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I am submitting herewith a dissertation written by Briana Hautau von Mizener entitled "The Effects of Choice and Reward Conditions on Math Performance and Voluntary Engagement in Math Activity." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Education.

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THE EFFECTS OF CHOICE AND REWARD CONDITIONS ON MATH
PERFORMANCE AND VOLUNTARY ENGAGEMENT IN MATH ACTIVITY

A Dissertation Presented for the Doctor of Philosophy Degree
The University of Tennessee, Knoxville

Briana Hautau von Mizener
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DEDICATION

This dissertation is dedicated to my husband, family, and friends who have stood by me through many endeavors. Their encouragement and unconditional support mean the world to me.

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Abstract

The study examined the effects of two conditions—task choice and reward—on 1) performance during a treatment phase and 2) performance and voluntary engagement after treatment conditions were removed. Voluntary engagement was measured during a continuous-choice activity during which students chose between math tasks and distractor tasks for 10 min. During the treatment phase, students assigned to the Choice conditions were given a choice of math worksheet types, whereas students in the No-Choice conditions were assigned a math worksheet type. Additionally, students worked under either a performance-contingent bonus point condition or a no bonus condition. During treatment, students completed one of two addition worksheets for a 5-min period and answered one question related to perception of choice regarding the task at the end of the assignment. In pretest, posttest, and followup phases, students participated in a 5-min math performance activity and a 10-min continuous-choice activity.

A repeated measures analysis of covariance mixed design (with treatment phases as the repeated measure and choice condition and reward condition as between-subjects variables) was used in the analysis of both math performance and voluntary engagement in math activity. Neither voluntary engagement nor math performance was significantly affected by the treatment conditions. However, visual inspection of plots of the data indicate high levels of voluntary engagement during the posttest phase for students who received both the provision of choice and performance-based bonus points during the treatment phase, followed by students who received the provision of choice with no external reward. Visual inspection indicates that students who received bonus points and no choice of assignments showed the highest levels of performance while treatment

conditions were in place (followed by students who received the provision of both bonus points and choice) and on the short-term posttest measure. The data tentatively suggest an additive effect of bonus points and choice on voluntary engagement measures. Students who received neither the provision of choice nor bonus points displayed the lowest levels of performance on almost all measures.

TABLE OF CONTENTS

Chapter 1	1
Literature Review.....	1
Theoretical Perspectives	1
Research on the Overjustification Effect	9
Choice Research.....	15
The Current Experiment	21
Chapter II	24
Method	24
Participants.....	24
Materials	24
Conditions	26
Dependent Measures	27
Pre-treatment Phase	27
Treatment Phase.....	29
Posttest and Followup Activities	31
Interrater Reliability.....	31
Procedural Integrity	32
Chapter III.....	33
Results.....	33
Preliminary Analyses.....	33
Self-reported Choice	34
Bonus	37
No Bonus	37
Composite	37
Worksheet Type.....	41
Effects of Treatment Conditions on Performance across Time Periods	45
Effects of Treatment Conditions on Performance across Treatment Days.....	46
Effects of Treatment Conditions on Voluntary Engagement.....	50
Correlational Analyses.....	60
Chapter IV	63
Discussion	63
Perception of Choice.....	63
Math Performance.....	64
Voluntary Engagement	66
Overjustification Effect.....	69
Limitations and Future Research	71
Concluding Remarks.....	78
References.....	80
Appendices.....	88
Vita.....	109

LIST OF TABLES

Table 1. <i>Raw Means with (Number of Participants, and Standard Deviations) for Accurate Math Performance in Voluntary Engagement Activities across Continuous-Choice Periods and by Treatment Condition.</i>	37
Table 2. <i>Raw Means with (Number of Participants, and Standard Deviations) for Accurate Math Performance across Performance Periods and by Treatment Condition.</i>	38
Table 3. <i>Percentage of Worksheet Types Chosen and Responses to Choice Questions across Treatment Days and by Treatment Condition.</i>	39
Table 4. <i>Adjusted Repeated Measures Means with (Number of Participants, and Standard Error) for Accurate Math Performance across Performance Periods and by Treatment Condition.....</i>	47
Table 5. <i>Adjusted Repeated Measures Means with (Number of Participants, and Standard Error) for Accurate Math Performance across Treatment Days and by Treatment Condition.....</i>	49
Table 6. <i>Adjusted Repeated Measures Voluntary Engagement Means with (Number of Participants, and Standard Error) for Accurate Math Performance across Continuous-Choice Periods and by Treatment Condition.</i>	53
Table 7. <i>Adjusted Repeated Measures Voluntary Engagement Means with (Number of Participants, and Standard Error) for Digits Attempted across Continuous-Choice Periods and by Treatment Condition.</i>	56
Table 8. <i>Mean Percentage of Students (and valid total number of students) in each Condition who Attempted Any Math Problems during each Continuous-Choice Period.</i>	58
Table 9. <i>Correlations between Continuous-Choice and Performance Measures (and Number of Participants) at each Stage.</i>	61

LIST OF FIGURES

Figure 1. <i>Flowchart of Experimental Phases</i>	28
Figure 2. <i>Raw Voluntary Engagement Means (Number of Digits Correct) across Continuous-Choice Periods and by Treatment Condition</i>	35
Figure 3. <i>Raw Math Performance Means (Number of Digits Correct) across Performance Periods and by Treatment Condition</i>	36
Figure 4. <i>Percentage of Students who Reported Perceived Choice in the Math Activity across Treatment Days and by Treatment Condition</i>	40
Figure 5. <i>Percentage of Students in Choice Conditions who Chose Each Worksheet Type across Treatment Days</i>	42
Figure 6. <i>Relative Performance on Worksheet A and Worksheet B across Treatment Days</i>	44
Figure 7. <i>Adjusted Repeated Measures Math Performance Means across Performance Periods and by Treatment Condition</i>	48
Figure 8. <i>Adjusted Repeated Measures Math Performance Means across Treatment Days and by Treatment Condition</i>	52
Figure 9. <i>Adjusted Repeated Measures Voluntary Engagement Means across Continuous-Choice Periods and by Treatment Condition</i>	54
Figure 10. <i>Adjusted Repeated Measures Voluntary Engagement Means for Digits Attempted with across Time Periods and by Treatment Condition</i>	57
Figure 11. <i>Mean Percentage of Students who Attempted Any Math Problems by Treatment Condition and across Continuous-Choice Periods</i>	59

Chapter 1

Literature Review

A major controversy in education relates to best practices in using extrinsic rewards in the classroom. Researchers and theorists study how best to use extrinsic rewards without undermining intrinsic reinforcement derived from an activity. In some cases, rewards are thought to strengthen behaviors and intrinsic interest, whereas in other instances, providing extrinsic rewards for an activity is thought to weaken continued engagement in that activity, a phenomenon referred to as the overjustification effect.

Theoretical Perspectives

Motivation is a construct that has been studied for centuries. Theorists of both behavioral and cognitive perspectives have defined motivation with respect to its forms and components. Two commonly described forms of motivation are intrinsic and extrinsic. Intrinsic motivation is defined as engaging in an activity because of the inherent satisfaction it brings, whereas extrinsic motivation pertains to engaging in an activity because of some separable outcome (Ryan & Deci, 2000a). Although both extrinsic and intrinsic reinforcement can be valuable, there are purported benefits of intrinsic motivation over extrinsic motivation. In a classroom setting, for example, intrinsic motivation contributes to task engagement that is independent of a teacher's presence or behavior (Williams & Stockdale, 2004).

Intrinsic motivation often has been operationally assessed using "free choice" measures in which research participants have the opportunity to engage in a target task or various distractor activities without extrinsic consequences for their choice (Ryan & Deci, 2000a). For example, researchers have measured motivation for an activity by the

number of seconds the subject(s) spent on the activity versus alternative activities when left alone during a free-choice period (Cameron, Pierce, Banko, & Gear, 2005; Deci, 1971; Vansteenkiste & Deci, 2003). Mcloyd (1979) measured interest in reading by allowing children to choose between reading and other activities (e.g., a scrabble game, a book of crossword puzzles, and a math game book) during a free-choice period. In Mcloyd's study, interest was measured by number of seconds spent reading, number of words read, the child's rating of the fun associated with reading, and the frequency with which the book was first contacted during the free-choice period.

Along with free-choice behavior measurements, such self-report instruments as surveys or inventories are commonly used measures of intrinsic motivation (Cameron, Banko, & Pierce, 2001; Deci, Koestner, & Ryan, 2001). For example, Lepper, Corpus, and Iyengar (2005) measured students' reported intrinsic and extrinsic motivation using Harter's scale of intrinsic versus extrinsic orientation in the classroom. Cordova and Lepper (1996) used three 7-point Likert scale measures to ask students questions about how well they liked the target task overall, how willing they would be to stay during recess or after school to do the task, and how well they enjoyed the task relative to their favorite games and subjects in school. McLoyd (1979) brought students into an experimental room individually to measure initial interest in specific storybooks by asking them to point to the book they would like to read best, followed by second best, and so on, until five books were chosen.

Theorists of both behavioral and cognitive perspectives have attempted to explain how various aspects of rewards can lead to the overjustification effect, as well as what situations and reward conditions can affect intrinsic motivation. Both the nature of and

contingencies attached to rewards may moderate their effects on intrinsic motivation. Reward contingencies relate to what students must do to earn the reward. Specifically, task-contingent rewards are those given for engaging in or completing a given activity without regard to performance or accuracy. Performance-contingent rewards are based on the quality of performance on an activity (e.g., meeting an absolute performance standard, improvement over past performance).

Overall, research has produced mixed conclusions regarding the effects of various reward contingencies on intrinsic reinforcement and voluntary task engagement. One perspective is that rewards have a pervasive negative effect on intrinsic motivation (Deci, Koestner, & Ryan, 1999) whereas another perspective is that these negative effects are very limited (Cameron & Pierce, 1994). Each of these perspectives specifies certain circumstances that allow for the opposite effect. Some theorists (e.g., Deci et al., 2001; Karniol & Ross, 1977) agree that external rewards can have both informational and controlling aspects, with each yielding different effects on intrinsic motivation: (1) the informational aspect enhances intrinsic motivation by conveying self-determined competence, and (2) the controlling aspect undermines intrinsic motivation by decreasing the perception of self-determination. Theorists have differing views regarding which of these aspects is more salient and which is more likely to affect intrinsic reinforcement.

Cognitive explanations. Some cognitive theorists suggest avoiding the extensive use of extrinsic rewards because of negative outcomes on intrinsic motivation. Kohn (1996) recommended “avoiding the use of incentives to control people’s behavior, particularly in a school setting (p. 3).” One explanation used to explain the negative effects of rewards on intrinsic motivation is the control hypothesis. This explanation

proposes that the overjustification effect can occur as a result of perceived loss of control and autonomy caused by external regulation of behavior. Researchers who support this hypothesis (e.g., Deci et al., 2001) have concluded that engagement-contingent, completion-contingent, and performance-contingent rewards all have the potential to significantly undermine intrinsic motivation.

Self-determination theory (SDT) was developed as an explanation for human motivation (Ryan & Deci, 2000b). SDT focuses on three basic psychological human needs: the needs for competence, relatedness, and autonomy (or self-determination) (Deci, Vallerand, Pelletier, & Ryan, 1991). Autonomy refers to self-initiation and self-regulation of one's own actions. Cognitive evaluation theory is considered a subtheory within SDT (Ryan & Deci) and explains the overjustification effect in terms of perception of control by proposing that rewards experienced as controlling undermine feelings of self-determination and intrinsic motivation. A reward may be experienced as controlling "if the activity must be done in some particular way, at some particular time, or in some particular place" in order to receive the reward (Ryan, Mims, & Koestner, 1983, p. 738). This perspective asserts that when an activity is performed for external reinforcement, a person may *cognitively reevaluate* the activity as one that is done for external rather than internal reasons (Deci, 1972).

Various factors are considered when predicting whether a reward will be perceived as controlling or informational and whether it is likely to undermine intrinsic motivation. For example, tangible rewards are considered more controlling than verbal rewards and expected rewards are considered more controlling than unexpected rewards (Deci et al., 2001). Reward contingencies also are considered when predicting the

influence of rewards on intrinsic motivation. Deci (1975) hypothesized that rewards not contingent on performance are less likely to result in a perception that the rewards are the reason for the performance. For example, a study by Deci (1972) indicated that when a tangible extrinsic reward is given contingently it can negatively affect intrinsic motivation, but when given non-contingently has little influence on intrinsic motivation. In other words, when given regardless of performance, external rewards are less likely to be perceived as controlling and are less likely to undermine intrinsic motivation than when given for success at a task. However, it is also widely accepted that the informational aspect of performance-contingent rewards is stronger than that of engagement-contingent or completion-contingent rewards (Deci et al., 1999).

One difficult issue is determining whether various types of reward contingencies are more likely to be interpreted as controlling or informational. Rewards may contain both controlling and informational properties, causing the two processes to work against each other and making it difficult to predict the reward's effect on intrinsic motivation. These cases, therefore, may require other factors (e.g., interpersonal contexts) to be considered (Deci et al., 1999). According to cognitive evaluation theory, performance-contingent rewards have the potential to affect intrinsic motivation positively or negatively depending on whether the individual interprets the reward informationally (as a confirmation of competence) or in a controlling way (Deci et al., 2001). Because of the unique tendency of performance-contingent rewards to contain some informational and some controlling aspects, the effects on intrinsic motivation may be more difficult to predict. Deci (1980) noted that the salience of informational versus controlling aspects of rewards can vary depending on the type of reward and how it is given. Deci et al. (1999)

noted that with performance-contingent rewards, “there is even stronger control – people have to meet some standard in order to maximize rewards – so there is a strong tendency for these rewards to undermine intrinsic motivation (p. 628).” However, these negative effects may be offset if they affirm competence via the information provided (Deci et al., 1999).

