Paying people to protect the environment: A meta-analysis of financial incentive interventions to promote proenvironmental behaviors

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Highlights

- Financial incentives had small-to-medium effect on behavior while in place (d_+=.36).
- Incentives also had small-to-medium effect on behavior even after removal (d_+=.41).
- Variable schedule incentives were more effective than fixed schedule incentives.
- Future research should explore how and when incentives lead to maintained behavior.
- Additional work should also examine incentive types currently rare in literature.

Abstract

What effect do financial incentive interventions have on *initial* and *sustained* proenvironmental behavior, how do different *types of incentives* (e.g., cash, transit tickets) affect proenvironmental behavior, and how does the effect of incentive interventions vary across different *types of behaviors* (e.g., recycling, travel behavior)? A meta-analysis of 22 studies (k=30) addressed these questions. Incentive interventions had a small-to-medium effect on behavior while incentives were in place (d_+=.36) and after they were discontinued (d_+=.41). Moreover, certain financial incentives features tended to be more effective at changing behavior, such as incentives distributed on variable schedules as compared to fixed schedules. Finally, financial incentive types were more effective at changing specific proenvironmental behaviors; cash incentives had a stronger effect on recycling and non-cash incentives had a stronger effect on travel behavior. These findings suggest that financial incentives can change proenvironmental behavior, can contribute to sustained behavior, and are particularly effective in certain contexts.

Keywords: Financial incentives, behavior change, proenvironmental behavior, intervention, meta-analysis

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1. Introduction

Given that many well-documented threats to the environment (e.g., climate change, water degradation) are the product of people engaging in distinct behaviors that are harmful to the natural environment (Gifford, 2014; Kazdin, 2009), there is a continuing need for strategies that successfully alter individuals' proenvironmental behaviors (e.g., recycling, efficient travel behaviors, energy conservation). One strategy that has elicited considerable interest is offering people financial incentives to engage in proenvironmental behaviors, such as providing people free bus passes to encourage public transit use (e.g., Bamberg, 2006) or implementing lottery contests to promote recycling (e.g., Menes & Palacio, 2003).

Though a common approach to promoting proenvironmental behavior (Abrahamse, Steg, Vlek, & Rothengatter, 2005; Steg & Vlek, 2009; Osbaldiston & Schott, 2012), this area of work would benefit from a meta-analytic synthesis of studies that focuses on three key questions pertaining to the use of financial incentive interventions when promoting individuals' proenvironmental behaviors. First, what effects do financial incentive interventions have on *initial* and *sustained* proenvironmental behavior? To address many pressing environmental problems, people must not only initiate proenvironmental behaviors, but also maintain those behaviors over time. Theory suggests that offering individuals financial incentives may increase proenvironmental behavior initially, but motivation to sustain the behavior may be reduced when the incentive is discontinued (e.g., Deci, 1972; Deci, Koestner, & Ryan, 1999). Second, how do different *types of financial incentives* affect proenvironmental behavior? To date, there has been no systematic examination of whether different types of incentives (e.g., cash, lotteries,

fines/fees) are more effective at changing proenvironmental behaviors, though theory suggests that different features of incentives might have distinct effects on behavior (e.g., fixed versus variable schedules of reinforcement; Burns et al., 2012; Skinner, 1953). Third, how does the effect of financial incentive interventions vary across different *types of behaviors*? Because proenvironmental behaviors vary in a number of important ways, including the perceived difficulty of performing different behaviors (e.g., Kaiser & Wilson, 2004), the effect of financial incentives might vary across types of behaviors (e.g., recycling versus energy conservation behaviors).

1.1 Why examine the effect of financial incentives on behavior change in the proenvironmental domain?

Why have researchers often chosen to use financial incentives to change proenvironmental behavior? Traditionally, incentives have been a prototypical source of motivation for initiating a new behavior. Many approaches to understanding and influencing human behavior, including rational actor models (e.g., Best, 2011; Fishburn, 1981; Opp, 1999), propose that incentives can increase the appeal of the incentivized behavior, thereby leading to an increase in the frequency of the behavior (e.g., Osbaldiston & Schott, 2012) and improved performance (e.g., Wiersma, 1992). However, conceptual approaches informed by cognitive evaluation theory (CET; Deci & Ryan, 1980, 1985) have postulated that although financial incentives can promote extrinsic motivation to engage in a behavior, financial incentives also tend to undermine intrinsic motivation, thereby making sustained behavior change less likely (Deci et al., 1999). And yet, some meta-analytic evidence suggests that incentives actually *increase* favorable attitudes toward a task, potentially increasing intrinsic motivation (Eisenberger & Cameron, 1996).

Although we did not set out to examine whether incentives change proenvironmental motivation, given that the effect of financial incentives on motivation more generally is unclear, financial incentives have the potential to break existing consumption and behavior patterns by making a competing behavior more attractive, thereby contributing to the development of new patterns of behavior that may possibly be maintained over time (e.g., Bamberg, 2002; 2006). Furthermore, on a policy level, providing incentives is a behavior change strategy that is well suited for broad dissemination across local, state, and federal entities (e.g., McDonald, Keesler, Kauffman, & Schneider, 2006). These features, among others, make the use of incentives a potentially appealing approach to changing proenvironmental behaviors.

Despite their appeal, however, it is unclear whether incentive interventions should have a reliable, positive effect on proenvironmental behavior, and, if they do, just how large the effects should tend to be. Building upon prior narrative reviews of the effect of financial incentives on proenvironmental behaviors (e.g., Stern et al., 1986; Stern, Berry, Hirst, 1985; Stoft & Gilbert, 1994), three meta-analyses have provided an initial, quantitative assessment of the effect of financial incentives on proenvironmental behaviors (Delmas, Fischlein, & Asensio, 2013; Hornik, Cherian, Madasnky & Narayana, 1995; Osbaldiston & Schott, 2012). Hornik et al. (1995) focused on behavior change strategies used to alter recycling behaviors and found that providing financial incentives tended to increase the frequency of recycling behaviors (r = .33). Delmas et al. (2013) focused only on programs designed to promote energy conservation in the home, finding that incentives increased energy conservation behaviors. However, this effect did not hold after controlling for other factors, such as the other types of intervention strategies simultaneously provided to participants. Osbaldiston and Schott (2012) examined a broader range of proenvironmental behaviors and found that financial incentives had, on average, a

"medium-sized" effect on behavior (d_+ = .46), though there was some variability in the effect of incentives on different types of behavior. For example, the effect of incentives on various recycling behaviors (ranging from d_+ = .61 to .73) tended to be larger than the effect of incentives on energy conservation behavior (d_+ = .45).

However, none of the prior meta-analyses compared the effect of incentives on behavior while the incentive was in place (i.e., initial behavior) to the effect of incentives on behavior after the incentive has been removed (i.e., sustained behavior). In addition, because the prior meta-analyses were designed to assess the effectiveness of a wide range of behavior change intervention strategies (e.g., messages, modeling, cues, planning, or incentives), they did not pursue questions regarding whether different types of incentive strategies had differential effects on behavior, and were limited in their ability to determine whether these effects varied across different types of behaviors.

1.2 Do financial incentives affect both initial and sustained proenvironmental behavior?

It is important to determine whether financial incentives differentially affect people's ability to initiate and sustain changes in proenvironmental behavior. Prior work has shown that initial and sustained behavior are distinct phases of the behavior change process (Rothman, 2000; Rothman, Baldwin, & Hertel, 2004) and reviews of the effect of incentives in the health domain have largely found that an incentive elicits changes in behavior while it is offered, but that these changes are generally not sustained after the incentive has been removed (e.g., Burns et al., 2012; Cahill & Perera, 2011; Mitchell et al., 2013; Paul-Ebhohimhen & Avenell, 2008; Strohacker, Galarraga, & Williams, 2014). The distinction between initial and sustained behavior has not been considered in prior reviews of the effect of incentive interventions on proenvironmental behavior, and the expected pattern of effects in this domain is not obvious.

On one hand, we may expect that proenvironmental behavior will return to baseline levels when the incentive is discontinued because the source of extrinsic motivation has been removed (Deci, 1972; Deci et al., 1999). On the other hand, in some cases changes in proenvironmental behaviors produce concrete, tangible outcomes, such as financial savings, that may serve to reinforce the behavior even after the incentive is removed. Given the theoretical distinction between initial and sustained behavior and the need for proenvironmental behaviors to be sustained to benefit the natural environment, the effect of incentives on initial and sustained proenvironmental behavior requires elucidation.

