and became not significant (β = −0.112, p = 0.142) when intrinsic motivation was added to the model as a potential mediator of weight loss. Moreover, in this model, the indirect effect from treatment to weight loss via intrinsic motivation was also significant (β = −0.075, 95%CI: −0.141, −0.009) and thus intrinsic motivation for weight management was shown to be a mediator of the treatment effect on weight loss. See Figure 3 for the graphic representation of the standardized path effects for the full mediation model.

A final model was examined to determine the effects of including both intrinsic and extrinsic motivation simultaneously as potential joint mediators of the relationship between treatment and weight loss at 3-month follow-up. This model also allows us to examine whether extrinsic motivation might "crowd out" or undermine the mediation effects of intrinsic motivation. The inclusion of both extrinsic and intrinsic motivation for weight management in the same model did not alter the individual indirect effects through either type of

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motivation on weight loss, as the indirect effect from treatment to weight loss via intrinsic motivation remained significant (β = −0.074, 95%CI: −0.139, −0.009), while the indirect effect from treatment to weight loss via extrinsic motivation remained not significant (β = −0.061, 95%CI: −0.164, 0.043), and thus intrinsic motivation was shown to remain a mediator of the treatment effect on weight loss at 3 months. Additionally, the sum of the indirect effects for treatment on weight loss via intrinsic and extrinsic motivation are significant (β = −0.135, 95%CI: −0.253, −0.016). See Figure 4 for the graphic representation of the standardized path effects for the concurrent mediation model.

To further examine whether the financial incentive intervention undermined intrinsic motivation for weight management, we compared WBWL+$ and WBWL on behavioral outcomes, specifically weight regain trajectories from the point in which incentives were removed (i.e., post-treatment, or month 3) and motivation during the no treatment follow-up period (month 3 to month 12). According to psychology models (Promberger & Marteau, 2013), the undermining effect would be evident if the incentive arm experienced a greater magnitude of weight regain from month 3 to month 12. Results showed that the magnitude of weight regain in the two groups was not significantly different (WBWL+$: +2.9±4.3kg, WBWL: +3.4±5.5kg, p=.58, d=.10). We also examined changes in extrinsic and intrinsic motivation for weight management over time. For extrinsic motivation, there was a significant time effect and a significant group by time interaction; both groups had a decrease in extrinsic motivation from month 3 (post-treatment) to month 12 (p<.001, d=.74), with WBWL+$ having a greater decrease than WBWL (−1.0±0.9 vs. −0.2±0.5, p<.001, d= −1.10). For intrinsic motivation, there was a significant time effect but no significant group by time interaction; both groups had a significant decrease in intrinsic motivation for weight management over time (−0.8±1.3, p<.001, d=.62) and the decreases were not significantly different from one another (p=.95).

4. Discussion

In the present study, participants given modest financial incentives reported higher levels of both extrinsic and intrinsic motivation for weight management than those given a comparable program without financial incentives. Moreover, extrinsic motivation was associated with weight loss success and, consistent with previous findings demonstrating the importance of intrinsic motivation for health behavior change (Teixeira et al., 2012), participants' intrinsic motivation for weight loss was associated with post-treatment weight loss success in the current study. This latter relationship persisted even when simultaneously accounting for extrinsic motivation, thus demonstrating that a "crowding out" effect – wherein the presence of extrinsic motivation reduces intrinsic motivation – was not at play in the current study. The fact that both groups had similar weight regain despite higher rates of extrinsic motivation in the WBWL+$ arm provides further support for this conclusion. Taken together, these findings suggest that provision of small financial incentives for self-monitoring behaviors and weight loss has the potential to yield greater weight losses without reducing intrinsic motivation, even after those incentives are removed.