Some researchers have attempted to more directly test these self-determination and control hypotheses by studying the effects of external rewards on perceived autonomy and perceived competence. Eisenberger, Rhoades, and Cameron (1999) concluded that externally rewarding students for high performance increases perceived autonomy and intrinsic motivation. However, Houlihan, Koestner, Joussemet, Nantel-Vivier, and Lekes (2002) determined that performance-contingent rewards had a negative impact on affective autonomy (absence of feelings of pressure and tension) but not on decisional autonomy (feelings of choice). Although students in performance-contingent reward conditions tended to report higher levels of perceived competence in this study, they also reported higher levels of anxiety and pressure to perform the task well.

Behavioral explanations. Some theorists propose that task-contingent rewards are more likely to undermine intrinsic reinforcement than performance-contingent rewards because task-contingent rewards do not require success at the task. They further expect performance-contingent rewards to contribute to feelings of self-competence at a task. These theorists (e.g., Boggiano & Ruble, 1979; Arkes, 1978) may support the competency hypothesis, which suggests that rewards contingent on performance provide evidence of success at a task and therefore positively contribute to the task’s intrinsic

reinforcement value, whereas task-contingent rewards are more likely to undermine a task's intrinsic value because they fail to provide this evidence.

One important theoretical issue is whether success at a task is reinforcing. Providing students with performance feedback can be effective in enhancing academic performance in academic areas such as reading (Eckert, Dunn, & Ardoin, 2006) and mathematics (Carson & Eckert, 2003). A meta-analysis addressing the effects of various aspects and methods of instruction indicated a strong relationship between learning outcomes and corrective feedback (Walberg, 1984). Feedback that conveys success at a task is thought to positively contribute not only to performance but also to the intrinsic reinforcement value of the task. This feedback can be provided in many forms (e.g., verbal praise conveying high quality work, high scores or grades on assignments).

In accordance with the competency hypothesis, Karniol and Ross (1977) noted that rewards contingent on performance convey tangible evidence of an individual's success, evidence which should contribute to intrinsic interest in the task. Drew, Evans, Bostow, Geiger, and Drash (1982) concluded that providing privileges for accurate and complete math responding improves performance in math, which in turn may increase interest in math. Schunk (1983) found that performance-contingent rewards, as opposed to task-contingent rewards, promote children's task accomplishments, skill development, and perceptions of efficacy. Schunk suggested that although individuals receiving performance-contingent rewards may perceive those rewards as controlling their behavior, the informational aspect of the reward is likely to be highly salient because the reward is tied to skill development. The conclusions from these studies support the competency hypothesis in that the informational aspect of performance-contingent

rewards is salient and provides competency information that positively affects task interest.

Type of reinforcement schedule is another condition related to continued engagement in an activity after external rewards are removed. Exposure to intermittent or partial reinforcement schedules have been found to increase resistance to extinction more so than continuous reinforcement schedules, a phenomenon that has been termed the partial reinforcement extinction effect (e.g., Lerman & Iwata, 1996; Jenkins & Stanley, 1950). During extinction, behaviors that were continually reinforced decrease more rapidly than those that were intermittently reinforced, perhaps because students realize more quickly that the continuous schedule is no longer in place. This suggests that students who have been intermittently rewarded in the past may engage in activities when no reward is present, but not necessarily without the expectation or hope of a reward. In their review of research, Lerman and Iwata concluded that occasional delay of reinforcement produces greater resistance to extinction and promotes greater stimulus generalization than consistent and immediate reinforcement (Crum, Brown, & Bitterman, 1951). After experiencing these types of learning conditions, a student's engagement in a behavior may still be influenced even when rewards are not visibly present. Additionally, a student may continue to engage in a behavior after external rewards are removed because the behavior continues to be reinforced in conditions where the original reward is not apparent.

Rewards do not affect all students equally because students' history of reinforcement plays a role in the interpretation and reaction to rewards. Pallak, Costomiris, Sroka, and Pittman (1982) asserted "the nature of prior experience with

rewards and reward contingency may affect the relative salience of informational and controlling properties and thereby enhance or undermine intrinsic motivation (p. 1382).”

In the Pallak et al. study, the authors hypothesized that children who have been given systematic experience with rewards as reflections of competence would react similarly to verbal and symbolic rewards (i.e., handwritten award for good behavior), whereas children without this systematic experience would perceive the controlling aspect of symbolic rewards as more prominent. Pallak et al. studied differential reactions of children attending two types of schools having different traditions with respect to use of symbolic rewards: schools that extensively used symbolic rewards for achievement versus those that did not systematically use symbolic rewards for achievement. The findings indicated that whether children have been given systematic experience with rewards in school is an important determinant of students’ reactions to reward characteristics. For example, in schools that made little use of symbolic rewards, providing students expected symbolic rewards undermined intrinsic motivation whereas providing unexpected praise enhanced intrinsic motivation. Children attending schools in which symbolic rewards were used systematically drew pictures longer after receiving expected rewards than unexpected rewards. Thus, the authors hypothesized that the informational aspects of symbolic rewards may be more salient for students who have more often experienced symbolic rewards, whereas the controlling aspects may be more salient for students without such experience.

Research on the Overjustification Effect

The question of whether rewards undermine intrinsic motivation has been the source of continuous debate between researchers. Various factors, such as type of reward

contingency, have been considered when determining whether rewards are likely to negatively affect motivation. The results of Cameron and Pierce's (1994) meta-analysis indicated that extrinsic rewards do not decrease intrinsic motivation, except in very specific circumstances (i.e., expected tangible rewards given for task-engagement). Cameron and Pierce (1996) contended that rewards can be used to maintain or enhance interest in academic activity, especially when given verbally and when tied to performance. Even tangible rewards offered contingent upon performance or given unexpectedly can maintain motivation levels in the activity or subject area. In opposition to the findings of the Cameron and Pierce (1994) meta-analysis, Deci et al. (2001) concluded that engagement-contingent rewards, completion-contingent rewards, and performance-contingent rewards all have the potential to significantly decrease intrinsic motivation.

The nature of reward is a commonly considered factor when determining effects on intrinsic motivation. Deci et al. (1999) contend that tangible rewards are generally deleterious to intrinsic motivation. Dollinger and Thelen (1978) studied the effects of tangible, verbal, symbolic, and self-administered symbolic rewards on intrinsic motivation in a maze task and concluded that the presumably more controlling, tangible rewards resulted in lower levels of intrinsic motivation (time spent on the task during a free-play period) than verbal or symbolic rewards.

Information regarding competency also is a factor that can mediate the effects of rewards on subsequent behavior. Rosenfield, Folger, and Adelman (1980) determined that higher-level rewards led to higher levels of intrinsic motivation, but only when the level of reward reflected ability. However, when rewards did not reflect ability level, the

highly-valued rewards led to lower levels of intrinsic motivation, regardless of whether they were contingent on performance. The authors concluded that the presence or absence of competency feedback is more influential than reward contingencies per se.

Whether a reward is expected or unexpected may mediate its effects on intrinsic motivation. According to self-perception theory, the overjustification hypothesis “is formulated in terms of the perception of oneself as having undertaken an activity in order to obtain some extrinsic goal,” regardless of the nature of the goal or the reward (Lepper, Greene, & Nisbett, 1973, p. 129). According to this theory, doing an activity as a means to earning a reward should undermine intrinsic motivation. However, receiving an unforeseen, unexpected reward after engaging in an activity should have little negative effect on intrinsic motivation (Lepper et al.). Deci et al. (1999) note that cognitive evaluation theory also considers whether the rewards are expected or unexpected. Specifically, if rewards are unexpected, the person is not likely to experience their behavior as being controlled by the rewards, and therefore decreases in intrinsic interest are less likely to occur.

In a study by Greene and Lepper (1974), preschool children engaged in high-interest activities either for an extrinsic reward or with no extrinsic reward attached. Follow-up intrinsic interest was measured via classroom observations of children who were free to choose between the target activity and several other options. Students who were given expected extrinsic rewards during the treatment phase showed less intrinsic interest several weeks later than children who were rewarded unexpectedly or who did not receive a reward. Lepper et al. (1973) examined the effects of reward expectancy on intrinsic interest in target tasks. Students were given either expected or unexpected

“Good Player Awards” (3 X 5 inch, personalized certificates) or were given no reward for drawing. Subsequently, students in the expected-award condition showed less intrinsic interest in the target activity than students in the unexpected-award and no-award conditions. The effects of reward expectation may vary, depending on the type of reward. For example, Pallak et al. (1982) concluded that expected verbal praise was found to enhance intrinsic motivation.

The developmental level of children may affect how they interpret reward contingencies and competency information. Boggiano and Ruble (1979) concluded that the overjustification effect did not occur when a tangible reward was given based on performance. Preschool and elementary children were rewarded with candy for a high-interest task based on either an absolute standard of performance, on task engagement, or were not externally rewarded. Children also were provided with competency information either in terms of their absolute performance or their performance relative to peers (i.e., they were either told they scored lower or higher than peers). For preschool-aged children, providing rewards for an absolute level of competency sustained intrinsic interest in post-treatment measures. For elementary-aged children, the task-contingent reward decreased interest only when the competency information indicated a lower score than peers, or when no competency information was provided. The authors also concluded that their results provided strong support for the competency hypothesis in that information regarding competence on a task (in this case given in terms of social comparison) can neutralize the undermining effect of extrinsic, tangible rewards on intrinsic interest.

Rewards may have differential effects depending on students' initial interest or motivational level in a task. Loveland and Olley (1979) studied the effects of external rewards on interest and performance for students who were identified as having "high" or "low" interest in drawing based on observed time spent drawing. During treatment, students were either rewarded or not rewarded for their drawing with a "Good Player Award" for participation. Children with high initial interest who expected a good player reward produced significantly more drawings during the time of the reward but the drawings were lower in quality compared to non-reward groups. For children with low initial interest, the reward led to more drawings during the experimental period without quality being significantly affected by the reward. Students with high initial interest who were rewarded showed a short-term decrease in interest, but this effect dissipated during a follow-up measure. Students with initially low interest showed an increase in interest at the 1-week follow up but returned to original levels at the 7-week follow up point. These results indicate that students with high initial interest may be more susceptible to short-term undermining effects of extrinsic rewards than those children who have initially low interest in a task. Also, the effects of extrinsic rewards on interest level may be transient rather than long-term.

Some studies have sought to determine the long-term effects of rewards on interest. Flora and Flora (1999) examined college students' responses to survey questions regarding the amount of reading they currently did each week, their current intrinsic interest in reading, whether they participated in the Book It! program as children, and whether their parents extrinsically rewarded them with money for reading during childhood. (Book It! is a program run by Pizza Hut that rewards children with free pizza

certificates for meeting reading goals.) This study found no significant relationship between the Book It! reading program or monetary rewards given for reading during childhood and students' current intrinsic motivation for reading or self-reported amount currently read per week.

Previous related research (Oliver & Williams, 2006) used bonus points to examine the differential effects of a non-reward contingency versus performance-contingent and completion-contingent reward contingencies on students' performance during a reward phase and after rewards were removed. Although the performance and completion contingencies led to higher rates of accuracy and completion of math problems during the reward phase, the study showed that a performance-contingent bonus condition was more likely than a control condition to undermine intrinsic motivation after the provision of bonus points was removed, possibly because the former reward condition was perceived as controlling. Intrinsic motivation was measured in a "continuous-choice" phase during which students could choose to work on one or both of two activity options (the target activity and a distractor) for a period of 10 minutes. During this phase, students' math accuracy rates and math completion rates were (non-significantly) higher following the control condition than following the bonus point conditions.

The findings of the Oliver and Williams (2006) study suggested a possible overjustification effect following both the performance-related (completion and accuracy) contingencies. Patterns of student performance during the continuous-choice follow-up assignment were consistent with the control hypothesis of motivation in that students were less likely to complete math problems following the more controlling conditions (reward conditions), especially following the accuracy contingency, than following less

controlling conditions (no-reward conditions). Regarding the argument of informational versus controlling aspects of rewards, Oliver and Williams concluded that the controlling aspect had a greater influence on students' continued engagement in the task.

Choice Research

The opportunity for individuals to make choices may be linked to self-determination, and may be related to internal locus of causality. Deci (1985) suggests that when individuals are self-determining, they make choices, and may become more engaged in the activity. This experience is consistent with an internal perceived locus of causality for engaging in an activity. Deci (1980) claims that "the operation of will – the capacity to choose behaviors based on inner desires and perceptions – is the basis of self-determination (p. 5)." Cognitive evaluation theory predicts that rewards perceived as controlling are more likely to decrease intrinsic motivation in a task. Providing choices is one possible way to give students some degree of control over their academic activities. Offering choices to students may therefore lead to increased voluntary engagement in academic activity. Providing choices in combination with external rewards also may mediate potential negative effects of rewards.

