Numeracy and the Strength of Monetary vs. Non-Monetary Incentives on Effort

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Author Note

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Abstract

Traditionally, monetary incentives (such as paychecks and bonuses) have been one of the primary methods companies use to show their employees that the work they do is valued. Generally, past research has found that money tends to result in higher performance than non-monetary, tangible incentives (e.g., a meal, gift, etc.). More recent research has found that in some settings, a monetary incentive is less motivating to workers' effort and productivity than a non-monetary incentive of equal value. However, there is reason to believe that non-monetary incentives may not influence everyone equally. Differences could be due, in part, to objective numeracy, defined as the ability to understand and use probabilistic and other mathematical concepts. Based on prior research, I hypothesized that those who test higher in objective numeracy and who receive a high amount of a monetary incentive would be, across all conditions, the most motivated to put effort into the clerical task than those lower in objective numeracy. The proposed study examined the effects of objective numeracy and incentive level (low or high) and type (monetary or non-monetary) on effort exerted to perform a clerical-like task. I found that incentive level and incentive type interacted in an unexpected way to predict effort. In particular, participants who received the low amount of the monetary incentive attempted significantly more effort task items than those who received the high amount of the monetary incentive; effort did not differ by amount in the non-monetary incentive condition. This effect was not moderated by the participant's level of objective numeracy. Our results suggest that high amounts of a monetary incentive can be de-motivating irrespective of numeracy.

Keywords: Effort, incentives, numeracy

Context

Since the Industrial Revolution, companies and firms have relied primarily on monetary means to keep employee job satisfaction and productivity high, on the assumption that this economic exchange produces the highest amount of motivation (Bonner & Sprinkle, 2002). However, in the 1920s and 1930s, a series of studies focused on employee productivity at the Western Electric Company in Chicago, Illinois demonstrated that the most important factor behind the continuous increase in work output was not the lighting in the facility or the amount of break time, but it was the improved personal relations between workers and management (Wickström & Bendix, 2000). These studies fundamentally changed the way companies viewed their employees and brought to light the idea that, in order to have a high work output, employees needed to be treated as people and not machines. For the first time, employees' attitudes and opinions toward their job were taken into account and subsequently altered how the companies were operated. Since then, companies' interest in their employees' job satisfaction and well-being has not only increased but has provided large and small companies alike with a different way of viewing their company's goals, values, and intended image (Helm, 2011). While aspects of firms have evolved over time, one has remained constant: employee incentives. Monetary incentives (such as paychecks and bonuses) have been the primary method companies use to show their employees that the work they do is valued (Bonner & Sprinkle, 2002).

However, do traditional paychecks truly motivate employees to perform their best in the workplace? Recent research has found that sometimes monetary incentives are significantly less motivating to worker productivity than non-monetary incentives of the same value such as gifts, candy, or restaurant coupons (Heyman & Ariely, 2004). Non-monetary incentives differ from monetary incentives in that they are non-numeric and are more representative of a "gift" exchanged between two individuals that can ultimately benefit the social relationship between the two of them, such as that between firms and employees. Choosing between rewarding one with monetary versus non-monetary incentive is also prevalent in everyday life situations. For example, imagine you are invited to a friend's house for dinner. You wish to be a good guest and consider two options to repay your gracious host: (1) give them a $50 bill upon arriving; or (2) give them a bottle of good wine worth $50. The former is socially taboo and will most likely make for an awkward evening, whereas the latter will provide your host with a pleasant surprise adding to the evening's enjoyment. This example demonstrates the difference between gifts and money in terms of social relationships. When one needs a friend to help them move furniture, you offer to buy them dinner, not to give them the equivalent amount of money; the dinner fosters the social relationship between the two individuals. Similar to this idea, a study looking at non-monetary incentives in the workplace found that some were willing to sacrifice monetary earnings and were willing to exert more effort while in the presence of friends (Bandiera et al., 2010). Overall, the net effect of non-monetary incentives on the firm's performance was positive.