Possible explanations for the absence of a crowding out effect are consistent with those proposed by Promberger and Marteau (2013), who highlight two contextual factors that

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increase the likelihood for rewards to undermine intrinsic motivation for health behavior: rewarding a behavior that is in itself enjoyable and perception of the reward as coercive (Promberger & Marteau, 2013). Given the level of effort required to keep detailed monitoring logs and past research demonstrating low participant adherence to self-monitoring behaviors, particularly over time (Burke, Wang, & Sevick, 2011), it is unlikely that this is an enjoyable or inherently interesting activity for most people. However, while the process of self-monitoring was likely not rewarding, it is plausible that the connection between self-monitoring and weight loss was reinforcing for participants, which may have enhanced intrinsic motivation for self-monitoring behaviors and moved participants along the continuum from extrinsic reinforcement to a greater internalization and integration of the behavioral goals as they began to see the behavior as personally relevant and important (Deci & Ryan, 2002; Deci & Ryan, 2000; Teixeira et al., 2012).

Given the design of the financial incentive scheme in the current study, it is unlikely that participants perceived the rewards to be controlling or coercive. Participants earned no more than $10 per week – and sometimes as little as $1 per week – for engaging in self-monitoring behaviors, with no one earning more than $45 over the course of the 12-week treatment period (i.e., maximum earnings were an average of $3.75 per week). Further, the reward for weight loss itself (which is arguably more intrinsically motivating than self-monitoring) was not guaranteed, but offered in the context of a raffle. Thus, it is possible that rather than viewing financial incentives as unduly coercive, participants instead viewed these as an indication of increased competence for weight loss and related behaviors, which in turn may have contributed to the high rates of intrinsic motivation for weight control seen among participants in the WBWL+$ arm. This mechanism is consistent with cognitive evaluation theory, a subtheory of self-determination theory (Deci & Ryan, 1985), which emphasizes the importance of an individual's interpretation of the reward, rather than the simple presence of the reward.

Of note, these findings are consistent with those of Crane and colleagues (2012) who reported no detrimental effects of a financial incentive weight loss intervention on intrinsic motivation. As such, this is the second incentive trial to report the lack of an undermining effect for intrinsic motivation specifically related to weight loss. Importantly, the Crane study included the full TSRQ but did not include any items specific to financial incentives, which may explain why they did not find differences in extrinsic motivation between the incentivized and non-incentivized group. In contrast, the present study included the full TSRQ plus additional items specific to financial incentives, which may explain why we observed differential scores on extrinsic motivation between arms. Thus, the present trial adds to the limited findings in this area by demonstrating that intrinsic motivation for weight management is not adversely impacted by modest incentives even in the presence of higher levels of extrinsic motivation. In fact, the addition of small financial incentives actually yielded *higher* levels of intrinsic motivation for weight control.

The financial incentive scheme used in the current paradigm is of interest given that it is in conflict with recently-recommended "guiding principles" of financial incentive use in health behavior change (Lynagh et al., 2013), which encourage use of higher-magnitude incentives offered on an incremental (rather than variable) reinforcement schedule. Larger incentives

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may yield larger weight losses (Lynagh et al., 2013), thereby also offering greater statistical power for mediation analyses even among a small sample size – a limitation of the current study. At the same time, however, larger financial incentives may alter participant perceptions of autonomy and competence – thus making long-term sustained change less likely once incentives are removed (Hagger et al., 2014). Indeed, a recent healthy lifestyle intervention offering significantly larger incentives (up to $50/week for meeting diet and physical activity goals) found evidence for poorer behavior change maintenance (Moller, McFadden, Hedeker, & Spring, 2012) and decreased enjoyment of engaging in health behaviors (Moller, Buscemi, McFadden, Hedeker, & Spring, 2014) among those who reported higher levels of financial motivation.