Williams (1998) proposed that choice is a cognitive construct that can affect motivation. The more meaningful (valued) the choice alternatives and the greater the uncertainty of choice outcomes, the greater perceived choice on the part of the person choosing. Williams believed that choice over outcomes is more likely to be perceived as internally generated than choice over activities, although both can result in increased levels of intrinsic motivation. Individuals experience choice when they "select an option from among meaningful alternatives that possess relatively equal attractiveness and some

degree of indeterminacy (p. 1).” That is, when an individual has difficulty determining which option to choose, the perception of choice is greater. Williams also contended that an individual’s level of self-determination strongly regulates the extent to which choice influences intrinsic motivation.

Various factors may affect the outcomes and perceptions of the provision of choice. Related research by Harvey and Harris (1975) determined that participants experienced greater levels of perceived choice when selecting from positively valenced options (pleasant alternatives) than from negatively valenced options (distasteful alternatives). This study also indicated that in positive outcome conditions (offering a choice between pleasant options), perceived choice was significantly greater when choices represented small rather than large differences (i.e., when options are relatively close in nature rather than very different from one another). This information suggests that in order to enhance a students’ perception of choice, options should (1) contain some valued rather than superficial differences, (2) be similar enough so that students may be somewhat drawn to both (or all) options rather than have a strong preference toward only one, (3) have uncertain outcomes, (4) target what is to be accomplished rather than how it is to be accomplished, and (5) be positive in nature.

Hautau and Williams’ (2007) review of choice research in education concluded that the major dependent variables that have been targeted are task engagement, problem behavior, assignment completion, quality of work, attitude toward choice arrangements, and voluntary engagement. Problem behavior (e.g., noncompliance, tantrums) was the most commonly targeted dependent variable across the studies and was found to be significantly reduced by choice arrangements in all studies reviewed. Task engagement

(on-task behavior) and voluntary engagement were other commonly targeted variables and were improved in all studies reviewed. Choice arrangements had more variable effects on assignment completion, quality of work, and attitude toward tasks.

Hautau and Williams (2007) concluded that educators typically do not permit students to make salient, fundamental choices regarding their education, but rather more superficial and safe choices related to which assignment they will do, how they will schedule their assignments, how much time they will spend on selected assignments, which work conditions they prefer, and what rewards they will be given for their work.

Providing options of which academic assignments to complete is one popular method of providing choices to students. The empowerment principle purports that giving students these choices is likely to increase the probability of assignment engagement (Skinner, Pappas, & Davis, 2005). Providing assignment choices is “most appropriate when all choice options will result in equivalent learning” in order to avoid the principle of least effort (Skinner et al., p. 395). Some evidence suggests that students are likely to choose easier tasks over more difficult tasks when given the opportunity. For example, Cooke, Guzaukas, Pressley, and Kerr (1993) found that students generally preferred tasks that required less effort (i.e., those made up of a lower ratio of new to review items). This research suggests that maintaining equivalency in task difficulty, as well as providing equivalent opportunity for learning while offering choices, is most appropriate.

Choice of learning activity has been shown to positively affect self-concept and voluntary engagement in a task. Kunes and Gilman (1999) examined whether choice increased students’ reading self-concept and value placed on reading. Pretest and posttest scores on a reading survey were compared after students were given the opportunity to

choose their reading materials. Based on survey results, reading self-concept increased for students allowed to make choices in their reading program. McLoyd (1979) studied effects of combining the provision of choice and external rewards by measuring the effects of high- versus low-value rewards on third-grade students' intrinsic interest in reading high- versus low-interest stories. Reward value and students' initial interest in the stories had been previously determined on the basis of the students' choices. Except for children who received a high-value reward (i.e., their first-choice reward for reading), children in the high interest group (i.e., who were given their first-choice story to read) generally spent more time reading and read more words during the subsequent free-choice period than those in the low-interest group, suggesting that the provision of choice led to higher levels of engagement in the task. Of children in the high-interest group, those who received no reward spent more time reading and read more words than those in the reward conditions. Results indicated that adding a highly-valued reward to the provision of choice led to decreased subsequent voluntary reading, whereas providing a highly-valued reward to students who received their last-choice story increased subsequent voluntary reading.

Researchers also have studied the effects of scheduling choices on academic and behavioral measures. In a two-part study, Dunlap et al. (1994) compared the effects of assignment choices made by the teacher versus students on academic engagement and disruptive behavior of students with emotional and behavioral problems. In the first study, 2 elementary school students selected their assignments from a list of options constructed by the teacher. When these students were given a choice in their assignments, they showed increased academic engagement and decreased disruptive behavior in

comparison to a no-choice phase. In the second study, a kindergarten student displayed fewer incidences of disruptive behavior when given an option choice of which books were read to him than when given no choice regarding the books read. A review of the choice-making research with severe and profound disabilities by Lancioni, O'Reilly, and Emerson (1996) noted that offering scheduling choices can increase on-task behavior, increase task initiation, and decrease levels of problem behavior. Watanabe and Sturmey (2003) introduced choice-making within activity schedules for autistic men by allowing them to choose the order of tasks assigned to them by a supervisor. The authors found the provision of choice to be an effective antecedent-based intervention to increase on-task behavior (when combined with social praise for appropriate behaviors).

In addition to measuring the effects of choice on behavioral and academic outcomes, researchers have measured attitudinal and cognitive variables. Cordova and Lepper (1996) used the provision of choice over several aspects of an activity in an attempt to increase students' sense of control and self-determination. Intrinsic interest was measured by asking the students questions regarding their enjoyment of the activity itself and the comparative enjoyment of the activity versus school subjects and board games. Greater increases in learning and intrinsic motivation occurred for students who were given choices than those who were not. Zuckerman, Porac, Lathin, Smith, and Deci (1978) concluded that individuals in a choice puzzle-solving condition (in which students chose which puzzles they wanted to work on and for how long) reported greater perception of control and spent more time engaging in puzzles during a free-choice period than those in a no-choice condition.

Although some research has suggested that providing choices leads to desirable outcomes, Flowerday, Schraw, and Stevens (2004) concluded that choice had little effect on college students' multiple-choice test performance or reading engagement. This research studied the effects of choice and interest levels on reading engagement, attitude, and learning. The authors noted the importance of separating the effects of choice itself from interest in what one chooses. Researchers had college students choose between two packets of reading material and assignments related to the readings, without their knowing the contents of the packets, in an attempt to differentiate the effects of choice and interest in the topic chosen. Overall, results showed that choice and interest measures had no effect on the outcome measure of multiple-choice tests measuring students' understanding of main ideas and factual information from the readings. Choice also did not significantly impact reading engagement or attitude. In fact, higher writing scores were found under the no-choice than the choice condition for the content essay. Thus, providing students a choice between the packets either did not improve the quality of students' writing or diminished the quality of their writing. The authors suggested that a more long-term systematic program involving choices may be more powerful than allowing students to choose materials once in a low-stakes situation. This hypothesis may apply, in fact, to many related studies.

In two separate experiments, Flowerday and Schraw (2003) measured the effects of choices on various attitudinal and performance outcomes. In the first experiment, students were given a choice between an essay task or crossword puzzle. A 12-item attitudes checklist (including questions related to deep processing, enjoyment, effort, motivation, and sense of self-control) was used to measure affective engagement. Choice

was found to have a positive impact on some affective engagement measures (e.g., relating readings to personal experiences, self-reported sense of control) but a negative impact on others (e.g., self-reports of work effort). The second study examined differences between a self-paced and researcher-paced study session and found that self-pacing led to substantially less time spent studying than researcher-pacing, and that choice had a detrimental impact on deeper learning (e.g., construction of thematic responses, holistic interpretation of text).

The Current Experiment

The current study examined the effects of two variables – choice versus no choice of math tasks and bonus points versus no bonus points for math performance – on both immediate math performance and subsequent voluntary engagement and performance in math activity. This study builds most directly on the Oliver and Williams (2006) research findings and attempts to further examine the adequacy of the control hypothesis versus the competency hypothesis as an explanation for the effects of performance-contingent rewards on task performance while rewards are in place and voluntary task engagement after rewards are removed.

Research questions. The study addressed the following questions related to the effects of choice and bonus credit on math performance and voluntary engagement in math activity:

1. How does allowing students to choose between math assignments versus providing no choice affect the following outcome variables: student perception of choice in the math activity, math performance during treatment

periods, and subsequent math performance and voluntary engagement in math activity when non-math alternatives are available?

2. How does providing performance-contingent bonus points versus no bonus points affect the following outcome variables: math performance during the period when the bonus points are applied and subsequent math performance and voluntary engagement in math activity when non-math alternatives are available?
3. Is there an optimal combination between the choice and bonus-points variables (e.g., choice and bonus contingency) for increasing math performance during the treatment performance, as well as voluntary engagement in math activity in a subsequent period when non-math alternatives are available?

Conceptual hypotheses. The conceptual frameworks differentiating the control and competency contributors to the intrinsic reinforcement value of academic activity point to the following directional hypotheses.

1. Based on the assumption that the competency dimension is more important than the control dimension in increasing the intrinsic-reinforcement value of an activity, one would hypothesize that bonus points rather than no bonus points for accurately solving math problems will not only increase math performance during the period when the bonus points are applied but will also increase voluntary engagement in math activity in subsequent periods when non-math alternatives are available.

2. Based on the assumption that the control dimension is a more important contributor than the competency dimension to the intrinsic-reinforcement value of an academic activity, one would predict that bonus-points contingent on performance and absence of choice with respect to a math assignment would each diminish subsequent voluntary engagement in math activity when non-math alternatives are available. Thus, the optimal combination for promoting voluntary engagement in math activity would be no bonus points and choice of math assignment, whereas the combination of contingent bonus-points and no choice in the math activity would be most detrimental to future voluntary engagement in math activity when non-math alternatives are available.

Chapter II

Method

Participants

Participants included 89 students in four fourth-grade ($n = 47$) and four fifth-grade ($n = 42$) classrooms in an urban inner-city elementary school in the southeast. Students were primarily from lower income households, and over 90% of the students received free or reduced lunch. Participants within each grade level were given math instruction during the same block of time each day and were taught specific types of math skills on the same schedule throughout the school year. All teachers within each grade level were using the same math instructional program to guide teaching. Participants were 55.1% male and 44.9% female, and the majority were African American.

Materials

All worksheets used to measure math performance were constructed to be relatively equivalent across measurement periods. The primary researcher created a template pretest worksheet on which to base the eight other performance worksheets (two for each treatment day, the math performance posttest, and the math performance followup). The template contained a specific number of each numeral (0 through 9, with 0 and 1 used rarely) in each set of 10 digits (columns). The number of times each numeral was used was held constant across all performance worksheets. A similar template and procedure was used for the continuous-choice measures: a pretest template was used to create the continuous-choice posttest and followup worksheets. The math performance pretest, posttest, and followup worksheets, and the continuous-choice pretest, posttest, and followup worksheets contained a mixture of 1-digit by 1-digit, 2-

digit by 2-digit, and 3-digit by 3-digit problems in a particular sequence that was held constant within and across worksheets to ensure appropriate comparisons. The sequence and problem type for these pretest, posttest, and followup performance and continuous-choice measures were chosen to be similar to the treatment worksheets.

Two types of relatively equivalent treatment worksheets were used in this study and were labeled worksheet A and worksheet B. Both worksheets each day were designed to be equivalent to one another and to corresponding treatment day worksheets. The two worksheets differed in that worksheet A (example in Appendix A) was composed of 100 multiple-digit by multiple-digit problems, whereas worksheet B (example in Appendix B) was composed of 200 problems, consisting of a mixture of multiple-digit and single-digit problems. The two types of worksheets were similar in that they contained the same number (fifty) of 2-digit by 2-digit problems requiring carrying. However, worksheet A also contained fifty 3-digit by 3-digit problems without carrying, whereas worksheet B contained those same fifty 3-digit by 3-digit problems but broken down into three separate 1-digit by 1-digit problems with the same numerals (totaling 150 single-digit problems). Despite these apparent differences, both worksheet types essentially required the same mathematical operations. Worksheets contained more problems than students were expected to complete in the designated 10-minute period.

Because the treatment worksheet types appeared different, especially at first glance, students probably could easily identify which worksheet was consistent with their preferences. Both worksheet types had elements of appeal. For example, a student choosing based on the principle of least effort may have chosen type A because it offered fewer problems to complete and therefore may have looked shorter, whereas type B had

the appeal of shorter, easier looking problems. In addition to math worksheets, word-search puzzles and word jumbles served as additional options for students during the continuous-choice periods. The primary researcher created the word-search and word-jumble activities using internet resources. These alternative activities also were designed to be too long for students to complete in a 10-minute period and included content such as games, foods, plants, and other topics familiar to fourth- and fifth-grade students.

Conditions

Two classrooms (one from each grade level) were randomly assigned to each of four contingency combinations. There were 21 students in the Choice/Bonus condition, 19 in the Choice/No Bonus condition, 23 in the No Choice/Bonus condition, and 26 in the No Choice/No Bonus condition. The reward (bonus point) condition was an accuracy contingency. Students in the Bonus conditions received written feedback on their performance and earned bonus points based on digits completed accurately on treatment worksheets, whereas students in the No Bonus conditions received the same written feedback with no bonus points attached. Feedback on performance, in the form of number of digits completed accurately, was provided to students in both Bonus and No Bonus conditions, to ensure that both groups of students received competency information regardless of whether an extrinsic reward (bonus points) was attached. Students in the Choice conditions were able to choose between two math worksheet types each day during the treatment phase. Each day, students chose either type A (containing 100 problems) or type B (containing 200 problems). Students in the No Choice conditions were randomly assigned one of these two worksheet types based on the percentage of each worksheet chosen by students in the corresponding Choice condition.