Background

Research comparing the effectiveness of monetary and non-monetary incentives is becoming increasingly prevalent. Heyman and Ariely (2004) proposed that monetary and non-monetary factors are key components relating payment to effort. In one their studies, participants were tasked to drag a ball into a box that was on the opposite side of the computer screen. Participants repeated this task as many times as possible within a three-minute time period. Heyman and Ariely (2004) manipulated both the size (high versus low) and type (money versus jelly beans) of payment. Those who received a low amount of the monetary incentive

($0.10) exerted significantly less effort across all conditions. Those who received a low amount of the non-monetary incentive (5 jelly beans), the high amount of the monetary incentive ($4.00), the high amount of the non-monetary incentives (8 oz bag of jelly beans), as well as those in the control condition all showed comparable levels of effort. This research demonstrates that those who received a low amount of non-monetary compensation for their work exerted significantly more effort than those who received a low amount of a monetary incentive, despite similar cash values of the two incentives. These studies suggest that non-monetary rewards may not be as detrimental to effort when compared to monetary rewards, at least at low values. Additionally, other research has found participants who were incentivized with a five-euro bill folded into an origami shirt and a two-euro coin glued to it (mimicking a button), entered, on average, 23% more characters during their tasks than those participants who received a standard monetary compensation of seven euros (Kube et al., 2012). Although the origami shirt was still monetary-based, this reward demonstrated that significantly more time and effort invested by the giver led to higher productivity of the receiver, when holding constant the monetary value of the incentives.

However, there may be reason to believe that non-monetary incentives do not necessarily influence everyone equally. Higher objective numeracy, defined as the ability to understand and use probabilistic and other mathematical concepts (measured with a math test), has been found to correlate with more normative or rational decision making (Peters et al., 2006; Cokely & Kelley, 2009; Pachur & Galesic, 2013). Those higher in objective numeracy have been found to make more optimal choices, consistent with the numbers, compared to those lower in objective numeracy.

Although we are beginning to understand how the basic underlying mechanism of non-monetary incentives can sometimes be more motivating than monetary incentives, little research has investigated how these incentives motivate employees differing in numeric ability. If companies begin to use this information in their reward systems, then they should not necessarily assume this change is going to increase effort equally for all individuals. In particular, the highly numerate tend to derive more meaning from numbers and numeric comparisons when compared to the less numerate and then rely on that greater meaning in judgments (Peters et al., 2006). Additionally, the highly numerate also appear to have better numeric memory which facilitates the evaluation of current numeric information with past experience with numbers (Garcia-Retamero & Galesic, 2011). These findings suggest that more highly numerate individuals may be more likely than those who are less numerate to compare and contrast numbers in such a way that they derive more evaluative meaning from these comparisons, and use numeric information more. Although participants in this study are not aware of the other incentive conditions, could evaluate the incentives relative to a past experience.

In contrast, the less numerate appear more likely than the highly numerate to use nonnumeric information instead of numeric information (Peters et al., 2009). Nonnumeric sources are more influential when numeric information lacks evaluative meaning (Kahneman, 2003), and the less numerate are chronically less likely to derive evaluative meaning from numeric information. For example, in one experiment, the highly numerate were more impacted by the probabilities of an event occurring (a terrorist attack) than the clarity of a verbal report regarding the event; whereas the less numerate were more impacted by the clarity of the report than the probabilities (Dieckmann et al., 2009). These findings suggest that those higher in objective numeracy rely on numeric information more, thus supporting the idea that they would respond more strongly to money than non-monetary incentives.

Monetary incentives have also been shown to increase task performance for those higher in objective numeracy. A study found that the use of monetary incentives increased performance in a comprehension-related task for those higher in numeracy and did not for those lower in numeracy (Rommel et al., 2017). Although this was not compared to a non-monetary incentive as in the current study, it does lend credence to the idea that those higher in objective numeracy will produce more effort in the face of monetary incentives as compared to the less numerate.