1.3 Do types of financial incentives differentially affect proenvironmental behavior?

Any variability in the effect of financial incentives on proenvironmental behavior may be partially attributable to the different *types* of incentives that have been used in past research. Recently, a theoretical framework has emerged that draws from classic and contemporary psychological theory to highlight how specific features of incentives (i.e., type and schedule) may influence behavior (Burns et al., 2012). For example, operant conditioning theory posits that increasing the frequency of a behavior may be achieved by offering a pleasant consequence (i.e., positive reinforcement) or by removing an unpleasant consequence (i.e., negative reinforcement) if the target behavior is performed (Skinner, 1953). In the incentive intervention literature, a cash reward is an example of *positive reinforcement*. A fee, in which people forfeit their own money unless they perform the target behavior, is an example of *negative reinforcement* because the aversive threat of losing one's money is removed by performing the behavior. Research has demonstrated that the disadvantage of losing money is perceived to be greater than the advantage of gaining the same amount of money (Tversky & Kahneman, 1981), and that people perceive items that they own to have more monetary value than identical items that they do not own

(Carmon & Ariely, 2000). Therefore, strategies that utilize fees are expected to have a greater effect on proenvironmental behavior than do those that use rewards because one's own money is perceived to be more valuable than money that is not under one's ownership.

Incentives may also vary in the schedule on which they are distributed (Skinner, 1953). Incentives may be administered at a *fixed*, predictable rate (e.g. $0.10/bottle recycled) or at a *variable*, unpredictable rate (e.g. $0.01-$1.00/bottle recycled). Research has demonstrated that a variable schedule is relatively more effective at producing and sustaining behavior change because it prevents habituation, which is a process whereby the perceived value and enjoyment of an object decreases as it is repeatedly encountered (McSweeney, 2004). Thus, incentives administered on a variable schedule are expected to have a greater effect on proenvironmental behavior than do incentives administered on a fixed schedule.

Other features of incentives may also influence proenvironmental behavior. Incentives can be classified as either cash incentives or non-cash incentives. Cash incentives refer to incentives provided in the form of coins or notes with a strict monetary value (e.g., the amount of cash offered as a prize or taken away as a fee). The value of non-cash incentives, however, is not revealed to recipients at the time of receiving the incentive or cannot be directly exchanged for cash (e.g., gifts or coupons). Non-cash incentives are generally evaluated more positively than cash incentives; people report enjoying their non-cash rewards more and are more likely to tell others about the reward (Shaffer & Arkes, 2009). Research has also demonstrated that when gifts are not assigned an explicit value, people work harder for the gift regardless of its actual value (Heyman & Ariely, 2004). Accordingly, incentive strategies that provide non-cash incentives are expected to have a larger overall effect on proenvironmental behavior than do those that provide cash incentives.

1.4 Do financial incentives differentially affect different types of behaviors?

Variability in the effect of financial incentives on proenvironmental behavior may also be partially attributable to the different types of behaviors that have been incentivized. Proenvironmental behaviors vary in a number of important ways, but investigators have tended to focus on the difficulty of performing various behaviors (Kaiser & Keller, 2001). For example, prior research suggests that recycling behaviors tend to be perceived as the easiest to perform, followed by energy conservation behaviors; efficient travel behaviors, such as carpooling or taking public transportation, tend to be viewed as the most difficult (Kaiser & Wilson, 2004). Behaviors that are more difficult to perform inherently have more barriers, therefore, additional motivation, such as that provided by incentives, may be needed to encourage people to overcome these barriers. Thus, incentives may have the strongest effect on behaviors perceived to be the most difficult to perform.

Yet, Osbaldiston and Schott (2012) found that incentives tended to have a larger effect on recycling behaviors as compared to conservation behaviors, which is inconsistent with the hypothesized effect regarding behavior difficulty. However, prior research has suggested that neither recycling nor conservation behaviors are perceived to be particularly difficult relative to other proenvironmental behaviors, such as public transportation use (Dietz, Gardner, Gilligan, Stern, & Vandenbergh, 2009; Kaiser & Keller, 2001). Efficient travel behaviors, which are perceived to be some of the most difficult types of proenvironmental behaviors to engage in, might provide a more rigorous test of whether incentives have a stronger influence on certain types of proenvironmental behaviors. Guided by prior research on perceptions of the difficulties of engaging in distinct proenvironmental behaviors (Dietz et al., 2009; Kaiser & Keller, 2001), we specifically examined whether incentives might have a stronger effect on efficient travel than

on recycling and energy conservation behaviors. Finally, given the importance of distinguishing between objective and self-reported measures of behavior in the proenvironmental area (Kormos & Gifford, 2014), we also examined whether the influence of incentives on proenvironmental behavior was greater when the behavior was self-reported, rather than objectively measured.

1.5 Current research

This meta-analysis extends prior research by assessing the quantitative experimental literature on the use of financial incentives as a strategy to change proenvironmental behaviors by examining (1) the effect of financial incentives on both initial and sustained proenvironmental behavior, (2) the effect of different types of financial incentives on proenvironmental behavior, and (3) the effect of financial incentives on different types of proenvironmental behaviors. We focused on effects on proenvironmental behavior, whether objective or self-reported, and did not include studies that assessed only intentions or willingness to behave. Guided by best meta-analytic practices (e.g., Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009), we collected and coded data from previous studies using multiple coders and computed inter-rater agreement, employed random effects models, conducted a series of tests to assess bias in the meta-analytic results, and considered other methodological characteristics that may also influence the effect of incentives on proenvironmental behavior (e.g., the nature of the control or comparison condition).

2. Method

2.1 Search Strategies

A search for articles was conducted, guided by inclusion criteria, for articles published within 25 years from the initial search data, from 1977 to 2012, using the following social scientific databases: Business Source Premier, Digital Dissertations, Econlit, PsychINFO,

Scopus, and Web of Knowledge. We electronically examined the abstract and the title of articles for search terms related to both types of proenvironmental behavior and types of incentives, and the search terms were as follow: recycling, conservation, bus, organic food, public transportation, conserve, and consumption, and incentive*,[1] coupon, tickets, pay, and lottery. We also reviewed reference lists of articles identified through the search as well as the previous meta-analyses by Osbaldiston and Schott (2012) and Delmas et al. (2013); any articles used in those meta-analyses that fit our inclusion criteria were included (including an article from 1975, which we used despite it being earlier than our cutoff year, to better replicate prior efforts). A call for papers on the Society for Personality and Social Psychology (SPSP) forum board was also put out, as well as the Facebook pages for the American Psychological Association Division 34 (Society for Environmental, Population, and Conservation Psychology) and the Sustainability Psychology Society for Personality and Social Psychology group.

2.2 Pre-search decisions and inclusion criteria

To determine whether types of financial incentives differentially affect proenvironmental behavior, we included studies that considered the following types of incentives: cash, fines or fees, lotteries, contests, coupons, reimbursements or rebates, and tickets. Studies that considered the following behaviors were also included: recycling plastic, glass, and aluminum, recycling paper, energy conservation, public transportation use, carpooling, efficient driving behavior, and biking/walking explicitly framed as effectively reducing energy consumption related to motorized vehicle use. These lists were based, in part, on previous lists used in other meta-analyses and reviews in the environmental domain (e.g., Osbaldiston & Schott, 2012). Behaviors

[1] Incentive* searches used all words that contain "incentive" at the beginning (e.g., incentive and incentives).

such as technology adoption, sustainable food choices, and wildlife conservation were excluded because few studies by environmental psychologists have focused on changing these types of behaviors in experimental contexts using financial incentives.

The five inclusion requirements were: (1) the study investigated one of the focal proenvironmental behaviors, (2) the study included at least one of the focal types of financial incentives, (3) the study employed an experimental or quasi-experimental design and provided a comparison of at least two groups or two time points, such as studies that have an incentive treatment group compared to a control group, or a within-subjects design of a baseline time point versus a time point when an incentive was administered, (4) the study included a measure of the proenvironmental behavior, and (5) the study reported statistical results that allowed for the calculation of an effect size.

2.3 Search results

In total, 24,028 articles were found in our initial search and 55 other articles were identified through the reference lists of the previous meta-analyses (i.e., Delmas et al., 2013; Osbaldiston & Schott, 2012). After removing articles from the database that did not qualify based on a review of abstracts and titles, 49 relevant articles remained and were analyzed according to our five inclusion criteria based on a review of the full article. Figure 1 is the PRISMA figure that describes how articles were selected and filtered through different phrases of the search process, including reasons for excluding articles during the in-depth review stage (Moher et al., 2009). Six articles were rejected because they were not empirical or they did not have an experimental or quasi-experimental design, one article did not report a measure of behavior, three articles did not target proenvironmental behavior, and four articles did not include a financial incentive condition. In addition, 13 articles did not provide usable statistics

for the meta-analysis. In the end, 22 articles met our inclusion criteria, and from those research studies we were able to derive $k = 30$ effect sizes.