Dependent Measures

Dependent measures included math-completion rates (digits attempted), math-accuracy rates (digits correct), and the percentage of students in each condition who attempted one or more problems (“any attempted”) during voluntary engagement (continuous-choice) pretest, posttest, and followup periods. During math performance pretest, posttest, and followup phases, as well as during the treatment phase, digits correct was the primary measure, supplemented with students’ responses to a question (found at the end of worksheets during the treatment phase) related to perception of choice in the activity. Dependent variables were compared across bonus conditions, choice conditions, and phases of the study. Digits rather than number of problems were targeted because the two types of worksheets contained a different number of problems, albeit the same number of numerical operations, on each page and overall. Measuring digits correct, therefore, allowed for more accurate comparisons across worksheet types. Because students may have been relatively unfamiliar with this type of grading system, researchers explained the procedure for scoring digits correct using examples on a large poster board as part of the treatment instructions each day.

Pre-treatment Phase

The pre-treatment phase occurred during the first day of the study (a Monday). (Figure 1 provides a flowchart of experimental phases and conditions.) First, students engaged in a continuous-choice activity for a pre-treatment measure of relative voluntary engagement in math activity in comparison to other activities. The continuous-choice activity was a 10-minute period in which students had the opportunity to choose between a math activity and two other types of activities (a word-search puzzle and a word-jumble

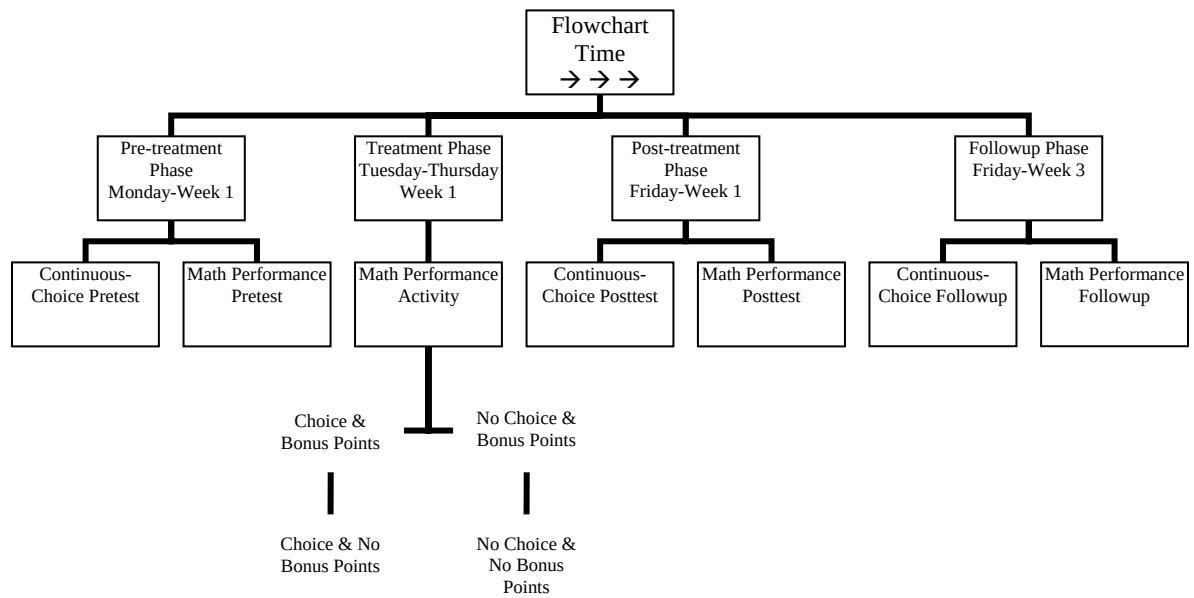


Figure 1. *Flowchart of Experimental Phases*

worksheet). Each activity set contained two front and back pages, stapled together. All activities were designed to be too lengthy to finish within the 10-minute time period. This phase is similar to the continuous-choice follow-up phase used by Oliver and Williams (2006) during which students were given an assignment made up of math problems and a word-search activity. Students in the current study were asked to place the activity choices side by side on their desk and were told that they may choose to work on one, two, or all of the assignments during the 10-minute period. The continuous-choice activity was repeated on Friday of the first week (posttest phase) and 2 weeks after treatment (followup phase).

After the continuous-choice activity on the first day of the study, students in each of the eight classrooms engaged in a math performance pretest involving a worksheet containing a mixture of 1-digit by 1-digit addition problems without carrying, 2-digit by 2-digit addition problems with carrying, and 3-digit by 3-digit addition problems without carrying. Students were given 5 minutes to complete as many problems accurately as they could. Students' responses from the pretest were scored for accurate completion of problems and served to determine equivalency across classrooms. (The pretest was also used as a covariate during subsequent analyses). No feedback was given to students regarding their performance on the math performance or continuous-choice pretest activities.

Treatment Phase

The four classrooms at each grade level were randomly assigned to Choice/Bonus, Choice/No Bonus, No Choice/Bonus, or No Choice/No Bonus conditions. One classroom from each grade level was assigned to each treatment combination.

Students in Choice conditions were each able to choose which math activity to complete, whereas students in the No Choice conditions were not. Within the Choice conditions, the Choice/Bonus groups were rewarded with bonus points based on performance (digits completed accurately) and Choice/No Bonus groups were not rewarded. On each day during the treatment phase students in the Choice conditions chose a math worksheet type from two types placed on their desk. Students were instructed to take a moment to look at both worksheets, choose one to keep on their desk, and then a researcher would collect the other. Students were asked to complete the problems in order until the designated 5-minute period had ended.

The researchers collected and scored the worksheets and then returned them to the students so that they received immediate feedback on their performance (and number of bonus points earned for students in Bonus conditions). Worksheets were scored against a clearly marked answer key for efficient rating. Corrective feedback (correct responses were replaced for incorrect responses) was marked directly on the worksheet for each digit missed, and the total number of digits correct (plus the bonus points earned in Bonus conditions) were written on the top of the worksheet. All raters used blue pens to mark on assignments.

After the math activity, the percentage of each worksheet type chosen by students in the Choice conditions was calculated by dividing the number of each worksheet type chosen by the total number of students who participated that day. Researchers proceeded to the classrooms assigned to the No Choice conditions and randomly distributed the appropriate number of each type of math task to students. The number of each type for distribution was calculated by taking the percentage of each type chosen in the

corresponding Choice classroom and multiplying by the total number of students participating. After worksheet distribution, the same procedures used in the Choice classrooms were used in the No-Choice classrooms. Students then engaged in the math worksheet they received for the 5-minute period. The No Choice/Bonus groups were given feedback and bonus points for problems completed accurately and No Choice/No Bonus groups were given feedback only. The same math activity procedures were used on Tuesday, Wednesday, and Thursday during the treatment phase.

Posttest and Followup Activities

On Friday of the study, after treatment conditions were in place for three days, students participated in the post-treatment day consisting of a second 10-minute continuous-choice posttest, as a measure of math interest, and a math performance posttest. Two weeks following the second continuous-choice activity, students participated in a followup phase, consisting of a third continuous-choice activity followed by a math performance measure that was scored for digits completed accurately. No feedback or bonus points were provided during these phases.

Interrater Reliability

The primary rater and research assistants scored all math worksheets. Treatment worksheets were scored directly after completion by researchers and the scores were written directly on the worksheets. Because the primary raters' scores were clearly visible, secondary raters did not score the treatment worksheets. Secondary raters scored 25% of math performance pretest, posttest and followup activities for number of digits completed accurately and 25% of continuous-choice pretest, posttest, and followup worksheets for number of digits attempted and number of digits completed accurately.

The primary researcher first scored the worksheets and recorded scores for the dependent variables on a prepared spreadsheet. The secondary raters then scored the worksheets and recorded their ratings either on a separate prepared worksheet or directly on the worksheets. All worksheets (aside from on the treatment days) were scored outside of the classroom setting using clearly marked answer keys. Primary and secondary raters' scores were correlated to determine reliability of ratings. Interrater reliability ranged from $r = .957$ to $r = 1.00$.

Procedural Integrity

Researchers followed specific instructions including reading scripted directions for students (Appendix C) for all phases of the study to ensure treatment integrity. Secondary researchers evaluated whether experimental methods were implemented as designed using a procedural integrity checklist for each phase of the study (Appendix D). Procedural integrity was calculated at 100%.

Chapter III

Results

Univariate repeated measures designs with pretest covariates (ANCOVAs) were used to examine the effects of bonus points, choice, and the four treatment combinations on math performance and voluntary engagement in math activity. Reward condition and choice condition served as the between-subjects measures and students' scores across phases (treatment, post-treatment, and followup) as the repeated measure.

Preliminary Analyses

In the pre-treatment phase, preliminary analyses were done to determine whether initial performance and voluntary engagement levels were equivalent across classrooms within each grade level and between grade levels. One-way analyses of variance (ANOVAs) were used to determine significant differences between treatment combinations. There were no initial differences in voluntary engagement level between students in the four treatment groups, $F(3, 88) = 1.725, p = .168$, or between fourth and fifth graders $F(1, 88) = 1.784, p = .185$, as measured by the continuous-choice pretest. Additionally, there were no differences in initial performance level across treatment combinations, $F(3, 88) = .339, p = .797$, as measured by the math performance pretest. However, the initial mean performance level of fifth-grade students was significantly higher than that of fourth-grade students, $F(1, 88) = 18.856, p < .001$. This difference was expected, given the additional instruction and practice in math activity that fifth-grade students have received in comparison to fourth-grade students.

Because students within grade levels were randomly assigned to research conditions and because there were no differences among groups of various treatment

combinations, remaining analyses compared effects of the treatment conditions on groups collapsed across grade level. That is, the fourth- and fifth-grade classrooms assigned to each condition were combined into one larger group representing each choice and reward combination. Furthermore, because grade level was not a variable of interest in the study, the researcher did not separate the analyses for fourth- and fifth-grade levels.

Although there were no significant differences between the four treatment groups on either of the pretest measures, Figures 2 and 3 show some absolute differences on pretest measures across treatment groups (also see pretest measures in Tables 1 and 2). Because of these apparent differences, subsequent analyses for both performance and voluntary engagement measures used the respective pretest scores as covariates rather than as the first time point (level) in the repeated measures analysis. Using the pretest as a covariate was a more conservative method of data analysis in that the covariate would allow treatment comparisons to be made from a statistically equivalent starting point.

Self-reported Choice

On each day of the treatment phase after students completed the 5-minute math activity, they were asked to respond to the question, “Do you feel you had a choice in this activity?” by circling either YES or NO at the bottom of their assignment. Taken as a whole, 84.7% of students responded that they perceived a choice on the first treatment day (see Table 3 and Figure 4). Overall, 72.8% of students responded that they perceived a choice on the second treatment day and 79.5% of students responded that they had a choice on the third treatment day. Despite the fact that the majority of students in all conditions responded that they had a choice during the treatment periods, the Choice conditions were consistently associated with higher percentages of reported perceived

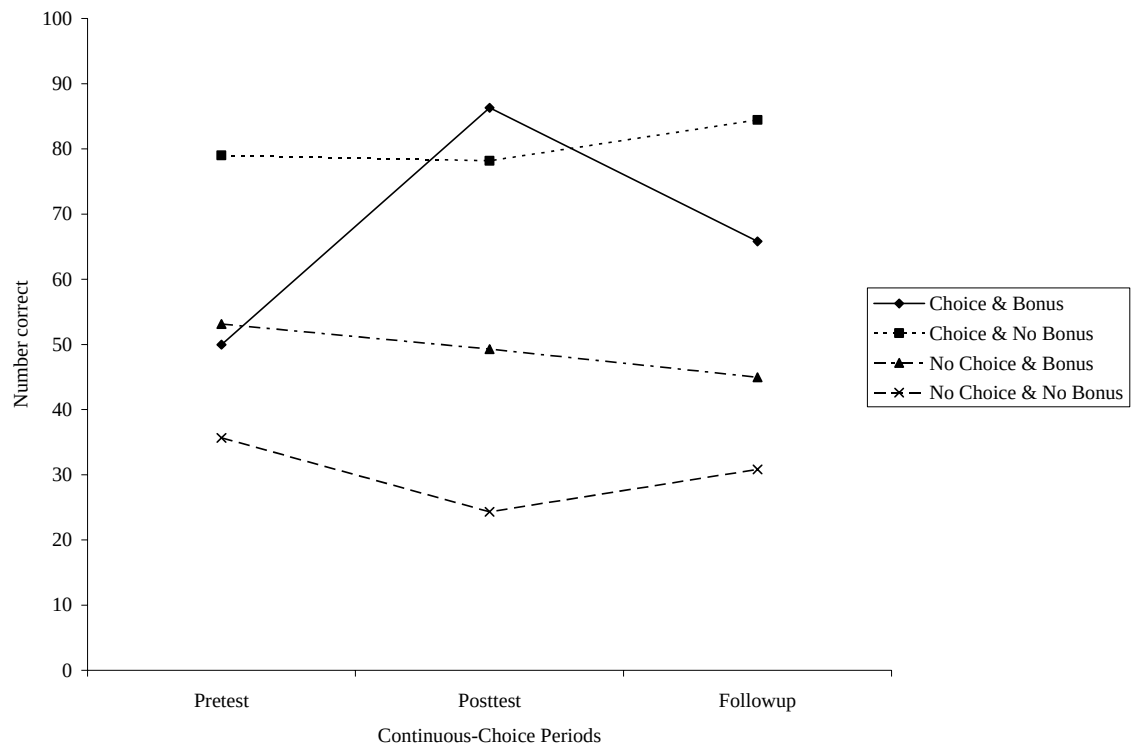


Figure 2. *Raw Voluntary Engagement Means (Number of Digits Correct) across Continuous-Choice Periods and by Treatment Condition.*