With this prior research in mind, one could begin to imagine how monetary incentives may be better at motivating effort than non-monetary incentives for those higher in objective numeracy. Certain vocations, such as accountants or engineers, inherently require a higher level of mathematical comprehension, so it stands to reason that employees in these fields would register higher in objective numeracy. In the real world, companies adopting the use of non-monetary incentives may be under-motivating their employees who work in accounting or the engineering department. From an academic standpoint, the current research may fail to account for individual differences in employee numeracy and may hinder our understanding of individual motivational differences. Research on this topic can bring to light a more comprehensive view of what incentives will help employees feel greater meaning and happiness from their work, and thus, more efficient and productive. If employees are not sufficiently motivated by the incentives provided to them, then effort, motivation, morale, and worker productivity can suffer as a consequence, thus decreasing the economic efficiency of firms (Vosloban, 2012).

Present Research

The aim of this study is to understand whether numeracy relates the effects of non-monetary and monetary incentives on effort and motivation while completing a clerical-like task similar to one experienced in a workplace environment. I hypothesize that those higher in objective numeracy will be more motivated by higher amounts of monetary incentives than those lower in objective numeracy. Based on this hypothesis, I also predict that those higher in objective numeracy will be less motivated by a low monetary incentive than those who are lower in objective numeracy. Therefore, those who are higher in objective numeracy will put more effort into and thus be more motivated by a higher level of payment. As presented in the previous section, much of the current research has shown that, at low incentive amounts, non-monetary incentives are more motivating and prompt higher levels of productivity than monetary incentives. Ultimately, the purpose of this study is to gain better insight into how employee effort in response to incentives relates to numeric ability.

Methods

Participants

Undergraduate students (*N*=214) from The Ohio State University participated in the current study and received class credit for their participation through the Research Experience Program (REP). In addition to course credit, participants received a monetary or non-monetary incentive with either a $6.00 or $0.50 value.

Procedure

Participants were randomly assigned to the cells of a 2 (monetary vs. non-monetary incentives) × 2 (low vs. high level of payment) between-participants experimental design. Participants completed the study in small sessions of up to five people in our computer lab. After providing consent, participants completed a baseline round of the effort measure. They were then shown a screen indicating what incentive they would receive. At the same time, the experimenter placed the appropriate incentive on the participant's desk and told the participant they could continue with the study. After receiving the incentive, participants completed the effort measure a second time. Finally, participants completed tests for objective numeracy and then subjective numeracy.

Incentive Conditions

In order to keep participants blind to other conditions, assignment to incentive condition was conducted at the session level rather than at the individual level. Sessions were randomly selected to receive either money or Jelly Belly jelly beans. Each form of payment had a low ($0.50 in the monetary condition or a 0.35 oz bag of jelly beans in the non-monetary condition) and a high level ($6.00 in the monetary condition or a 7 oz bag of jelly beans in the non-monetary condition).

Measures

Effort Measure

At baseline and after receiving the incentive, participants completed the measure of effort. This measure was loosely based on the unique class schedules task (Earley & Kanfer, 1985) in which participants were tasked with scheduling five courses that did not conflict with each other from a list of eight courses that had ten sections each. The unique class schedules task relies heavily on numeric information, so I came up with non-numeric versions for my effort task. I was concerned that a numeric task would advantage the highly numerate, thus making it difficult to determine whether a difference in effort was due to the task or the incentive. Like the unique schedules task, the effort task I developed is similar to logic puzzles in that participants are given a set of premises (i.e., a set of skills, tasks, items, etc.) and must offer a solution that satisfies the premises. Each round of my task consisted of a series of 15 scenarios. Each of these scenarios had groups of three, five, or seven people with unique attributes that had to be accommodated when assigning groups of peoples to tasks or schedules. These included scheduling five employees who each had two days of availability to cover five days' worth of shifts (see Figure 1), assigning paint colors to three children based on one to two of their favorite colors, assigning research tasks to five research assistants based on their two skills, and assigning party supplies to be purchased by seven neighbors based on one or two liked or disliked items.

Responses could be coded in multiple ways, including number of scenarios completed, number of people assigned (i.e., items), or number of scenarios or individual items completed correctly. I used number of items attempted regardless of correctness. For example, if a participant incorrectly responded to an individual item but still responded, I coded that as a completed item. I chose this approach because number of items is a better measure of the amount of effort participants exerted, which was the primary focus of my hypotheses. In contrast, performance is a function of effort and ability. Incentives cannot realistically improve ability in a single experimental session. Instead, incentives tend to improve performance when worse performance is due to lack of effort than ability (Deci, Koestner, & Ryan, 1999). Thus, I expected stronger effects on number of items completed than number of scenarios completed correctly.