2.4 Additional coded study features

Several additional features were coded that could influence the strength of the effect of financial incentives on proenvironmental behavior. First, the type of behavior targeted was coded (i.e., recycling, energy conservation, or efficient travel behavior). All recycling behaviors (i.e., recycling plastic, glass, and aluminum, and recycling paper) were combined into the recycling behavior category, energy conservation behaviors remained its own category, and taking public transportation, carpooling, engaging in efficient driving behaviors, and biking/walking were combined into an efficient travel behavior category. Because all studies that targeted multiple behaviors focused on more than one recycling behavior, these studies were included in the recycling behavior category.

Second, the type of financial incentive used was coded (i.e., cash versus non-cash incentives). We first coded lottery and contest incentive interventions as either including a cash or non-cash prize. We then classified incentives that explicitly focused on cash and fines/fees as being cash incentive studies, and classified incentives using coupons, reimbursements/rebates, and tickets as non-cash incentives. Interventions that combined both cash and non-cash incentives were not placed in either of these two groups. We also coded for whether each study included an incentive that relied upon positive versus negative reinforcement, whether the incentive followed a fixed versus variable ratio reinforcement schedule, and finally the size of the incentive.

Third, characteristics of the study or intervention design were coded. We distinguished between studies that compared (1) an incentive intervention to a control condition, (2) an

incentive intervention to another active comparison condition (e.g., a planning intervention), or (3) a baseline assessment to an assessment following the incentive intervention (i.e., within-subject design). We distinguished between studies that provided only an incentive (a "pure" incentive intervention) and those that provided an incentive along with another type of intervention (e.g., eliciting commitment; a "combined" incentive intervention). We examined how the length of the incentive intervention phase (i.e., how long the incentive was in place) influenced behavior and how the amount of time between the end of the intervention and the final measurement of behavior affected the likelihood of behavior maintenance. Additionally, we coded whether studies measured behavior objectively or via self-report. Finally, we distinguished between studies that did and did not refer to theory as the basis for the intervention design.[2]

2.5 Reliability of coding

The coding framework was agreed upon prior to the coding process. Two research assistants independently coded the moderator variables and effect sizes for each study. The first author compiled the final codes. Kappa coefficients for categorical variables indicated a moderate level of agreement (median = 0.70, mean = 0.68), and intra-class correlations for continuous variables indicated a high level of agreement (median = 0.95, mean = 0.87).

2.6 Meta-analytic strategy

All articles deemed eligible for the meta-analysis were coded according to the aforementioned dimensions and quantitative effect sizes were calculated. Cohen's *d* was the effect size metric used in the meta-analysis. If a study had multiple conditions, we prioritized and compared the conditions according to a pre-determined hierarchy. The primary aim was to select

[2] Additional study features were coded but ultimately not examined or included in the current manuscript. For a full list of features please contact the authors.

conditions that captured the difference between incentivized groups and non-incentivized groups, which is consistent with the aim of the research to examine whether incentives have an effect on proenvironmental behavior. The ranking of comparisons was as follows, and we only computed effects sizes for the highest ranked option for each study. First, we compared an incentive condition to a control condition. If there was no control condition, we then compared an incentive condition with a comparison treatment condition. If this option was also not available, we then used pre/post comparisons before and after the incentive intervention. Among the 30 effect sizes included in the analysis, 19 effect sizes generated compared an incentive condition to a control condition, two effect sizes generated compared an incentive condition to another treatment condition, and nine effect sizes generated compared follow-up time points to baseline measures within an incentive condition.

We calculated effect sizes, when possible, for the studies in our meta-analysis using the last available time-point while the incentive was in place and the last available time-point after the incentive had been removed. Effects at both of these time points were examined – the behavioral outcome assessed during the intervention indicated the immediate effect of the incentive on proenvironmental behavior, and the behavioral outcome assessed after the completion of the intervention indicated whether the behavior was sustained after the incentive had been removed.

Consistent with previous meta-analyses in this area (e.g., Abrahamse & Steg, 2013; Karlin, Zinger, & Ford, 2015; Lokhorst, Werner, Staats, van Dijk, & Gale, 2013), we examined comparisons between studies (e.g., between incentive schedules of reinforcement) only if two or more studies qualified for each comparison group. Differences between effect sizes across moderator categories were tested (e.g., types of incentives) using the *Q* statistic and the

corresponding *p*-value. The meta-analysis was conducted using STATA Version 11 (StataCorp, 2009). Weighted average effect sizes were calculated based on the random effects model. Cohen's (1992) guidelines were used for the interpretation of effect sizes; $d = .20$ is considered a "small" effect size, $d = .50$ is a "medium" effect size, and $d = .80$ is a "large" effect size.

3. Results

3.1 Do financial incentives affect both initial and sustained proenvironmental behavior?

We first examined the overall effect of financial incentives on proenvironmental behavior while the incentives were in place and after they had been removed. Among the 30 studies included in the meta-analysis (see Table 1), 25 effect sizes were computed for behavior observed while the financial incentive was in place, and 13 effect sizes were computed for behavior observed after the incentive had been removed. While the incentive was in place, 20 out of 25 effect sizes indicated that incentives led to an increase in proenvironmental behavior. The forest plots (see Figures 2 and 3) indicate that the overall mean effect size was significantly greater than zero. Specifically, during the time period when the incentive was in place, incentives had a small-to-medium effect on proenvironmental behaviors (overall effect size $d_+ = 0.36$, *CI* = 0.22 to 0.50, $k = 25$, $N = 2{,}971$, $Q = 58.87$, $p < .001$). During the follow-up period (i.e., after the incentive had been removed), the pattern of results was similar (overall effect size $d_+ = 0.41$, *CI* = 0.26 to 0.56, $k = 13$, $N = 701$, $Q = 0.35$, $p = .56$). For these two analyses, the fail-safe N indicated that 523 or 110 unpublished studies with nonsignificant findings, respectively, would be needed to overturn the results (Orwin, 1983; Rosenthal, 1979). Overall the results suggest that publication bias was not problematic.

To further test whether the effect of incentives on behavior differs between when incentives are in place and after they have been removed, we examined the effect of incentives

on only those studies that reported behavior at both time points. When comparing only those studies that provided effect sizes at both time points (k = 8, N = 234), the overall effect sizes were similar when the incentive was in place (d_+ = 0.47, CI = 0.20 to 0.73, Q = 3.63, p = .82) and after the incentive had been removed (d_+ = 0.37, CI = 0.11 to 0.63, Q = 0.85, p = .98). These two effect sizes did not significantly differ from one another (Q = 0.09, p = .76).

Once the incentive has been removed, how long does the effect of the incentive on behavior persist? To examine this question, we tested whether the length of time between the intervention and the follow-up time point after the incentive had been removed had an influence on the size of the effect. Although the length of follow-up ranged from two weeks to three months later (M = 6.62 weeks, SD = 4.17), it was not a significant predictor of behavior after the incentive had been removed (b = .02, CI = -.02 to .06, p = .26).

A series of analyses were conducted to ensure that these findings were robust. First, Coyne, Thombs, and Hagedorn's (2010) criterion was employed to investigate whether the results differed if the analyses were limited to studies with adequate power (i.e., 55% power to detect a medium-sized effect). Thirty-three percent of the studies reporting an effect size regarding behavior during the intervention and fourteen percent of the studies reporting an effect size regarding behavior during follow-up had adequate power. Findings were largely unchanged when the meta-analysis was restricted to these studies. The effect when the incentive was in place (d_+ = 0.39, CI = 0.18 to 0.60, k = 8, N = 2,423) was comparable to the effect after the incentive had been removed (d_+ = 0.40, CI = 0.19 to 0.60, k = 2, N = 363), both of which are quite comparable to the effect sizes obtained when using all of the studies. Follow-up analyses demonstrated that these two effect sizes were not significantly different from one another (Q = 0.01, p = .93).

Second, given the low power in many of the studies, Egger's tests (Egger, Smith, Schneider, & Minder, 1997) were computed to examine whether there was a significant relationship between study effect sizes and the size of the sample from which the effect size was derived. Egger's tests were not significant while the incentive was in place ($t(25) = 1.04$, $p = .31$) or after it had been removed ($t(13) = 1.11$, $p = .29$), suggesting that effect sizes derived from small samples were not biasing the estimate of the overall effect sizes.