The present findings, while important, should be interpreted in light of some limitations. First, there was not an assessment of weight management motivation at baseline in this trial, which limits our ability to examine changes during the initial treatment program and precludes the optimal test of mediation, which involves demonstrating a change in the mediator prior to a change in the outcome. We also cannot be certain that there were not baseline differences between groups, though the randomized design mitigates this concern. Finally, the present sample size may not have been sufficient to detect the indirect effect of extrinsic motivation on weight loss. Future studies should seek to replicate these findings in larger and more diverse samples and carefully examine individual level variables that might influence treatment response to similar programs. It would also be of interest to test a comparable incentive structure compared to a more traditional paradigm that uses larger incentives tied only to weight loss to examine differential effects on motivation and other potential mechanisms of weight loss maintenance (e.g., perceived competence).

The long-term maintenance of health behavior change – particularly in the context of weight loss interventions, which involve a number of complex behaviors – has historically been difficult to achieve with financial incentive paradigms (John et al., 2011; Volpp et al., 2008). The inclusion of a 9-month follow-up period is a notable strength of the current study, especially in light of the finding that there was no differential weight regain between arms. Thus, not only were small financial incentives associated with greater initial weight loss, but also with maintenance of that weight loss at similar rates to participants not receiving incentives. This study represents a significant contribution to the ongoing dialogue regarding the role of financial incentives in health behavior interventions, as it is the first to explicitly measure both intrinsic and extrinsic motivation for weight control using relevant, validated measures in this type of paradigm. In addition, these results are particularly relevant in the current health care climate, which, since the implementation of the Affordable Care Act, has seen an increase in the use of incentives to promote health behavior change, especially within worksites. Results from this study suggest that delivering modest incentives consistent with learning theory and behavioral economics theory yields excellent weight loss outcomes without undermining intrinsic motivation.

This study is hypothesis generating. Future research is warranted to explore ways in which both extrinsic and intrinsic motivation can be harnessed in order to best promote long-lasting health behavior change. In addition, future studies could examine how participants' baseline levels of intrinsic motivation might influence treatment response within a similar incentives

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paradigm – it is plausible that even among those who exhibit high levels of intrinsic motivation at baseline, the incentives paradigm used herein might not have an undermining effect as the modest incentives may not be perceived as overly controlling. Exploring how other participant characteristics such as income level and perceived financial strain may impact perceptions and / or response to different incentive paradigms will also be important to address in future work. Finally, these study results demonstrate that researchers should look to psychological theory (i.e. behavioral economics theory, learning theory, and self-determination theory) and contextual factors when making decisions regarding financial incentive amounts and payout schedules, measurement of outcomes and mediators, and which behaviors to reinforce.

In sum, participants in the incentive condition of this trial reported higher levels of both extrinsic and intrinsic motivation for weight control at post-treatment compared to those given a comparable program without financial incentives. Moreover, there were not differential rates of weight regain after treatment ended and incentives were removed and although intrinsic motivation waned over time, these decreases were comparable across arms. Thus, the current findings suggest that modest financial incentives, when contingent upon both process and outcome goals, do not undermine intrinsic motivation for weight management. Similar models may hold promise for promoting sustained behavior change within obesity treatment programs.

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Appendix A.

There are many reasons why people try to lose weight or control their weight. Please read the following statements and circle how true each reason was for you. If a statement does not apply to you, circle the number that corresponds with “not at all true.”

Since the last visit, I tried to lose weight or control my weight because...								
1.	I knew that I could win money for losing weight.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
2.	I felt that it would improve my health.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
3.	My spouse, family, friends, or doctor would be upset if I didn't.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
4.	Being overweight makes it hard to do many things.	0	1	2	3	4	5	6