I also examined correctly answered scenarios out of the 15 possible as a measure of performance. If a participant incorrectly responded to any item within a scenario, the entire scenario was scored as incorrect, which penalized partial completion. Thus, trial performance was not a good measure of effort in that not every question was accounted for, but because performance should be improved by increased effort, I examined it in addition to number of items attempted (effort).

When looking at the effects of condition and numeracy on post-incentive effort, the primary dependent variable consisted of the difference scores for the number of items attempted from the baseline to the post-incentive round of the effort task. The difference scores allow us to look at the change between the two rounds of the effort task which permits us to directly examine the difference between baseline and post-incentive effort.

Objective Numeracy Scale (ONS)

Participants responded to seven free-response items designed to measure objective numeracy (modified from Cokely et al., 2012 and Lipkus et al., 2001). An example question is “Imagine that we roll a fair die (6 sides) 100 times. What is your best guess about how many times the die would come up as a number that can be divided evenly by 3?” This scale has been frequently used in studies to investigate relations with objective numeracy (Peters & Bjälkebring, 2015).

Subjective Numeracy Scale (SNS)

The subjective numeracy scale is a self-reported measure of a participant’s mathematical ability and preference for using numbers (Fagerlin et al., 2007). An example question is “How good are you at figuring out how much a shirt will cost if it’s 25% off?” Items are assessed on a 1-6 scale. Responses to 8 items were averaged together to develop a subjective numeracy score.

Although my hypotheses were focused on objective numeracy, I also measured subjective numeracy for exploratory analyses and to examine whether there were separable effects of subjective versus objective numeracy on effort or performance (Peters & Bjälkebring, 2015).

Results

I removed three participants for failure to follow instructions throughout the study and one participant who experienced complications with the internet connection, which left 214 participants for current analyses.

Demographics

The average age of participants who participated in this study was 19 (SD = 2.41) years old. The participants were 56.5% male, 69.2% White or Caucasian, 18.7% Asian, 8.4% Black or African American, 5.1% Hispanic, 0.5% American Indian, and 1.9% of participants selected more than one racial identity.

Analyses Overview

The following analyses use both number of items attempted and trial performance as the primary dependent variables. For each of these dependent variables, the analyses first examine baseline effort task effects using ANOVA and then post-incentive effort task effects using GLM. For the analyses looking at the post-incentive effects for both effort and trial performance, a difference score between these two dependent variables' baseline and post-incentive measures was used to assess improvements in effort and performance.

Effort

For the following analyses, I used number of individual items attempted as the dependent variable. The number of items attempted for each question was determined by the number of individual blanks completed by a participant, regardless of correctness. Since the effort task was relatively simple, the average performance for both the baseline and post-incentive rounds was above 90% for the number of items attempted.

Baseline Effort

To be sure that post-incentive differences on effort were not due to failure of random assignment, I examined the effects of condition on baseline effort. A 2 (incentive type: jelly bean or money) × 2 (incentive level: low or high) ANOVA showed no interaction between incentive level and incentive type ($F_{1,210} = .363$, $p = .548$) and no significant main effects of incentive type ($F_{1,210} = 1.10$, $p = .295$) or incentive level ($F_{1,210} = .848$, $p = .358$). Thus, there was no significant effect of condition at baseline.

Post-Incentive Effort

To see the effect of the incentive on effort, I used GLM with difference scores for the number of attempts from the baseline measure to test for the predicted interaction of objective numeracy, incentive type, and incentive level. This interaction was nonsignificant and was removed from the model. What remained was a significant interaction between incentive level and incentive type (see Table 1; Wald $\chi 2 = 4.670$, $p = .031$).