3.2 Do types of financial incentives differentially affect proenvironmental behavior?

We next examined whether different types of incentives had a stronger or weaker effect on proenvironmental behavior. While financial incentives were in place the use of tickets ($k = 2$) had a medium-to-large effect on behavior, fines/fees ($k = 1$), lotteries ($k = 4$), reimbursements/rebates ($k = 4$) and use of more than one type of incentive ($k = 2$) had a small-to-medium effect on behavior, and the use of cash ($k = 7$), coupons ($k = 4$), and contests ($k = 1$) had a small effect on behavior (see Table 2).. After the incentive had been removed, use of cash ($k = 3$) and tickets ($k = 5$) had a medium effect on behavior, lotteries ($k = 2$) and coupons ($k = 2$) had a small-to-medium effect on behavior, and using more than one incentive ($k = 1$) had a small effect on behavior.

Do different reinforcement features affect proenvironmental behavior? Because only one out of 30 incentive interventions used negative reinforcement (i.e., participants engaged in recycling behavior in order to avoid a fine/fee), we were unable to conduct any comparisons of positive and negative reinforcement interventions. However, we were able to examine differences between studies that relied on a fixed or variable schedule of reinforcement. When the incentive was in place, incentive programs that used variable schedules of reinforcement ($d_+ = 0.45$, $CI = 0.04$ to 0.86, $k = 5$) were significantly more effective at changing behavior than

those that used fixed schedules (d_+ = 0.30, *CI* = 0.19 to 0.41, k = 20; Q = 4.39, p = .04). After the incentive had been removed, incentives that used variable schedules (d_+ = 0.35, *CI* = 0.08 to 0.63, k = 2) did not differ from those that used fixed schedules (d_+ = 0.44, *CI* = 0.26 to 0.62, k = 11; Q = .29, p = .59). Finally, given the small number of effect sizes within each type of incentive, examining how the *size* of an incentive affected behavior was not feasible.

3.3 Do financial incentives differentially affect types of behaviors?

Next, we examined whether incentives had a stronger or weaker influence on different types of proenvironmental behaviors. Considering the effect of incentives on each type of behavior, when the incentive was in place they had the strongest effect on recycling paper and public transportation use, and the weakest effect on efficient driving behaviors, recycling multiple materials, and energy conservation (see Table 3). There was less variability in the effect of incentives on specific behaviors after the incentive had been removed, as they largely had a small-to-medium effect on most types of specific behaviors.

Categorizing behaviors into recycling, energy conservation, or efficient travel behaviors (see Table 4), when the incentive was in place, the effect sizes for both recycling behavior (k = 11) and travel behavior (k = 8) were of small-to-medium magnitude, whereas the effect size for energy conservation (k = 6) was of small magnitude. After the incentive had been removed, the effect size for energy conservation behavior (k = 1) during follow-up was of medium magnitude; the effect sizes for both recycling behavior (k = 2) and travel behavior (k = 10) were of small-to-medium magnitude.

Do types of financial incentives differentially affect types of behaviors? While the financial incentive was in place, cash had the strongest influence on recycling behaviors,

followed by travel behavior and energy conservation (see Table 5). Non-cash incentives had the strongest effect on travel behavior, followed by energy conservation and recycling behavior.

The effect of cash incentives on each category of behavior was compared to the effect of non-cash incentives. First, considering use of cash versus non-cash incentives while the incentive was in place, cash and non-cash incentives did not differ in their ability to change recycling behaviors ($Q = 2.50$, $p = .11$). Comparing the effect of cash versus non-cash incentives on travel behavior, there was a significant difference between interventions ($Q = 6.80$, $p = .009$), indicating that non-cash incentives led to larger increases in travel behavior. Differences between cash and non-cash incentives for energy conservation behaviors were not examined because only one intervention targeted this behavior category using a non-cash approach.

After the incentive had been removed, cash incentive interventions were used in relation to travel behavior and energy conservation; non-cash incentive interventions were administered in studies examining travel behavior and recycling, demonstrating comparable effects across those categories of behavior. Only travel behavior was targeted in both cash and non-cash incentive interventions that included a follow-up time point; there was not a significant difference between non-cash incentives and cash incentives ($Q = .07$, $p = .79$).

Do study/intervention features moderate the effect of the financial incentive intervention on behavior?

Does study design influence the effect of financial incentives on behavior? As to be expected, studies that relied on within-subject comparisons reported significantly stronger effects while the financial incentive was in place ($d_+ = 0.62$, $CI = 0.27$ to 0.97, $k = 8$) as compared to those that relied on comparisons of the incentive intervention to a control condition ($d_+ = 0.23$, $CI = 0.12$ to 0.33, $k = 15$) or to an active comparison condition (e.g., a planning activity; $d_+ =$

0.13, *CI* = -0.10 to 0.37, *k* = 2; *Q's* = 23.85 and 13.06, *p*s < .001). However, comparisons of the incentive intervention to a control condition did not significantly differ from comparisons of the incentive intervention to an active comparison condition (*Q* = 0.59, *p* = .44). After the incentive had been removed, within-subject comparisons revealed the strongest effects (d_+ = 0.64, *CI* = 0.05 to 1.24, *k* = 3), followed by comparisons of incentives to active comparisons (d_+ = 0.48, *CI* = -0.30 to 0.99, *k* = 2), and finally comparing incentives to controls (d_+ = 0.39, *CI* = 0.23 to 0.55, *k* = 8). The difference between the effects observed from a within-subject and a control comparison design was not significant (*Q* = .54, *p* = .46); nor was the difference between the effects observed from a within-subject and an active comparison design (*Q* = .64, *p* = .43). Finally, effect sizes observed in the control comparison and the active comparison designs were not different (*Q* = .11, *p* = .74).

Does combining a financial incentive intervention with other intervention components influence the effect of incentives on behavior? Interventions that only provided a financial incentive (pure incentive) were compared to those that combined an incentive with at least one other intervention component (combined). While the incentive was in place, combined interventions (d_+ = 0.37, *CI* = 0.11 to 0.62, *k* = 13) led to larger effects on behavior compared to incentive only interventions (d_+ = 0.27, *CI* = 0.15 to 0.39, *k* = 12), but this effect was not significant (*Q* = 1.83, *p* = .18). The direction and magnitude of this difference held after the incentive had been removed, but again was not significant (combined interventions d_+ = 0.48, *CI* = 0.27 to 0.69, *k* = 8; pure incentive interventions d_+ = 0.35, *CI* = 0.14 to 0.56, *k* = 5; *Q* = .72, *p* = .40).

Does intervention length influence the effect of financial incentives on behavior? The length of the financial incentive interventions ranged from minutes up to three months, on

average lasting just over nine weeks (M = 9.17 weeks, SD = 10.08). The length of the intervention was not a significant predictor of behavior while the incentive was in place (b = -.005, CI = -.02 to .01, p = .48) or after it had been removed (b = -.03, CI = -.11 to .05, p = .49).

Does objective versus self-reported behavior influence the effect of incentives on behavior? Studies that relied on objective reports of behavior were compared to those that relied on self-reports of behavior. While the incentive was in place, only one study relied on self-reported behavior, precluding any comparisons. After the incentive had been removed, three studies relied on self-reported behavior and ten relied on objective behavior; studies that used self-report measures (d_+ = .51, CI = 0.25 to 0.76, k = 3) reported larger effects on behavior compared to those that used objective measures of behavior (d_+ = .37, CI = 0.18 to 0.55, k = 10), but this difference was not statistically significant (Q = .76, p = .39).

Does explicitly grounding an intervention in a theoretical model influence the effect of financial incentives on behavior? Across the studies that generated the 30 effect sizes, there was relatively little mention of theory as the basis for hypotheses, study designs, and/or incentive intervention designs. Of the three studies that did refer to a theory, there was reference to insufficient justification (Katzev & Johnson, 1984), prospect theory (Abou-Zeid, Witter, Bierlaire, & Ben-Akiva, 2012), and the theory of planned behavior (Bamberg, 2006). While the incentive was offered, interventions that did not mention theory (d_+ = 0.38, CI = 0.23 to 0.52, k = 23) were not significantly less effective at changing behavior than theory-based incentive interventions (d_+ = 0.001, CI = -0.52 to 0.52, k = 2; Q = 2.04, p = .15). After the incentive had been discontinued, theory-based incentive interventions (d_+ = 0.52, CI = 0.24 to 0.80, k = 2) were not significantly more effective than interventions that did not mention theory (d_+ = 0.37, CI = 0.20 to 0.55, k = 11; Q = .78, p = .38).