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		Not at all true true or N/A			Somewhat true			Very true
5.	I worried that I would get in trouble with the research staff if I didn't.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
6.	I felt that it would improve my physical appearance.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
7.	I wanted to get as much money as possible at the end of the program.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
8.	I find weight loss to be an exciting, personal challenge.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
9.	Others on my Shape Up team and/or in my weight loss group would be upset if I didn't.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
Since the last visit, I counted calories, fat grams, and exercise minutes because.								
10.	I knew that I would win money each week if I did.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
11.	I felt that it helped me stay motivated.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
12.	My spouse, family, friends, or doctor would be upset if I didn't.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
13.	I worried that I would get in trouble with the research staff if I didn't.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
14.	I believe that it helped me stay focused on my weight loss efforts.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
15.	I wanted to get as much money as possible at the end of the program.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
16.	I found that it helped me stay under my calorie goal and exercise more.	0	1	2	3	4	5	6
		Not at all true true or N/A			Somewhat true			Very true
17.	I found it rewarding to track and view my personal progress.	0	1	2	3	4	5	6

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		Not at all true true or N/A			Somewhat true					Very true
18.	Others on my Shape Up team and/or in my weight loss group would be upset if I didn't.	0	1	2	3	4	5			6
		Not at all true true or N/A			Somewhat true					Very true

Scoring:

Intrinsic motivation = mean of items 2, 4, 6, 8, 11, 14, 16, 17

Extrinsic motivation = mean of items 1, 3, 5, 7, 9, 10, 12, 13, 15, 18

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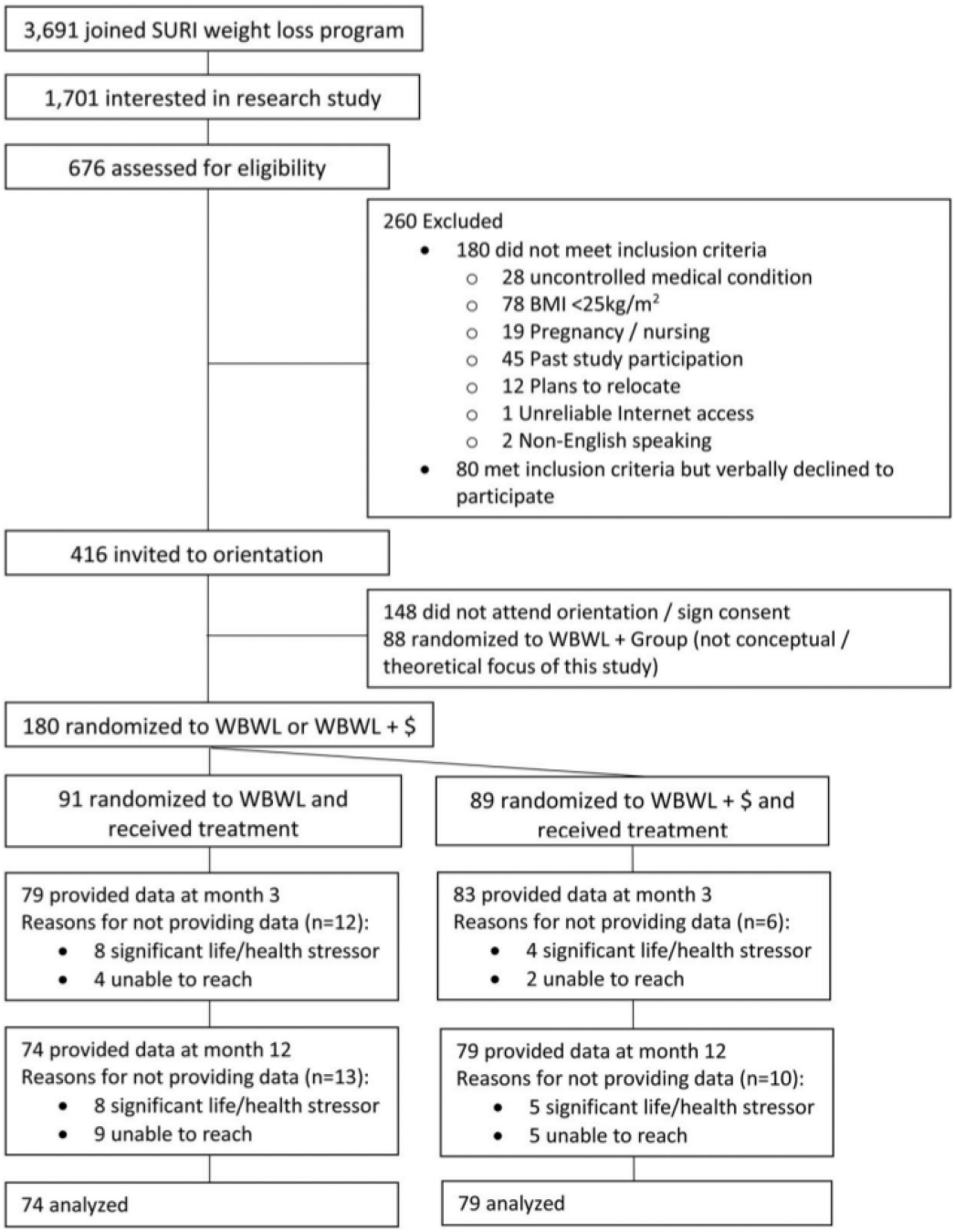