To decompose the interaction, I conducted a 2 (incentive level) × 2 (incentive type) ANOVA on the difference score in effort. There was also a level × type interaction ($F_{1,210} = 4.582$, $p = .033$). There were no significant main effects of incentive level ($p = .213$) or incentive type ($p = .957$). Examining the simple effects of incentive level (high versus low) and incentive type (monetary versus non-monetary), demonstrated that the interaction was driven by the difference in effort produced by incentive level for the monetary incentive ($F_{1,210} = 5.795$, $p = .017$) but not the non-monetary incentive ($p > .500$). The simple effects for low vs. high incentive were opposite in direction, but not significant. These results unexpectedly suggest that the high amount of the monetary incentive ($M = 3.02$, $se = .95$) may have been de-motivating to participants when compared to the low amount of the monetary incentive ($M = 6.20$, $se = .92$). In contrast, Heyman and Ariely (2004) found the low monetary incentive produced lower effort levels. Similarly, a 2 × 2 ANCOVA with post-incentive effort as the dependent variable with baseline effort as a covariate showed the same interaction ($F_{1,210} = 4.210$, $p = .041$). Exploratory analyses with subjective numeracy as the primary numeric measure in place of objective numeracy similarly showed effects of incentive that were not moderated by subjective numeracy.

Trial Performance

Although performance was not the focus of the aforementioned hypotheses, it should nevertheless be related to effort and therefore be affected by numeracy and incentives. I conducted analyses with performance as the primary dependent variable in exploratory analyses.

Baseline Performance

First, I conducted a 2 (incentive type: monetary versus non-monetary) × 2 (incentive level: high versus low) ANOVA which revealed no significant interaction between incentive type and incentive level ($F_{1,210} = .815$, $p = .368$) and no significant main effects of incentive type ($F_{1,210} = .815$, $p = .368$) or incentive level ($F_{1,210} = 1.701$, $p = .194$). Thus, there was no significant effect of condition at baseline.

Post-Incentive Performance

Consistent with my analyses for Time 2 with number of attempts as the dependent variable, I computed difference scores to look at the difference between Time 1 and Time 2 trial performance. After running a regression analysis and reducing the model by deleting non-significant effects one at a time and rerunning the model after each deletion, the two-way interaction of incentive type by incentive level that I found for effort was not significant (Wald $\chi 2 = 2.696$, $p = .101$). In fact, there were no significant effects of numeracy, incentive level, incentive type, or their interactions on performance (*p*’s > .10). Regardless of whether the dependent variable was number of attempts or performance, there was still a similar effect of incentive type by incentive level. Similar to number of attempts, exploratory analyses of subjective numeracy showed no significant effects.

Discussion

In this experiment, I explored the idea that objective numeracy might affect the extent to which people are motivated by incentives varying in type and amount. Contrary to my expectations, objective numeracy did not interact with incentive level or type. Instead, I found that those who received a monetary incentive completed fewer blanks in the high amount ($6.00) condition as compared to the low amount ($0.50), which suggests that the participants may have found a large incentive demotivating.

It is not entirely clear why our results were so different from previous results, but several possibilities exist. To begin, our incentive context differed from the prior study. In Heyman and Ariely's (2004) study, participants did not receive course credit for their participation. Therefore, they may have anticipated receiving some form of payment following their completion of the study and been insulted by the low amount of incentive. Because I used REP participants, my participants were already receiving course credit and did not anticipate any additional reward. In fact, I had to make changes to my method to convince them they were in fact receiving an additional incentive. At the beginning of data collection, I noticed that many of the participants seemed surprised that they were receiving the incentive the computer screen indicated to them that they would be receiving. In order to resolve this issue, I altered the instructions so the experimenter had to place the incentive on the participant's desk directly following the participant seeing the screen that indicated to them what incentive they would be receiving. This guaranteed that participants believed they were receiving an incentive during the experiment. As a result, any form of a reward could have improved my participants' effort on the task and they may not have found the low amount of incentive insulting. There is also the possibility that because the monetary and non-monetary incentives could have been considered out of the norm, they did not affect effort for the task because the behavior was not being controlled by a reward (Deci, Koestner, & Ryan, 1999). Thus, participants may have been completing the study as if there were no additional external motivators. This could provide support for the fact that, contrary to my hypotheses, none of the conditions showed a decrease in effort from the baseline to the post-incentive round of the effort task. However, a difference in norms would not lead to the high amount of the monetary incentive being de-motivating.