4. Discussion

This meta-analysis extends our understanding of the influence of financial incentives on proenvironmental behavior by addressing three questions. First, what effect do financial incentive interventions have on *initial* and *sustained* proenvironmental behavior? Results indicated that incentive interventions generally had a small-to-medium effect on proenvironmental behaviors both while the incentive was offered and after it had been removed. Although there were fewer studies that examined change in behavior after incentives had been removed, these results suggest that removing incentives may not lead to a return to baseline levels of proenvironmental behavior.

Second, do different *types of financial incentives* vary in their effect on proenvironmental behavior? Variable schedules of reinforcement tended to elicit greater increases in behavior compared to fixed schedules of reinforcement, but only when the incentive was in place. Furthermore, while incentives were offered, cash incentives had the strongest effect on recycling behavior and non-cash incentives had the strongest effect on efficient travel behaviors. However, when incentives were discontinued, both cash and non-cash incentives tended to have small-to-medium sized effects on all types of behavior. As a whole, these results reveal that the type of incentive may have a greater impact on behavior when they are in place, and that differences between the effect that types of incentives have on behavior maintenance may be limited once they have been removed. Finally, do the effects of financial incentive interventions vary across different *types of behaviors*? While incentives were in place, the largest changes in behavior occurred for recycling behaviors (consistent with past meta-analytic results; Osbaldiston & Schott, 2012) and travel behaviors (previously unexplored in meta-analyses). These results suggest incentives may be most effective when targeting select behaviors, such as recycling, and

less effective when trying to change others, such as conservation behaviors. However, fewer studies targeted energy conservation behavior, making estimates of those effects somewhat less reliable.

4.1 The sustained effect of financial incentives on proenvironmental behavior

Regardless of the length of the follow-up, financial incentives tended to lead to the persistence of proenvironmental behaviors even after the incentive had been discontinued. Based on the data, the effect of incentives on proenvironmental behavior was similar both while they were in place and after they had been removed. These findings are somewhat inconsistent with findings from incentive interventions that have been conducted in the health behavior domain (e.g., Burns et al., 2012, Cahill & Perera, 2011; Mitchell et al., 2013; Paul-Ebhohimhen & Avnell, 2008; Strohacker et al., 2014). However, researchers have occasionally found evidence that incentives can lead to sustained health behaviors (Marteau, Ashcroft, & Oliver, 2009) and that incentives do not always decrease intrinsic motivation to engage in a given health behavior (Promberger & Marteau, 2013). Prior research has also indicated that removing incentives can lead to a reduction in behavior, but that this is particularly the case when the targeted behavior was initially perceived to be interesting (Deci et al., 1999; Wiersma, 1992). The observed sustained change in behavior may reflect an initial lack of interest in proenvironmental behavior. Alternatively, this pattern of results may be attributable to the financial benefits that are derived relatively quickly from some proenvironmental behaviors (e.g., saving money on energy bills, possibly receiving payment for recyclables), an outcome that is not typically observed when people change their health behavior.

Cognitive evaluation theory (Deci & Ryan, 1980, 1985) is usually interpreted as predicting that financial incentives should always lead to an undermining of intrinsic motivation. However,

in some cases financial incentives could actually *increase* intrinsic motivation, such as when the incentives are viewed as informational and, thus, demonstrate a recipient's competence (Deci et al., 1999). Because participants in the studies included in this meta-analysis were asked to engage in a behavior that benefitted the environment, and required a certain degree of behavioral knowledge (e.g., what to recycle, how to conserve energy at home), it was possible that people perceived these incentives as evidence of their own competence. Thus, it is an open issue whether use of financial incentives may actually lead to an increase, decrease, or have no effect on intrinsic motivation to engage in proenvironmental behaviors in some contexts.

Regardless, these results may have important applied implications, as it is possible that efforts to effectively sustain proenvironmental behavior could only require offering incentives for a limited amount of time, thereby conserving scarce monetary resources. The present results also suggest that the length of the incentive intervention does not necessarily relate to how strongly behavior is affected, whether while the incentive is in place or after it is removed. Although this finding is intriguing, further research should systematically vary the length of a given incentive intervention to more directly examine whether the length of the incentive intervention matters and to determine whether there is a minimal length of time an incentive intervention needs to be in place.

4.2 The variable effect of types of financial incentives on behavior

This meta-analysis also contributes to the literature by seeking to determine which types of incentives have the greatest influence on proenvironmental behavior. Previous meta-analyses of incentive interventions for proenvironmental behavior (Delmas et al., 2013; Osbaldiston & Schott, 2012) did not consider these distinctions. Consistent with theory and prior research (e.g., Burns et al., 2012; Wathieu 2004), variable schedules of reinforcement led to larger effects on

behavior as compared to fixed schedules of reinforcement, but only when the incentives were in place. It may be surprising that this finding did not replicate when examining effects after incentives had been removed, but it is important to acknowledge that often there were a limited number of studies available when making comparisons such as this one. Hypotheses pertaining to the differential effects of positive and negative reinforcement could not be tested because our literature search revealed that incentives based on negative reinforcement were largely absent from the literature on proenvironmental behavior change. However, given that people are loss averse and value their own money more than money that is not their own (e.g., Carmon & Ariely, 2000; Tversky & Kahneman, 1981) incentives that use negative reinforcement (e.g., fees for not recycling) should be explored in future research. Finally, additional research should strive to specify the *amount* of an incentive that needs to be offered, as this knowledge would also help us maximize the utility of incentive interventions (e.g., Kanayet, Opfer, & Cunningham, 2014). Although some research suggests that offering larger amounts of cash might be better (e.g., Heyman & Ariely, 2004), given that little systematic work exists on the topic it deserves further attention.

4.3 The variable effect of financial incentives on types of behavior

Finally, this meta-analysis provided the first examination of whether the effectiveness of different types of financial incentives varies by the type of proenvironmental behavior targeted. While incentives were in place, cash incentives tended to be more effective at changing recycling behaviors, and non-cash incentives tended to be more effective at changing energy conservation and travel behaviors. These results suggest that future incentive interventions would benefit from matching the type of incentive (cash versus non-cash) to the behavior being targeted, but the absence of a clear theoretical model for the processes underlying these matching effects prevents

any strong conclusions from being drawn at this time. Future work should build upon conceptual models of proenvironmental behaviors (e.g., Kaiser & Wilson, 2004; Stern, 2000) to generate and test hypotheses concerning the matching of types of incentives to types of proenvironmental behaviors.

Finally, while the incentives were in place interventions did tend to have the largest effect on recycling behaviors, which is consistent with prior research (Osbaldiston & Schott, 2012), and efficient travel behaviors, which supports the argument that people might need additional motivation to engage in behaviors that are more difficult to perform (Kaiser & Wilson, 2004). However, future research should further explore conceptual distinctions between behaviors that could influence the effectiveness of incentives.

4.4 Study/intervention characteristics that influenced how much financial incentives affect behavior

Several methodological characteristics moderated the observed effect that financial incentives had on behavior. For instance, repeated-measure designs tended to report the largest observed effect sizes, followed by experiments with control conditions, and finally experiments with only comparison conditions. Incentives did lead to positive effect sizes across all designs at both time points, though it is worth noting that the confidence intervals comparing the incentive intervention with comparisons conditions did include zero. Additionally, although interventions that combined incentives with other intervention techniques trended toward being more effective than those that utilized only incentives, offering only incentives was not a significantly less effective intervention approach. Prior reviews in the health area have found that combining more than one type of intervention does tend to produce an advantage over providing just one intervention strategy (e.g., Michie, Abraham, Whittington, McAteer & Gupta, 2009). Studies

using systematic comparisons will be necessary in identifying which additional intervention components potentially have the greatest effect on behavior when paired with incentives. To date, there do not appear to be any principles or empirical work guiding the decisions as to which intervention components to combine with an incentive. Cost-free or low-cost interventions that can be combined with incentive approaches could help contribute to effective interventions that lead to sustained behavior (such as commitment or planning interventions; e.g., Bamberg, 2002; Osbaldiston & Schott, 2012). For those behaviors considered difficult to perform, such as efficient travel behaviors (Dietz et al., 2009; Kaiser & Wilson, 2004), perhaps interventions focused on teaching skills or increasing self-efficacy may be particularly potent approaches worth combining with incentive interventions.

The overwhelming majority of the studies included in this meta-analysis relied on objective measures of behavior. Because of the small number of studies that relied on self-reported measures of behavior, comparisons between studies that relied on self-report versus objective measures were limited. Consistent with prior meta-analytic evidence (Kormos & Gifford, 2014), there was a tendency for self-report measures to indicate stronger effects of incentives than did objective measures. Finally, because very few studies in the present meta-analysis explicitly grounded their design of the incentive intervention in a specific theory, it makes it difficult to determine which types of interventions may be most effectively combined with incentive interventions. Future work should consider this question, as research has sometimes suggested that theory-driven interventions lead to larger effects (e.g., Prestwich et al., 2014), and theory-driven interventions could help guide further exploration of how different types of interventions may effectively be combined with incentive interventions.