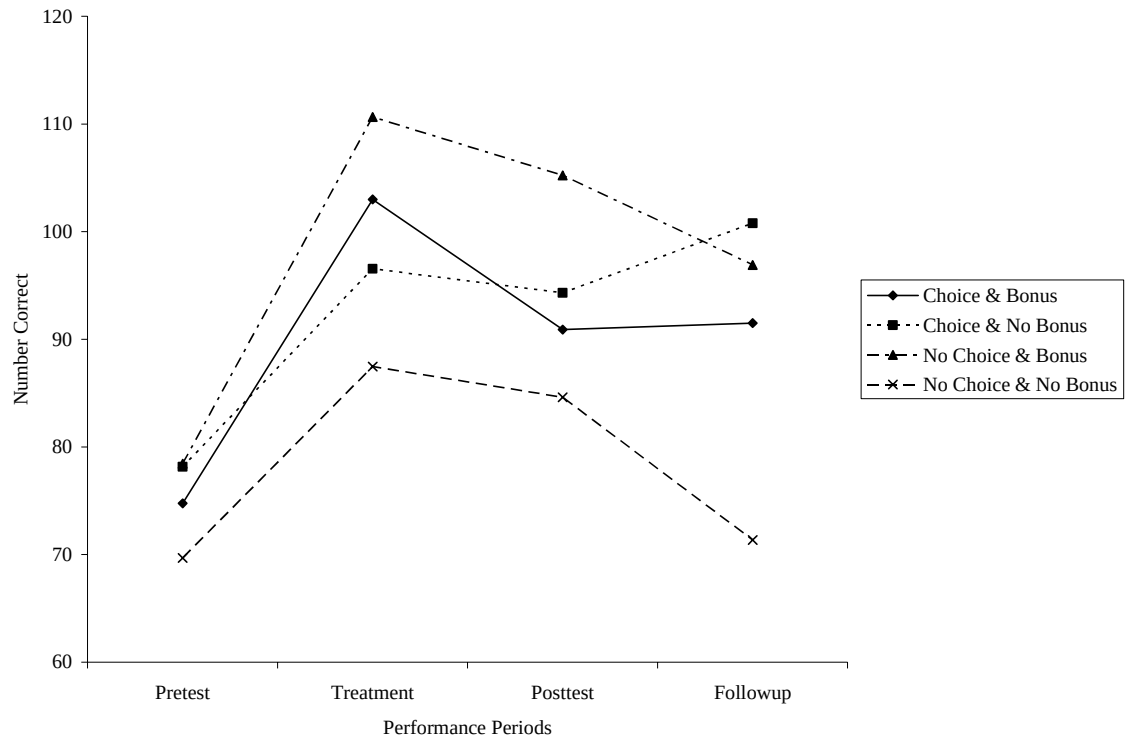


Figure 3. *Raw Math Performance Means (Number of Digits Correct) across Performance Periods and by Treatment Condition.*

Table 1. *Raw Means with (Number of Participants, and Standard Deviations) for Accurate Math Performance in Voluntary Engagement Activities across Continuous-Choice Periods and by Treatment Condition.*

	Choice	No Choice	Composite
Bonus			
CC Pre	49.95 (21, 65.34)	53.13 (23, 65.99)	51.61 (44, 64.93)
CC Po	86.29 (21, 107.14)	49.26 (23, 87.25)	66.93 (44, 97.90)
CC Fo	65.80 (20, 113.33)	44.96 (23, 90.56)	54.65 (43, 101.08)
No Bonus			
CC Pre	79.00 (19, 63.95)	35.65 (26, 59.27)	53.96 (45, 64.32)
CC Po	78.16 (19, 117.65)	24.30 (26, 66.17)	47.04 (45, 94.20)
CC Fo	84.44 (19, 120.39)	30.81 (26, 71.61)	52.75 (44, 97.07)
Composite			
CC Pre	63.75 (40, 65.52)	43.86 (49, 62.48)	
CC Po	82.43 (40, 110.87)	36.02 (49, 77.00)	
CC Fo	74.63 (38, 115.52)	37.45 (49, 80.50)	

Note. CC Pre refers to the continuous-choice pretest measure of voluntary engagement; CC Po refers to the continuous-choice posttest measure of voluntary engagement; and CC Fo refers to the continuous-choice followup measure of voluntary engagement. The Composite rows and columns refer to the mean of each condition collapsed across the other condition. These data include all students who participated in each measure.

Table 2. *Raw Means with (Number of Participants, and Standard Deviations) for Accurate Math Performance across Performance Periods and by Treatment Condition.*

	Choice	No Choice	Composite
Bonus			
Perf Pre	74.76 (21, 27.99)	78.43 (23, 32.18)	76.68 (44, 29.96)
Perf TX	103.00 (21, 30.22)	110.65 (23, 37.57)	107.00 (44, 44.09)
Perf Po	90.90 (21, 44.05)	105.22 (23, 36.19)	98.39 (44, 40.31)
Perf Fo	91.50 (20, 29.82)	96.91 (23, 47.59)	94.39 (43, 39.95)
No Bonus			
Perf Pre	78.16 (19, 30.43)	69.69 (26, 42.30)	73.27 (45, 37.60)
Perf TX	96.55 (19, 34.15)	87.46 (26, 43.84)	91.30 (45, 39.88)
Perf Po	94.32 (19, 44.30)	84.62 (26, 52.04)	88.71 (45, 48.63)
Perf Fo	100.78 (19, 36.41)	71.35 (26, 47.65)	83.39 (44, 45.37)
Composite			
Perf Pre	76.38 (40, 28.85)	73.80 (49, 37.77)	
Perf TX	99.94 (40, 31.90)	98.35 (49, 42.25)	
Perf Po	92.53 (40, 43.62)	94.29 (49, 46.03)	
Perf Fo	95.89 (38, 32.98)	83.35 (49, 48.86)	

Note. Perf Pre refers to the math performance pretest measure; Perf TX refers to the group mean of the median math performance scores over the three treatment days; Perf Po refers to the math performance posttest; and Perf Fo refers to the math performance followup measure. The Composite rows and columns refer to the mean of each condition collapsed across the other condition.

Table 3. *Percentage of Worksheet Types Chosen and Responses to Choice Questions across Treatment Days and by Treatment Condition.*

	Worksheet Type							
	Choice/Bonus		Choice/No Bonus		No Choice/Bonus		No Choice/No Bonus	
	A	B	A	B	A	B	A	B
TXday1	47.6	52.4	52.6	47.4	40.9	59.1	48.0	52.0
TXday2	47.1	52.9	58.8	41.2	42.9	57.1	46.2	53.8
TXday3	31.6	68.4	22.2	77.8	47.6	52.4	19.0	81.0
Total	42.1	57.9	44.4	55.6	51.4	48.6	38.9	61.1

	Choice Question							
	Choice/Bonus		Choice/No Bonus		No Choice/Bonus		No Choice/No Bonus	
	Y	N	Y	N	Y	N	Y	N
TXday1	95.2	4.8	88.9	11.1	76.2	23.8	80.0	20.0
TXday2	94.1	5.9	76.5	23.5	76.2	23.8	53.8	46.2
TXday3	94.4	5.6	88.9	11.1	71.4	28.6	66.7	33.3
Total	94.6	5.4	84.9	15.1	74.6	25.4	66.7	33.3

Note. TXday1 refers to the first of three days during the treatment phase; TXday2 refers to second of three treatment days; TXday3 refers to third of three treatment days; and Total represent the average across the three treatment days taking into account number of students present each day.

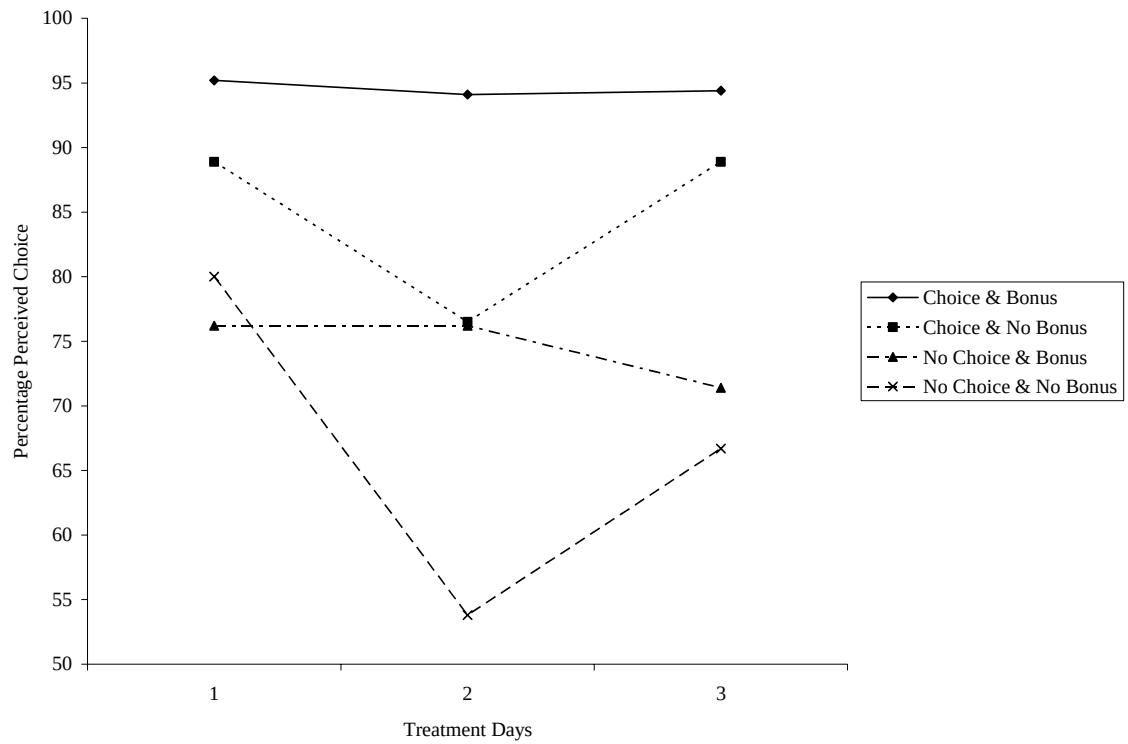


Figure 4. *Percentage of Students who Reported Perceived Choice in the Math Activity across Treatment Days and by Treatment Condition.*

choice than the No Choice conditions. On the first treatment day, 92.3% of students in the Choice conditions reported having a choice, whereas 78.3% of students in the No Choice conditions responded this way. According to Pearson Chi-Square tests of independence, this difference was not significant $\chi^2(1, N = 85) = 3.22, p = .073$. On the second treatment day, 85.3% of students in the Choice conditions reported having a choice, whereas 63.8% of students in the No Choice conditions reported having a choice. This differences in proportions was significant, $\chi^2(1, N = 81) = 4.59, p = .032$. On the third treatment day, a higher proportion of students in the Choice conditions (91.7%) reported having a choice compared to those in No Choice conditions (69%), $\chi^2(1, N = 78) = 6.08, p = .014$.

Worksheet Type

Table 2 (Figure 5) illustrates the percentage of each worksheet type chosen on each day of the treatment phase, as well as the corresponding percentage of worksheets given to students in the No Choice conditions. On the first and second days of treatment, a relatively equal percentage of students chose worksheet type A (fewer but longer problems) and type B (more but shorter problems). However, students in both the Choice/Bonus and the Choice/No Bonus treatment combinations were more likely to choose worksheet B on the third day of treatment. On the last treatment day, 31.6% of students in the Choice/Bonus condition chose worksheet A, whereas 68.4% chose worksheet B. Similarly, 22.2% of students in the Choice/No Bonus condition chose worksheet A, whereas 77.8% chose worksheet B. Pearson Chi Squares tests of independence indicated the treatment groups did not differ with respect to their preference of worksheet types on the first, $\chi^2(1, N = 40) = .1, p = .757$, second, $\chi^2(1, N =$

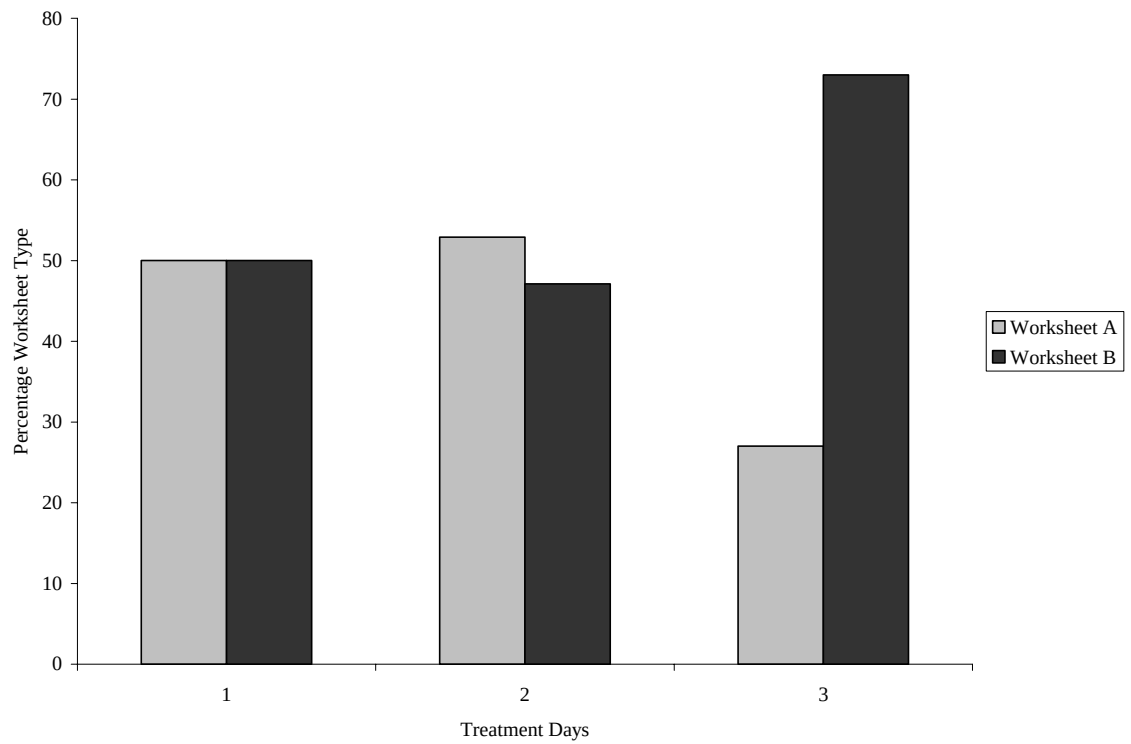


Figure 5. *Percentage of Students in Choice Conditions who Chose Each Worksheet Type across Treatment Days.*

34) = .472, $p = .492$, or third treatment day, $\chi^2(1, N = 37) = .410, p = .52$.