Another possibility is that participants may have made inferences about how enjoying the task was from the incentive. People regularly make inferences based on monetary values (e.g., inferring quality from price, Bagwell & Riodan, 1991; Cronley et al., 2005, Rao & Monroe, 1989; Deval et al., 2012). Similarly, in the context of an experiment, participants may infer the unpleasantness of a task based on how much money they received to complete it. If a participant received a high monetary incentive, than they may have inferred that the task was extremely mundane, thus making an inference on quality based on price. However, participants in the high monetary condition did exert more effort relative to baseline rather than less; they simply increased less than those who received the small incentive.

This finding is consistent with prior research also demonstrating that high monetary incentives can be de-motivating (Deci, 1971; Lepper, Greene, & Nisbett, 1973). This effect may be due to a decrease in intrinsic motivation when the high amount of the monetary incentive is presented. If participants are being paid high amounts of money to perform a task, they may reevaluate the task from one which is motivated by genuine interest to one that is motivated by the expectation of monetary rewards. In the context of this study, participants who were inherently interested in the task during the baseline measure may have lost some of their interest in the second round after receiving the high amount of the monetary incentive. I am interested in more closely examining this idea as it may turn out that this effect is present in an individual regardless of their numeric ability.

In future research, we may explore the effects of objective numeracy, subjective numeracy, and incentive type on affective reactions to the task and choice of incentive. From an employers' standpoint, it may be disappointing to hear there was no effect of incentive on performance. While performance is a function of both effort and ability, incentives tend to only improve effort. However, incentives may also improve employee satisfaction if they receive the incentives they prefer. Although the effect of incentive and numeracy may not have been pronounced in task performance, they may have an effect on one's satisfaction with an incentive (Shaffer & Arkes, 2009). When participants in Shaffer and Arkes's study were given a choice between a monetary reward or non-monetary reward, they tended to choose a monetary reward. However, when they rated the two types of rewards separately, participants gave higher ratings to the non-monetary reward. Critically, they did not find any effects on effort or performance. Thus, preferences for type of incentive may be a better avenue to explore the effects of objective and subjective numeracy.

Although those using incentives could find that higher amounts of a monetary reward de-motivate those being rewarded, more research is needed in this area. However, if true, this could provide insight for managers who want to most optimally reward their employees while also promoting efficiency and overall workplace satisfaction.

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Below is the work availability of a lab's research assistants. Due to the nature of the schedule, no two research assistants can work on overlapping days. According to the list of availability, choose the most optimal day for each research assistant to work.

Research Assistant	Available Days
Sara	Monday, Tuesday
Donna	Wednesday, Friday
Abby	Tuesday, Thursday
Adam	Monday, Thursday
Tom	Wednesday, Friday

Type the name of the research assistant next to the appropriate day.

Monday

Tuesday

Wednesday

Thursday

Friday

Figure 1. Sample question for effort task.