4.5 Mechanisms through which financial incentives affect behavior

Unfortunately, the field currently lacks a clear understanding of *how* financial incentives influence behavior (Ashcroft, Marteau, & Oliver, 2008; Strohacker et al., 2014). Although theory suggests that extrinsic or intrinsic motivation may underlie the effect of incentives on behavior (Deci, 1972; Deci et al., 1999), an improved understanding of how incentives elicit sustained proenvironmental behavior, even after they have been removed, could provide important guidance for how to optimize the design of interventions to change proenvironmental behaviors. Proposed mediators receiving attention in the literature that may explain how incentives affect behavior include the ability of incentives to help individuals reevaluate aspects of the behavior, such as appreciating future outcomes over present conditions (overcoming "present bias"; e.g., Camerer & Lowenstein, 2003; Gilbert & Wilson, 2007; Ikeda, Kang, & Ohtake, 2010), downplaying the anticipated regret of engaging in a behavior (e.g., Loomes & Sugden, 1982; Mellers & McGraw, 2001), or eliciting feelings of loss aversion (Gneezy, Meier, & Rey-Biel, 2011; Tversky & Kahneman, 1981). Moving forward, research on the effect of incentives on initial and sustained proenvironmental behavior should consider measuring these processes, and potential others.

Similarly, future research and theorizing should compare the effects of incentives on proenvironmental behaviors to their effects on other behaviors, such as health or prosocial behaviors. Differences in how incentives influence these different types of behavior may offer insight into the processes explaining why incentives are sometimes effective at both initial and sustained behavior change. Perhaps effective use of financial incentives leads people to save money after engaging in proenvironmental behaviors, but does not help people save money in health or prosocial contexts, thus potentially limiting the value of financial incentives for sustaining health or prosocial behavior change.

4.6 Implications for applied research and policy

Proenvironmental behavior requires participation by many people to optimize its collective environmental effect. Accordingly, incentives are an attractive intervention strategy as they can be scaled to reach a large population. Because many proenvironmental behaviors are tied to municipal services (e.g., recycling, energy use), local and federal agencies are well positioned to utilize incentives as a tool to change people's behavior. However, the effectiveness of these efforts is limited by the absence of evidence-based guidelines that would enable interventionists and policy makers to purposefully select a financial incentive type when designing an intervention or policy. As the results from this meta-analysis illustrate, there may be advantages to utilizing specific types of incentive structures when trying to change proenvironmental behavior more generally (e.g., variable schedules of reinforcement), or when trying to change particular classes of proenvironmental behavior (e.g., cash incentives for recycling and non-cash incentives for efficient travel behaviors).

4.7 Limitations

In this meta-analysis, several of the key behaviors that we hoped to include were absent or extremely rare (e.g., water conservation). Though we found that incentives were effective at changing the types of behaviors presently considered (i.e., recycling, energy conservation, and efficient travel behavior), their effect on other types of behaviors is still unclear and should be the focus of further research (e.g., buying local or organic food, water conservation, one-time purchasing behaviors of sustainable technologies). We also hoped to examine how features of the incentive design (i.e., positive versus negative reinforcement; fixed versus variable schedules) affect observed changes in proenvironmental behavior. Unfortunately, only one of the studies in the review utilized negative reinforcement and only a handful of studies used variable ratio

schedules. This not only made it impossible to test the difference between positive and negative reinforcement, but it also limited the confidence we can have in certain findings where very few studies were being compared.

We were also unable to look at combinations of these features of incentives, such as comparing positive reinforcement with a fixed schedule versus negative reinforcement with a variable schedule. The size of incentives (e.g., the amount of cash offered) is also a potentially important feature of an incentive intervention, but given the diversity in types of incentives used by studies included in the current meta-analysis we were unable to explore this factor. We suggest that future research should systematically investigate these key distinctions. Also, in the present meta-analysis we categorized tickets, coupons, and rebates as non-cash incentives, given that they cannot be traded in for cash and they necessarily dictate the item that can be obtained for a reduced price or for free. However, finer distinctions can be made in this area and researchers may want to pursue these distinctions directly in future research.

The effect of incentive interventions on behavior are likely sensitive to features of the broader context in which they are implemented. For example, providing incentives in public or private settings may influence whether people think about how others would view their decision to accept financial incentives for engaging in a proenvironmental behavior that benefits all people. To date, researchers do not typically report these contextual features in their journal articles. However, if they are recorded moving forward, the effect of these contextual factors can be tested in future meta-analyses. The field should also strive toward conducting a greater number of well-powered, randomized controlled trials that examine the effect of incentives on proenvironmental behavior, as many of the studies examined were underpowered. With a criterion of 55% power, only 33% of studies that measured behavior while the incentives were in

place had adequate power, as did only 14% of studies that measured behavior after the incentives had been removed. Although the findings were not drastically altered when considering only well-powered studies, future research would benefit from consistent efforts to secure sufficient statistical power.

Although the current meta-analytic approach utilized in this paper is consistent with use of meta-analysis in psychology (e.g., Abrahamse & Steg, 2013; Karlin et al., 2015), any interpretation of findings should keep in mind that the number of tests undertaken may increase the likelihood of false positives. Finally, the number of studies included in this meta-analysis and in specific sub-analyses, though typical for a proenvironmental behavior change intervention meta-analysis (e.g., Abrahamse & Steg, 2013; Karlin et al., 2015), highlight the need for additional studies on the influence of incentives on proenvironmental behavior. Some of the comparisons that were made in the present meta-analysis had two or three studies in a given comparison group. It will be important to reexamine these comparisons as the number of studies in this area increases.

4.8 Conclusion

The current findings summarize and extend the literature on the influence of financial incentive interventions on proenvironmental behavior. Results suggested that incentives effectively promote proenvironmental behavior. Moreover, these effects held regardless of whether looking at changes in behavior when the incentive intervention was in place or after the intervention had been discontinued. Results also revealed that types of incentives differentially affected behavior, and also varied in the strength of their effects on different types of behavior. The current findings can help the field of proenvironmental behavior change develop more

theory-driven empirical approaches to studying the effect of incentives on behavior, as well as develop better and more efficient incentive interventions to promote proenvironmental behavior.

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Table 1

Characteristics and effect sizes of studies included in the meta-analysis

Authors	Type of Incentive	Schedule of Reinforcement	Behavior	Effect sizes *d* (95% CI)	
				When incentive was in place	After incentive had been removed
Abou-Zeid et al., 2012	Free tickets	Fixed	Public transportation	N/A	0.80 [.06, 1.54]
Bachman & Katzev, 1982	Free tickets	Fixed	Public transportation	0.47 [-.21, 1.16]	0.34 [-.34, 1.01]
Bachman & Katzev, 1982	Free tickets	Fixed	Public transportation	0.69 [.06, 1.32]	0.50 [-.12, 1.12]
Bamberg, 2006	Free tickets	Fixed	Public transportation	N/A	0.47 [.16, .78]
Battalio et al., 1979	Rebates	Fixed	Energy conservation	1.19 [.16, 2.22]	N/A
Deslauriers & Everett, 1977	Coupons	Fixed	Public transportation	1.45 [.18, 2.72]	N/A
Diamond & Lowey, 1991	Lottery and cash	Variable	Recycling	0.33 [.10, .55]	N/A
Foxx & Schaffer, 1981	Lottery	Variable	Gasoline conservation	0.17 [-.85, 1.19]	0.65 [-.39, 1.69]
Fujii & Kitamura, 2003	Free tickets	Fixed	Public transportation	N/A	0.46 [-.15, 1.07]
Hake & Zane, 1981	Cash	Fixed	Gasoline conservation	0.37 [-1.03, 1.77]	0.44 [-.96, 1.84]
Hake & Zane, 1981	Cash	Fixed	Gasoline conservation	-0.07 [-1.46, 1.32]	0.30 [-1.09, 1.69]
Jacobs et al., 1982	Coupons	Fixed	Carpooling	0.29 [.13, .45]	N/A