Although there was some imbalance between the percentages of worksheet types chosen under the Choice conditions, those same percentages were assigned to the corresponding No Choice conditions. During the implementation of the study, the percentages of worksheet types used in the No Choice/Bonus conditions were matched to the percentages chosen in the Choice/Bonus conditions; and the percentages of worksheet types used in the No Choice/No Bonus conditions were matched to the percentages in the corresponding Choice/No Bonus conditions. However, due primarily to attrition of participants throughout the study, the percentage of each worksheet type was not exactly equal across corresponding Choice and No Choice groups.

Based on one-way ANOVA results, there was an unexpected significant difference between math performance on worksheet A versus worksheet B on only the first of the three treatment days. Figure 6 depicts overall performance on worksheet A versus B on each treatment day. On the first treatment day, students completed more math problems accurately on worksheet B (mean = 107.85) than on worksheet A (mean = 81.05). This difference was significant at $p = .001$. Interestingly, the opposite pattern was seen for the remaining treatment days. On the second and third treatment days, performance on worksheet A was nearly equal to or non-significantly higher than performance on worksheet B for students in Choice conditions, No Choice conditions, and for the total sample.

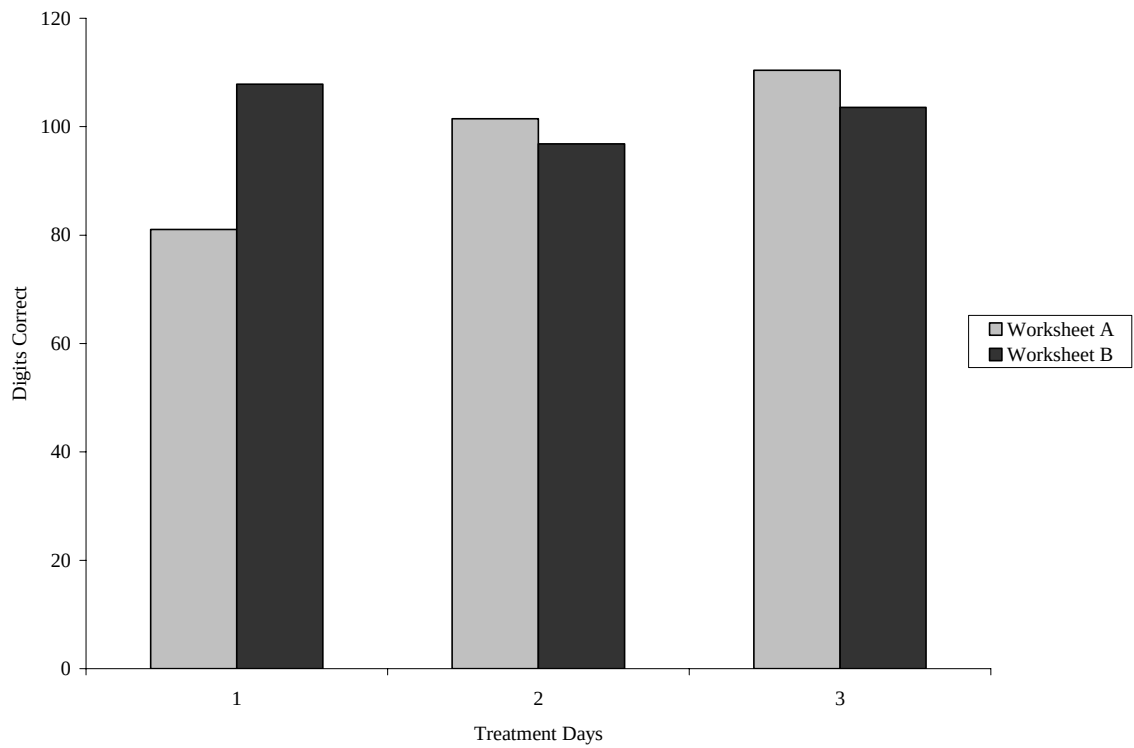


Figure 6. *Relative Performance on Worksheet A and Worksheet B across Treatment Days.*

Effects of Treatment Conditions on Performance across Time Periods

For math performance measures, accuracy scores were determined by recording the number of digits students completed accurately within the allotted time period. A repeated measures analysis of covariance (ANCOVAs) with the math performance pretest as a covariate were used to determine the effects of choice and bonus conditions, and the interaction between the two, on students' accuracy scores across the various performance periods. The math performance pretest was used as a covariate as a precautionary measure to ensure accurate comparisons across treatment groups based on statistically equated levels of initial performance. Students' adjusted median treatment accuracy scores (digits correct), students' adjusted accuracy scores on the math-performance posttest, and students' adjusted accuracy scores on the math performance followup test (in the followup phase) served as the three temporal levels for the repeated measure.

Tests of within-subjects effects indicated no statistically significant main effects. Because Mauchly's Test of Sphericity was significant at $p = .006$, the Huynh-Feldt corrected results for within-subjects effects are reported. The performance periods (time periods) effect was non-significant, $F(1.914, 82) = 1.355, p = .261$; the interaction effect between performance periods and bonus was non-significant, $F(1.914, 82) = .767, p = .461$; the interaction effect between performance periods and choice was significant, $F(1.914, 82) = 3.280, p = .042$; and the interaction effect between performance periods, bonus, and choice was non-significant, $F(1.914, 82) = .458, p = .571$. Further analysis of the significant interaction effect between performance periods and choice revealed no meaningful patterns.

Table 4 (also Figure 7) indicates adjusted performance mean and standard error measurements by treatment combination. Tests of between-subjects effects indicated no statistically significant main effects for choice $F(1, 82) = .029, p = .865$ or a bonus by choice interaction $F(1, 82) = 2.682, p = .105$. The overall higher mean performance of students in Bonus conditions (98.13) versus students in No Bonus conditions (90.16) yielded a near significant main between-subjects effect for bonus $F(1, 82) = 3.573, p = .062$.

Effects of Treatment Conditions on Performance across Treatment Days

To determine patterns of performance across the three treatment days, a repeated measures ANCOVA (with the math performance pretest covaried) was used with choice and reward conditions as between-subjects variables and adjusted accuracy scores during the first, second, and third treatment days as the three temporal levels for math performance (see Table 5). There was a significant within-subjects main effect for treatment days, $F(2, 66) = 3.319, p = .039$. Overall, students completed more digits accurately on the third treatment day (106.84) than the first treatment day (100.60) ($p = .018$).

The bonus contingency produced a significant ($p = .001$) between-subjects main effect on student performance across treatment days. Overall, the adjusted mean for the Bonus conditions (109.72) was significantly higher ($p = .001$) than the No Bonus mean (97.27). Choice did not produce a significant between-subjects main effect ($p = .791$), given that the overall mean for the Choice conditions of 103.96 was equivalent to the No Choice mean of 103.03.

Table 4. *Adjusted Repeated Measures Means with (Number of Participants, and Standard Error) for Accurate Math Performance across Performance Periods and by Treatment Condition*

	Choice	No Choice	Composite
Bonus			
Perf TX	103.12 (20, 3.71)	107.58 (23, 3.47)	105.35 (43, 2.54)
Perf Po	88.07 (20, 5.76)	101.94 (23, 5.37)	95.00 (43, 3.93)
Perf Fo	93.81 (20, 7.08)	94.23 (23, 6.60)	94.02 (43, 4.84)
Perf Mean	95.00 (20, 4.35)	101.25 (23, 4.07)	98.13 (43, 2.98)
No Bonus			
Perf TX	95.09 (18, 3.93)	92.74 (26, 3.27)	93.01 (44, 2.55)
Perf Po	91.23 (18, 6.09)	90.24 (26, 5.07)	91.08 (44, 3.95)
Perf Fo	94.99 (18, 7.49)	75.96 (26, 6.23)	85.47 (44, 4.85)
Perf Mean	94.00 (18, 4.61)	86.31 (26, 3.84)	90.16 (44, 2.99)
Composite			
Perf TX	99.10 (38, 2.70)	100.16 (49, 2.38)	
Perf Po	90.00 (38, 4.18)	96.09 (49, 3.68)	
Perf Fo	94.40 (38, 5.14)	85.09 (49, 4.53)	
Perf Mean	94.50 (38, 3.17)	93.78 (49, 2.79)	

Note. Perf TX refers to the group mean of the median math performance scores over the three treatment days; Perf Po refers to the math performance posttest; Perf Fo refers to the math performance followup measure; and Perf Mean refers to the average score across the three performance periods. The Composite rows and columns refer to the mean of each condition collapsed across the other condition. All mean scores are adjusted for the pretest covariate.

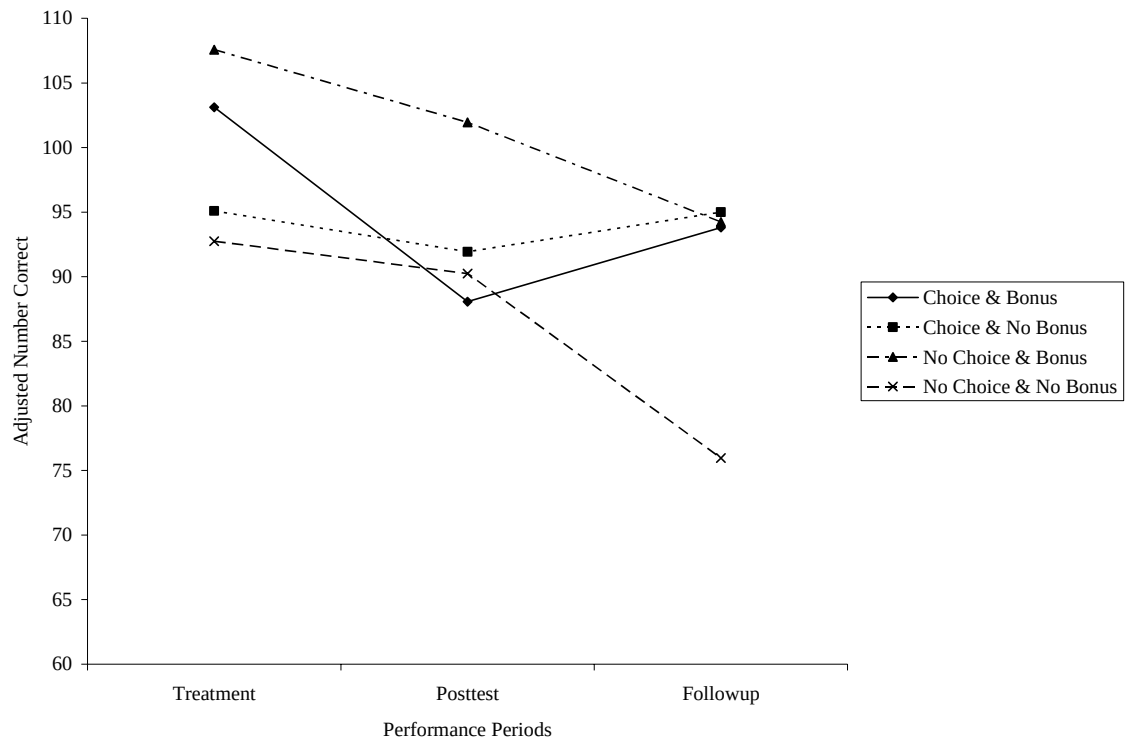


Figure 7. *Adjusted Repeated Measures Math Performance Means across Performance Periods and by Treatment Condition.*

Table 5. *Adjusted Repeated Measures Means with (Number of Participants, and Standard Error) for Accurate Math Performance across Treatment Days and by Treatment Condition.*

	Choice	No Choice	Composite
Bonus			
TXday1	107.39 (16, 4.05)	102.39 (19, 3.74)	104.89 (35, 2.74)
TXday2	109.96 (16, 4.63)	112.80 (19, 4.27)	111.38 (35, 3.13)
TXday3	110.76 (16, 4.81)	115.02 (19, 4.44)	112.89 (35, 3.25)
TX mean	109.37 (16, 3.28)	110.07 (19, 3.40)	109.72 (35, 2.49)
No Bonus			
TXday1	97.77 (16, 4.05)	94.85 (20, 3.64)	96.31 (36, 2.70)
TXday2	94.06 (16, 4.63)	95.38 (20, 4.16)	94.72 (36, 3.09)
TXday3	103.80 (16, 4.81)	97.75 (20, 4.32)	100.79 (36, 3.21)
TX mean	98.56 (16, 3.68)	95.99 (20, 3.31)	97.27 (36, 2.46)
Composite			
TXday1	102.58 (32, 2.85)	98.62 (39, 2.58)	
TXday2	102.01 (32, 3.26)	104.09 (39, 2.95)	
TXday3	107.30 (32, 3.39)	106.38 (39, 3.07)	
TX mean	103.96 (32, 2.59)	103.03 (39, 2.35)	

Note. TXday1 refers to the first of three days during the treatment phase; TXday2 refers to second of three treatment days; TXday3 refers to third of three treatment days; and TX mean refers to the average score across the three treatment days. All mean scores are adjusted for the pretest covariate.