Figure 1.
Overall participant flow including N who completed both weight and motivation measures at both month 3 and month 12.

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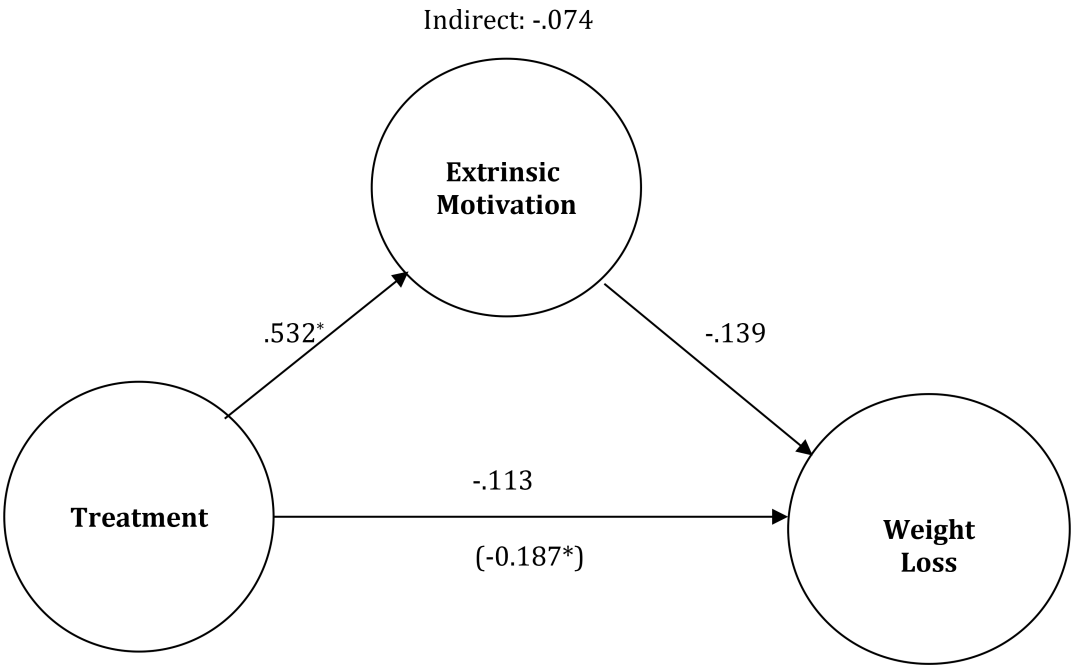

Figure 2.

Indirect effect through external motivation is not significant indicating extrinsic motivation does not mediate effect of treatment on weight loss at post-treatment (month 3).* indicates statistical significance at $p < .05$. () indicates effects prior to adding the mediator into the model.