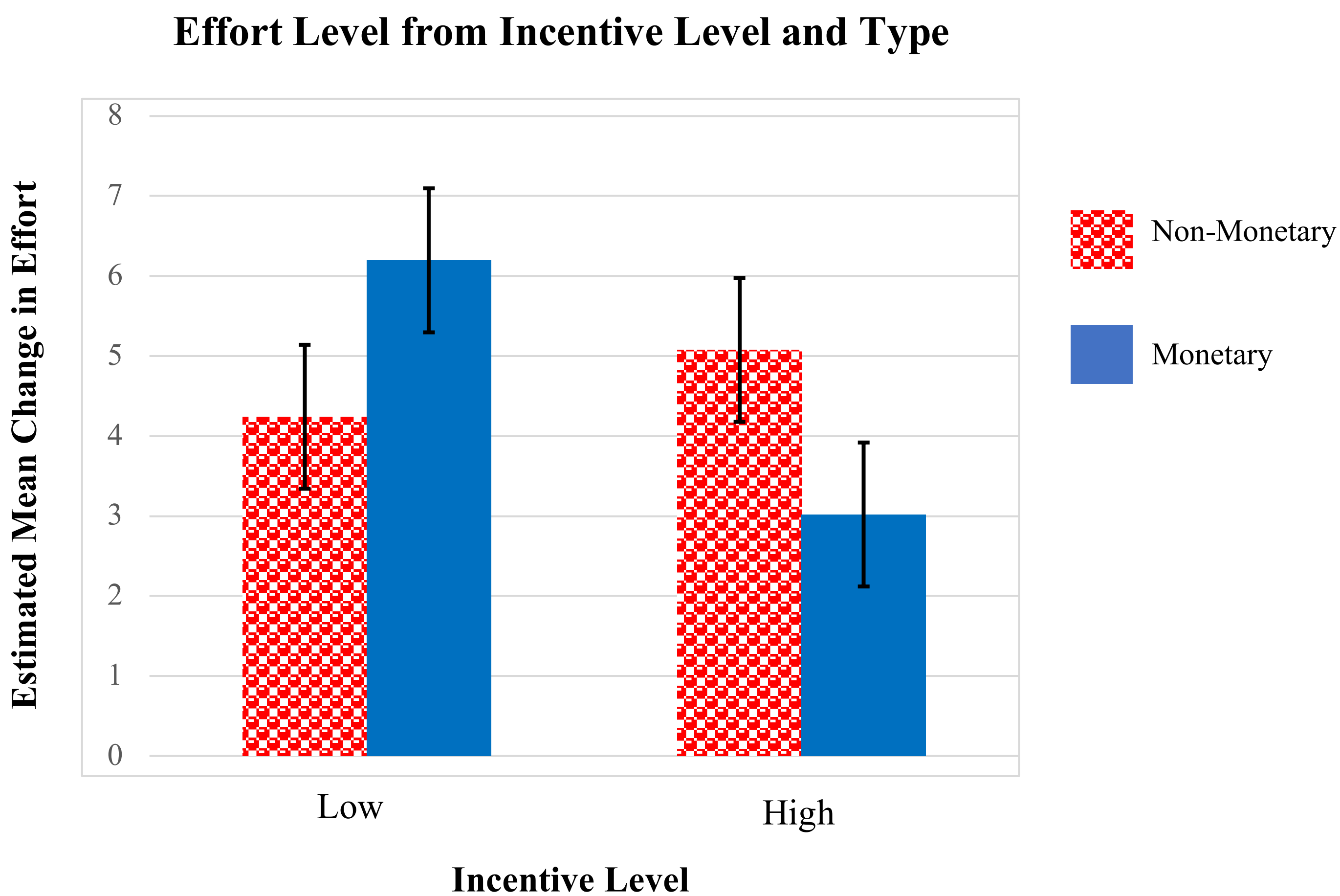

Figure 2. Estimated mean change in effort levels (Time 2 – Time 1) predicted from level of incentive (high or low) and type of incentive (monetary or non-monetary). Error bars are standard errors from the mean.

Table 1. Full and final regression models (unstandardized coefficients with standard errors in parentheses) predicting items completed in effort task (N=214).

	Full model			Final model		
Variables	***unstd b (SE)***	***Wald*** $\chi 2$	***p***	***unstd b (SE)***	***Wald*** $\chi 2$	***p***
Intercept	4.40** (0.92)	22.77	.000	4.24** (0.92)	21.07	.000
Objective Numeracy	0.89 (0.67)	1.75	.186			
Subjective Numeracy	0.77 (0.58)	1.75	.186			
Incentive Type	2.09 (1.33)	2.47	.116	1.96 (1.29)	2.28	.131
Incentive Level	0.67 (1.31)	0.26	.608	0.84 (1.32)	0.40	.526
Interaction (Incentive Type × Incentive Level)	-4.14* (1.88)	4.86	.027	-4.01* (1.86)	4.67	.031
Interaction (Objective Numeracy × Incentive Type)	-1.54 (0.98)	2.47	.116			
Interaction (Objective Numeracy × Incentive Level)	-1.12 (0.92)	1.49	.223			
Interaction (Objective Numeracy × Incentive Type × Incentive Level)	2.11 (1.34)	2.47	.116			

Note. For incentive type, 0 = non-monetary, 1 = monetary. For incentive level, 0 = low, 1 = high. Objective numeracy and subjective numeracy are continuous variables. *p<.05 **p<.001