Effects of Treatment Conditions on Voluntary Engagement

For the voluntary engagement (interest) measures, scores representing digits attempted and completed accurately were calculated during continuous-choice periods. Accuracy scores were determined by recording the number of digits completed accurately within the allotted time period. Digits attempted were calculated by counting each answer place where the student wrote a number within the allotted time period, whether correct or incorrect. Repeated measures analyses of covariance, with the continuous-choice (voluntary engagement) pretest as a covariate, were used to determine the effects of choice and reward conditions, and the interaction between the two, on scores across the various continuous-choice periods. The continuous-choice pretest (measuring voluntary engagement) was used as a covariate in order to ensure accurate comparisons across treatment groups based on statistically equated levels of initial voluntary engagement. Students' adjusted scores during the posttest and followup continuous-choice phases served as the two temporal levels for the interest repeated measures analyses.

Digits correct. The number of digits completed correctly during the continuous-choice posttest and followup phases was not significantly affected by the prior provision of choice or bonus points. Tests of within-subjects effects indicated no statistically significant main effects. The continuous-choice periods (time periods) effect was non-significant, $F(1, 82) = .858, p = .357$; the interaction effect between continuous-choice periods and bonus was non-significant, $F(1, 82) = 1.097, p = .298$; the interaction effect between continuous-choice periods and choice was non-significant, $F(1, 82) = .619, p = .434$; and the interaction effect between continuous-choice periods, bonus, and choice was non-significant, $F(1, 82) = .018, p = .895$.

Tests of between-subjects effects indicated no statistically significant main effects for bonus, $F(1, 82) = .669, p = .416$, choice, $F(1, 82) = 2.516, p = .117$, or a bonus by choice interaction, $F(1, 82) = .195, p = .660$. Despite non-significance, visual patterns (see Figure 8) suggest the various treatment combinations may have differentially affected voluntary engagement. (See Table 6 for adjusted voluntary engagement means for digits correct across continuous-choice periods.)

Figure 9 illustrates that students in the Choice conditions (mean = 74.90) performed better (although non-significantly) than those in the No Choice conditions (mean = 42.15) during the continuous-choice posttest. The same pattern occurred during the continuous-choice followup period – the Choice condition mean of 64.90 was non-significantly higher than the No Choice mean of 43.94. Additionally, the Choice/Bonus group (mean = 89.80) performed better than the Choice/No Bonus group (mean = 60.01) on the continuous-choice posttest, and also slightly better (mean = 72.24 > mean = 59.06) on the continuous-choice followup; however, these differences were also non-significant. The two treatment combinations most related to high levels of voluntary engagement (Choice/Bonus and Choice/No Bonus) included the provision of choice. Students in the Choice/Bonus combination completed the most problems accurately, followed by students in the Choice/No Bonus combination. This pattern suggests that the provision of choice may have been more influential than the performance-contingent rewards on voluntary completion of math problems. During the continuous-choice posttest measure, students in the No Choice/Bonus condition completed more problems accurately than those in the No Choice/No Bonus condition, but this difference was not significant and did not remain into the continuous-choice followup measure.

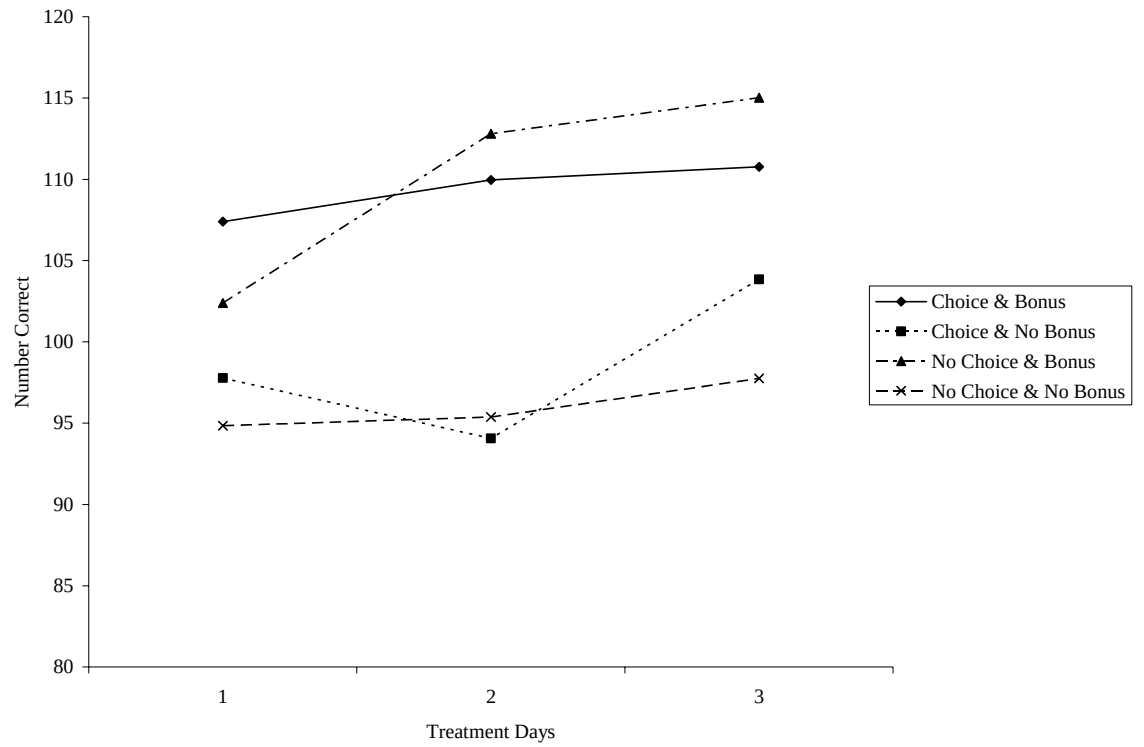


Figure 8. *Adjusted Repeated Measures Math Performance Means across Treatment Days and by Treatment Condition.*

Table 6. *Adjusted Repeated Measures Voluntary Engagement Means with (Number of Participants, and Standard Error) for Accurate Math Performance across Continuous-Choice Periods and by Treatment Condition.*

	Choice	No Choice	Composite
Bonus			
CC Po	89.80 (20, 18.92)	48.39 (23, 17.60)	69.09 (43, 12.92)
CC Fo	72.74 (20, 19.05)	43.97 (23, 17.73)	58.36 (43, 13.00)
CC Mean	81.27 (20, 17.64)	46.18 (23, 16.41)	63.73 (43, 12.04)
No Bonus			
CC Po	60.01 (18, 20.45)	35.92 (26, 16.73)	47.96 (44, 12.99)
CC Fo	59.06 (18, 20.59)	43.92 (26, 16.85)	51.49 (44, 13.08)
CC Mean	59.53 (18, 19.07)	39.92 (26, 15.60)	49.73 (44, 12.11)
Composite			
CC Po	74.90 (38, 13.82)	42.15 (49, 12.13)	
CC Fo	65.90 (38, 13.92)	43.94 (49, 12.22)	
CC Mean	70.40 (38, 12.89)	43.05 (49, 11.32)	

Note. CC Po refers to the continuous-choice posttest measure of voluntary engagement; and CC Fo refers to the continuous-choice followup measure of voluntary engagement; and CC Mean refers to the average score across continuous-choice periods. The Composite rows and columns refer to the mean of each condition collapsed across the other condition. All mean scores are adjusted for the pretest covariate.

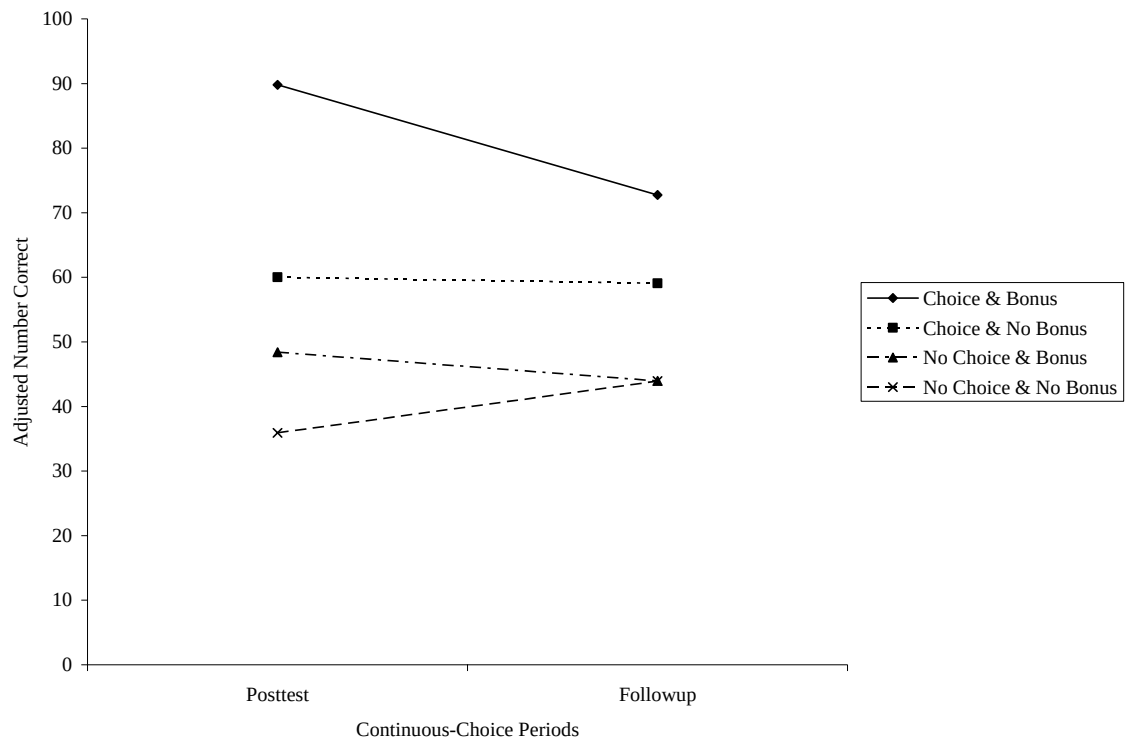


Figure 9. *Adjusted Repeated Measures Voluntary Engagement Means across Continuous-Choice Periods and by Treatment Condition.*

Digits attempted. Patterns that emerged for number of digits attempted during continuous-choice periods were very similar to those for digits correct (see Table 7 and Figure 10). Based on repeated measures analyses of covariance (with the number of digits attempted on the voluntary engagement pretest as a covariate), the number of digits attempted during the continuous-choice phases was not significantly affected by the prior provision of choice or bonus points. The continuous-choice periods (time periods) effect was non-significant, $F(1, 82) = 1.043, p = .310$; the interaction effect between continuous-choice periods and bonus was non-significant, $F(1, 82) = 1.071, p = .304$; the interaction effect between continuous-choice periods and choice was non-significant, $F(1, 82) = .601, p = .440$; and the interaction effect between continuous-choice periods, bonus, and choice was non-significant, $F(1, 82) = .011, p = .918$.

Tests of between-subjects effects also indicated no statistically significant main effects for bonus, $F(1, 82) = .675, p = .414$, choice, $F(1, 82) = 2.328, p = .131$, or a bonus by choice interaction, $F(1, 82) = .218, p = .642$. Although there were no significant effects, visual patterns suggest the various treatment combinations may have differentially affected voluntary engagement.