Jacobs & Bailey, 1982	Lottery	Variable	Paper recycling	1.37 [1.01, 1.73]	N/A
Jacobs & Bailey, 1982	Cash	Fixed	Paper recycling	0.57 [.14, 1.00]	N/A
Katzev & Bachman, 1982	Free tickets and coupons	Fixed	Public transportation	0.65 [.15, 1.15]	0.22 [-.26, .70]
Katzev & Johnson, 1984	Rebates	Fixed	Energy conservation	0.09 [-.63, .80]	N/A
Katzev & Johnson, 1984	Rebates	Fixed	Energy conservation	-0.09 [-.83, .65]	N/A
Katzev & Pardini, 1988	Coupons	Fixed	Paper recycling	0.56 [-.17, 1.29]	0.39 [-.33, 1.11]
Katzev & Pardini, 1988	Coupons	Fixed	Paper recycling	0.00 [-.72, .72]	0.39 [-.34, 1.10]
Koford et al., 2012	Cash	Fixed	Plastic, glass and paper recycling	0.20 [-.42, .82]	N/A
Koford et al., 2012	Cash	Fixed	Plastic, glass and paper recycling	-0.07 [-.69, .55]	N/A
Koford et al., 2012	Cash	Fixed	Plastic, glass and paper recycling	0.03 [-.54, .60]	N/A
Koford et al., 2012	Cash	Fixed	Plastic, glass and paper recycling	-0.03 [-.60, .54]	N/A
Mayer & Geller, 1982	Lottery	Variable	Biking	N/A	0.33 [.05, .61]
McClelland & Cook, 1980	Competition	Fixed	Gasoline conservation	0.16 [-.02, .34]	N/A
Meneses & Palacio, 2003	Lottery	Variable	Recycling	0.15 [-.10, .40]	N/A
Mizobuchi & Takeuchi, 2012	Rebates	Fixed	Energy conservation	0.61 [.06, 1.16]	N/A
Van Houtven & Morris, 1999	Avoiding a fee	Fixed	Recycling	0.35 [.05, .65]	N/A
Walker, 1979	Lottery	Variable	Energy conservation	0.15 [-.06, .36]	N/A

Winett & Nietzel, 1975	Cash	Fixed	Energy conservation	N/A	.57 (-.15, 1.29)

Note. Because all of the studies except Van Houtven and Morris (1999) used positive rather than negative, reinforcement, this feature of each intervention is not noted in the table; N/A = no effect size for that time point.

Table 2

Effect sizes by type of incentive

	When incentive was in place						After incentive had been removed					
	k	*N*	d_+	*95% CI*	*Q*	I^2	*k*	*N*	d_+	*95% CI*	*Q*	I^2
Cash	7	276	.20	-.04 to .44	4.71	0%	3	47	.50	-.08 to 1.08	0.12	0%
Fine/fee	1	168	.35	.05 to .66	N/A	N/A	-	--	--	----------	---	-
Lottery	4	760	.35	.20 to .49	37.05***	92%	2	209	.35	.08 to .63	0.34	0%
Contest	1	500	.16	-.02 to .34	N/A	N/A	-	--	--	----------	---	-
Coupon	4	672	.31	.16 to .46	4.31	30%	2	60	.39	-.12 to .90	0.00	0%
Reimbursement or rebate	4	128	.39	.04 to .75	5.21	43%	-	--	--	----------	---	-
Ticket	2	75	.59	.13 to 1.05	0.21	0%	5	317	.49	.26 to .71	0.89	0%
More than one incentive	2	466	.38	.18 to .59	1.34	25%	1	68	.22	-.26 to .70	N/A	N/A

Note. *N* = sample size, *k* = number of independent tests, d_+ = effect size, *95% CI* = 95% confidence interval, *Q* = homogeneity statistic, I^2 = percentage of effect due to heterogeneity, N/A = insufficient tests to compute statistic.

Table 3

Effect sizes by target proenvironmetal behavior

	When incentive was in place						After incentive had been removed					
	k	*N*	d_+	*95% CI*	*Q*	I^2	*k*	*N*	d_+	*95% CI*	*Q*	I^2
Recycling plastic, glass, and aluminum	1	168	.35	.05 to .66	N/A	N/A	-	--	--	----------	---	-
Recycling Paper	4	293	.67	.07 to 1.27	15.67**	81%	2	60	.39	-.13 to .90	0.00	0%
Recycling more than one material	6	744	.20	.05 to .34	3.10	0%	-	--	--	----------	---	-
Energy conservation	6	980	.21	.03 to .39	6.71	26%	1	31	.57	-.15 to 1.29	N/A	N/A
Public transportation use	4	155	.67	.35 to 1.00	1.76	0%	6	385	.44	.24 to .64	1.86	0%
Carpooling	1	600	.29	.13 to .45	N/A	N/A	-	--	--	----------	---	-
Efficient driving behavior	3	31	.16	-.55 to .87	0.19	0%	3	31	.50	-.21 to .12	0.17	0%
Biking/walking	-	--	--	----------	---	-	1	194	.33	.05 to .61	N/A	N/A

Note. *N* = sample size, *k* = number of independent tests, d_+ = effect size, *95% CI* = 95% confidence interval, *Q* = homogeneity statistic, I^2 = percentage of effect due to heterogeneity, N/A = insufficient tests to compute statistic.

Table 4

Effect sizes by target behavior category

	When incentive was in place						After incentive had been removed					
	k	*N*	d_+	*95% CI*	*Q*	I^2	*k*	*N*	d_+	*95% CI*	*Q*	I^2
Recycling	11	1,205	.35	.09 to .60	40.43**	75%	2	60	.39	-.13 to .90	0.00	0%
Energy Conservation	6	980	.21	.03 to .39	6.71	26%	1	31	.57	-.15 to 1.29	N/A	N/A
Travel Behavior	8	1,135	.38	.22 to .50	6.52	0%	10	610	.41	.25 to .57	4.97	0%

Note. *N* = sample size, *k* = number of independent tests, d_+ = effect size, *95% CI* = 95% confidence interval, *Q* = homogeneity statistic, I^2 = percentage of effect due to heterogeneity, N/A = insufficient tests to compute statistic.

Table 5

Effect of cash versus non-cash incentives on recycling, energy conservation, and travel behaviors when the incentive was in place and after it had been removed

	Cash					Non-cash				
	N	*k*	d_+	*95% CI*	*Q*	*N*	*k*	d_+	*95% CI*	*Q*
When incentive was in place										
Recycling	899	8	.38	.05 to .71	35.08***	306	3	.17	-.05 to .40	1.34
Energy Conservation	352	1	.15	-.06 to .36	N/A	628	5	.29	-.03 to .60	6.53
Travel Behavior	380	3	.16	-.55 to .87	0.19	755	5	.49	.22 to .76	6.02
After incentive had been removed										
Recycling	--	-	--	---------	---	60	2	.39	-.13 to .90	0.00
Energy Conservation	31	1	.57	-.15 to 1.29	N/A	--	-	--	---------	---
Travel Behavior	31	3	.50	-.21 to 1.22	0.17	579	7	.40	.24 to .57	2.25

Note. *N* = sample size, *k* = number of independent tests, d_+ = effect size, *95% CI* = 95% confidence interval, *Q* = homogeneity statistic, N/A = insufficient tests to compute statistic.