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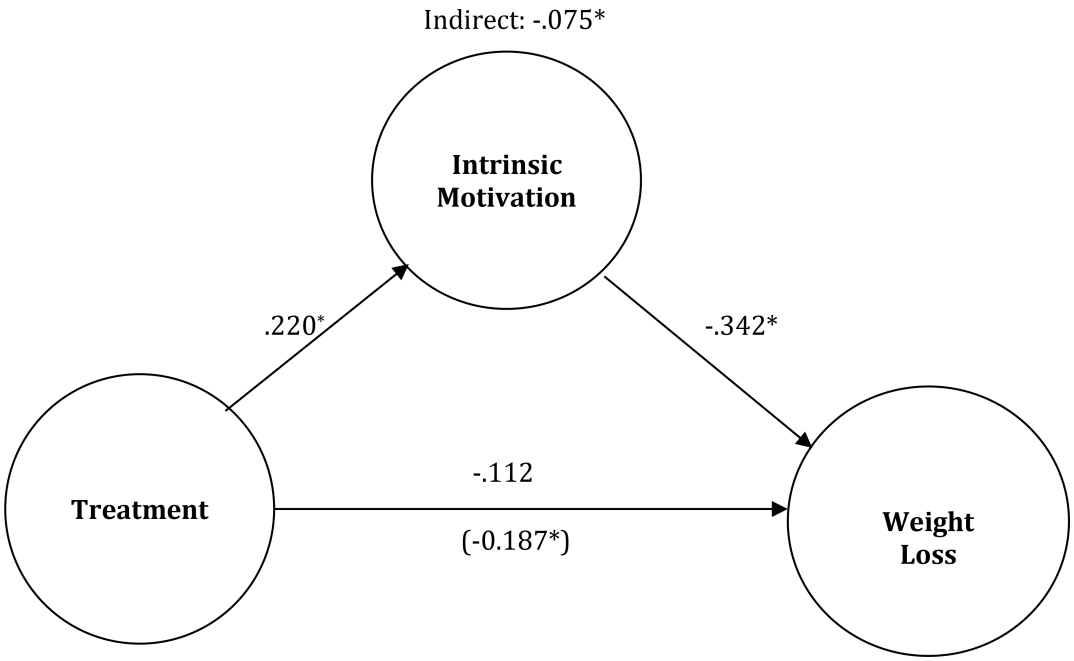

Figure 3.

Indirect effect through internal motivation is significant indicating intrinsic motivation does mediate effect of treatment on weight loss at post-treatment (month 3). * indicates statistical significance at $p < .05$. () indicates effects prior to adding the mediator into the model.