Figure 1

Flow of information through the phases of the present review

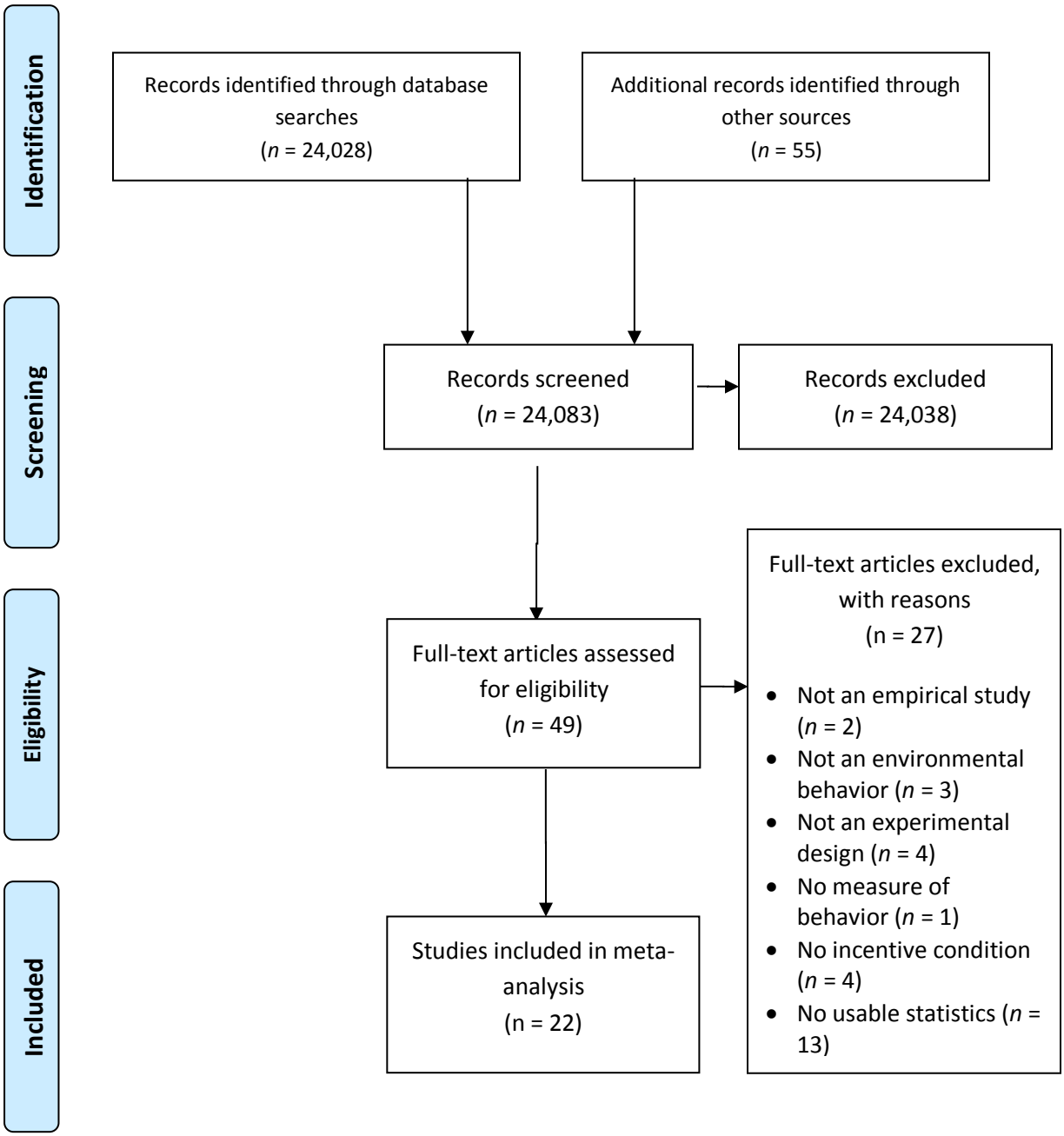
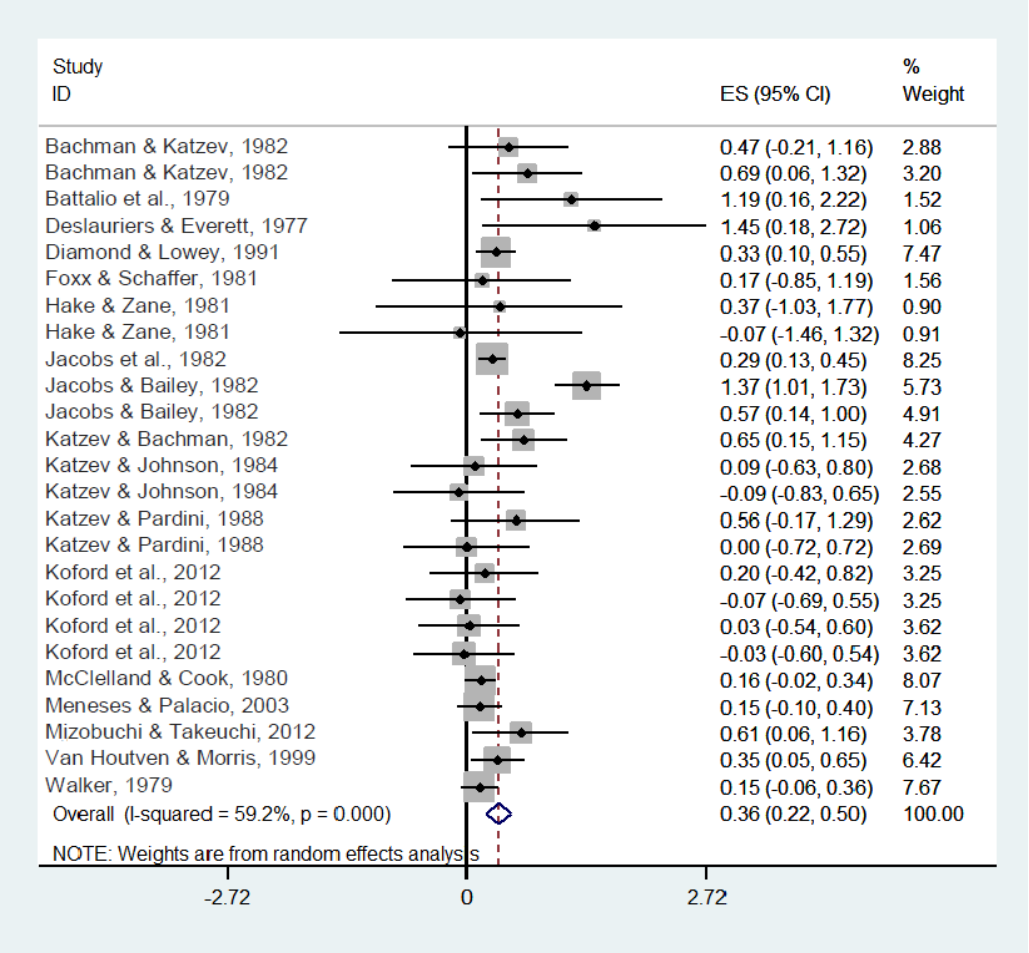


Figure 2

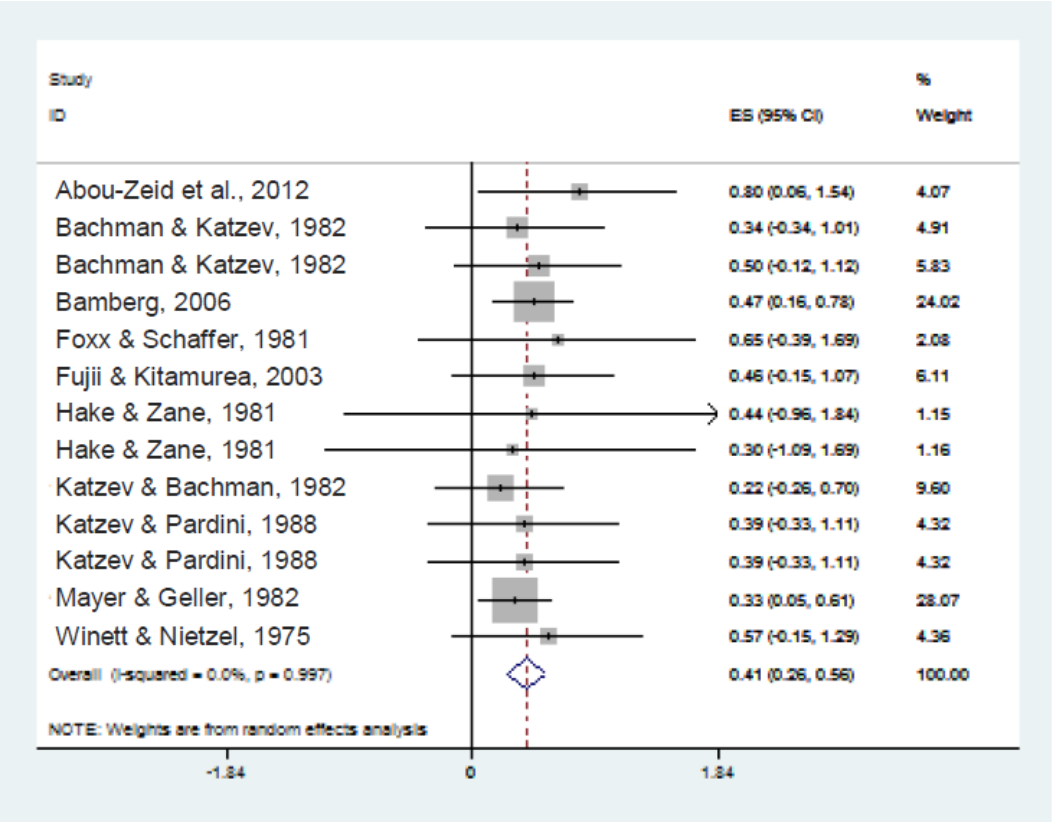
Forest plot of effect sizes, considering the effect of incentive interventions on proenvironmental behaviors when the intervention was in place



Note. ES = effect size, *CI* = confidence interval.

Figure 3

Forest plot of effect sizes, considering the effect of incentive interventions on proenvironmental behaviors after the intervention had been removed



Note. ES = effect size, *CI* = confidence interval.