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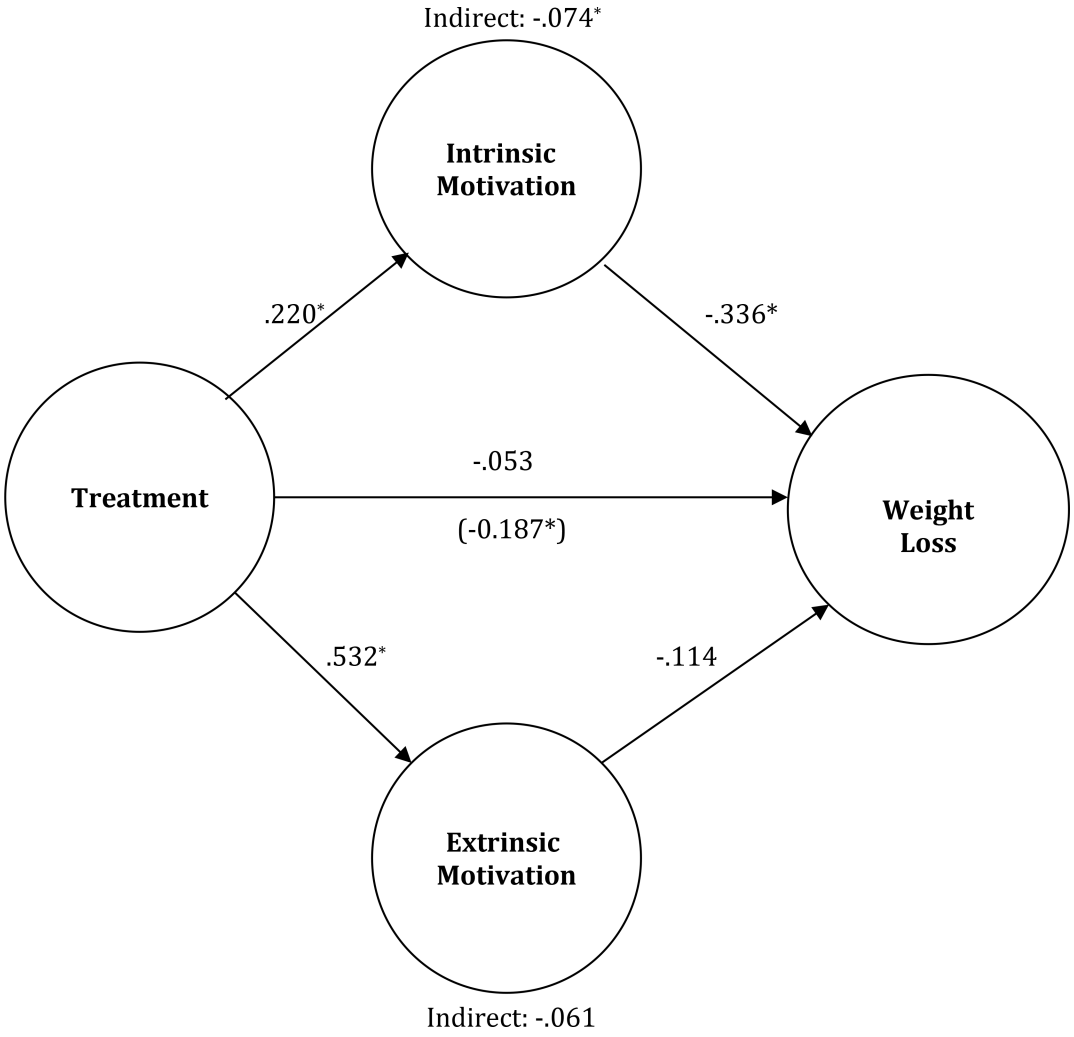

Figure 4.

Direct and indirect effects for concurrent mediation model, with significant mediation through intrinsic motivation at post-treatment (month 3). * indicates statistical significance at $p < .05$. () indicates effects prior to adding the mediator into the model.

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Table 1.

Participant baseline characteristics presented as sample size (percentage) for categorical variables and means (SD) for continuous variables.

	Total (N=153)	WBWL (n=74)	WBWL+$ (n=79)	*p*-value
Female, n (%)	123 (80.4%)	61 (82.4%)	62 (78.5%)	.538
Age, mean (SD)	45.7 (9.9)	45.1 (10.5)	46.3 (9.3)	.447
Race/Ethnicity, n (%)				
Non-Hispanic White	136 (89.5%)	67 (91.8%)	69 (87.3%)	.373
Non-White	16 (10.5%)	6 (8.2%)	10 (12.7%)	
Education				
Vocational/High School	7 (4.6%)	6 (8.2%)	1 (1.3%)	.143
Some College	28 (18.4%)	14 (19.2%)	14 (17.7%)	
College Graduate	70 (46.1%)	29 (39.7%)	41 (51.9%)	
Post-graduate	47 (30.9%)	24 (32.9%)	23 (29.1%)	
Weight, kg, mean (SD)	91.1 (18.8)	89.7 (16.5)	92.5 (20.7)	.358
BMI, kg/m^2, mean (SD)	33.2 (5.9)	32.8 (5.2)	33.5 (6.4)	.459

Note: One participant did not respond to Race/Ethnicity, and one participant did not respond to Education; analyses on those 2 variables used N=152.