Any problems attempted. The mean percentage of students in each condition who attempted any math problems during the continuous-choice periods was calculated. Table 8 (Figure 11) provides these percentages for each continuous-choice time period. That is, if a student attempted one or more problems, they were put into the “any attempted” category. Overall, Pearson Chi-Square tests of independence indicated a significant difference between Choice and No Choice conditions on the proportion of students who attempted any math problems during the voluntary engagement posttest,

Table 7. *Adjusted Repeated Measures Voluntary Engagement Means with (Number of Participants, and Standard Error) for Digits Attempted across Continuous-Choice Periods and by Treatment Condition.*

	Choice	No Choice	Composite
Bonus			
CC Po	90.73 (20, 19.26)	49.62 (23, 17.92)	70.17 (43, 13.15)
CC Fo	73.44 (20, 19.18)	44.72 (23, 17.85)	59.08 (43, 13.10)
CC Mean	65.32 (20, 16.69)	49.84 (23, 15.56)	57.58 (43, 11.41)
No Bonus			
CC Po	60.28 (18, 20.87)	37.20 (26, 17.05)	48.74 (44, 13.23)
CC Fo	58.90 (18, 20.79)	45.25 (26, 16.98)	52.08 (44, 13.18)
CC Mean	85.82 (18, 17.59)	30.83 (26, 14.64)	58.32 (44, 11.44)
Composite			
CC Po	75.51 (38, 14.09)	43.41 (49, 12.36)	
CC Fo	66.17 (38, 14.03)	44.98 (49, 12.31)	
CC Mean	75.57 (38, 12.13)	40.34 (49, 10.68)	

Note. CC Po refers to the continuous-choice posttest measure of voluntary engagement; and CC Fo refers to the continuous-choice followup measure of voluntary engagement. The Composite rows and columns refer to the mean of each condition collapsed across the other condition. All mean scores are adjusted for the pretest covariate.

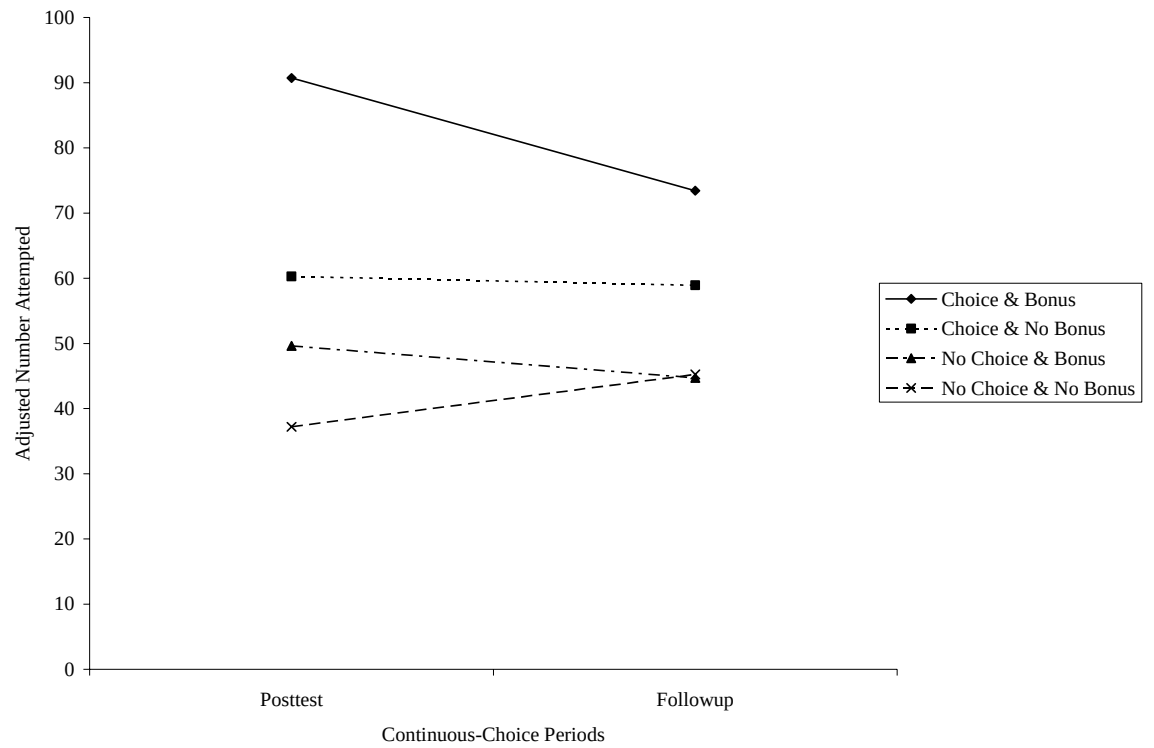


Figure 10. *Adjusted Repeated Measures Voluntary Engagement Means for Digits Attempted with across Time Periods and by Treatment Condition.*

Table 8. *Mean Percentage of Students (and valid total number of students) in each Condition who Attempted Any Math Problems during each Continuous-Choice Period.*

		Choice	No Choice	Composite
Bonus	CC Pre	61.9 (21)	56.5 (23)	59.1 (44)
	CC Po	71.4 (21)	39.1 (23)	54.5 (44)
	CC Fo	35.0 (20)	43.5 (23)	39.5 (43)
No Bonus	CC Pre	68.4 (19)	46.2 (26)	55.6 (45)
	CC Po	42.1 (19)	30.8 (26)	35.6 (45)
	CC Fo	50.0 (18)	30.8 (26)	38.6 (44)
Composite	CC Pre	65.0 (40)	51.0 (49)	
	CC Po	57.5 (40)	34.7 (49)	
	CC Fo	42.1 (38)	36.7 (49)	

Note. CC Pre refers to the continuous-choice pretest measure of voluntary engagement; CC Po refers to the continuous-choice posttest measure of voluntary engagement; and CC Fo refers to the continuous-choice followup measure of voluntary engagement. The Composite rows and columns refer to the mean of each condition collapsed across the other condition.

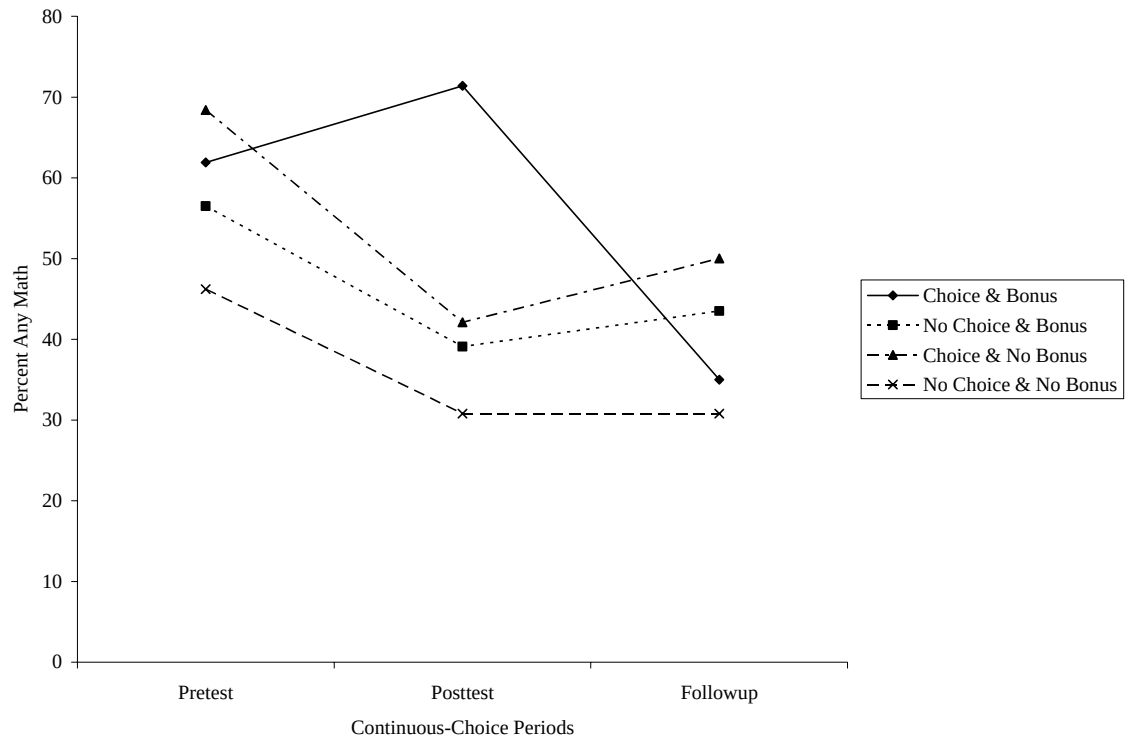


Figure 11. *Mean Percentage of Students who Attempted Any Math Problems by Treatment Condition and across Continuous-Choice Periods.*

$\chi^2(1, N = 89) = 4.63, p = .031$, with more students in the Choice conditions attempting one or more problem(s). This difference did not remain during the voluntary engagement followup measure. Pearson Chi-Square tests indicated a significant difference between the four treatment combinations on the voluntary engagement posttest measure, $\chi^2(3, N = 89) = 8.44, p = .038$, but not on the followup measure. The mean percentage of students (who attempted any problems) in each condition except for the Choice/Bonus condition decreased from the continuous-choice pretest to the posttest, and remained lower in the continuous-choice followup than the pretest (see Figure 8 for patterns across phases). This pattern was different only for the Choice/Bonus condition. During the continuous-choice pretest, 61.9% of students in the Choice/Bonus condition attempted one or more math problems. This number increased to 71.4% during the continuous-choice posttest but decreased to 35% in the followup phase.

Correlational Analyses

Correlations between continuous-choice (voluntary engagement) measures and performance measures were calculated at the pretest, posttest, and followup stage. (No correlations were performed for the treatment phase because no voluntary engagement measures were taken at this stage). Table 9 provides correlations between continuous-choice and performance measures at each stage by condition. No two treatment groups had significantly different correlations between voluntary engagement and performance measures at any phase of the study; however, several apparent differences are noted. Overall correlations between voluntary engagement and performance measures were higher for the Choice conditions in both posttest (.533) and followup (.551) stages than in

Table 9. *Correlations between Continuous-Choice and Performance Measures (and Number of Participants) at each Stage.*

		Choice	No Choice	Composite
Bonus	Pretest	.655** (21)	.395 (23)	.513** (44)
	Posttest	.577** (21)	.402 (23)	.451** (44)
	Followup	.547* (20)	.455* (23)	.454** (43)
No Bonus	Pretest	.433 (19)	.452* (26)	.447** (45)
	Posttest	.495* (19)	.365* (26)	.415** (45)
	Followup	.548* (18)	.357 (26)	.465** (44)
Composite	Pretest	.549** (40)	.429** (40)	
	Posttest	.533** (40)	.386** (49)	
	Followup	.551** (38)	.413** (49)	

Note. * refers to correlations that are significant at $p = .05$; ** refers to correlations that are significant at $p = .01$.

the No Choice conditions (.386 and .413, respectively). The stronger relationship between performance and voluntary engagement in the Choice conditions suggests that one's scores on these two measures are non-significantly more dependent (can predict one from the other) under the Choice conditions than under the No Choice conditions. Specifically, the Choice/Bonus condition was associated with higher correlations (.577) between voluntary engagement and performance during the posttest phase than any other treatment combination (ranging from .365 to .495).

Within the Choice conditions, the Choice/Bonus and Choice/No Bonus conditions were associated with relatively equal correlations between measures (.547 and .548) during the followup phase, and were higher than both No Choice conditions. Within No Choice conditions, the No Choice/Bonus condition was associated with non-significantly higher correlations between measures than the No Choice/No Bonus conditions during both posttest and followup phases. Overall, a weaker pattern emerged for the Bonus and No Bonus conditions. Specifically, the Bonus conditions yielded a higher correlation (.451) than the No Bonus conditions (.415) during the posttest phase, but a lower correlation (.454) than the No Bonus conditions (.465) during the followup phase. One important consideration is the initially strong correlation under the Choice/Bonus condition seen in the pretest phase. This initial relationship may have skewed subsequent correlation comparisons.

Chapter IV

Discussion

Oliver and Williams (2006) concluded that the provision of performance-related reward contingencies for math performance undermined intrinsic motivation, possibly due to the perception of loss of control. Among other objectives, the current study addressed the issue of control by offering a choice option in congruence with a bonus point arrangement, to determine whether the provision of choice interacts with the effects of external rewards on performance and voluntary engagement. Given the lack of statistically significant results, few conclusive statements from the current study can be made regarding the effects of bonus points and the provision of choice on math performance and voluntary engagement in math activity. Nor can the results from this study provide convincing support for or against the control or competency hypotheses.

Perception of Choice

Although students in the Choice conditions were significantly more likely to perceive a choice related to the math activity on two of the three treatment days, some students in No Choice conditions reported having a choice, and some students in the Choice conditions reported not having a choice. Possible explanations for students in the Choice conditions reporting having no choice may relate to the other restrictions and controls in place. For example, students were presented with an option choice with limited range (i.e., a choice between two types of worksheets), rather than a choice allowing more freedom (i.e., a choice to do a worksheet versus nothing). Students may have perceived the act of doing a worksheet as being mandatory, regardless of whether they chose between worksheet types, because students are typically expected to comply

with adult directions in a classroom setting. With regards to students in No Choice conditions reporting having a choice, a possible social desirability effect is noted, in that students may have perceived that YES was the preferred answer to the question. Also, agreeing to the terms of the study and signing the student assent form may have contributed to students' feeling of choice in doing the research activities. Additionally, the perception of choice question was fairly vague and no clarification from researchers was offered so as to maintain consistency between conditions and treatment integrity.

Interestingly, a non-significantly higher percentage of students in the Choice/Bonus conditions reported perceived choice across all treatment days than students in the Choice/No Bonus condition. This may point to a slight additive effect of the provision of choice and bonus points on students' perception of choice. Perhaps the fact that the points attached to performance were extra points, rather than part of a regular course grade, contributed to a perception that the assignment was optional.

Math Performance

A fundamental question regarding the provision of bonus points is whether providing them reinforced (increased) math performance. One way to determine this is to identify increases in performance across the treatment period. If students' performance increased after receiving bonus points and if students receiving bonus credit performed better than students not receiving bonus points, then bonus credit appears to have reinforced performance. Also, there was a significant within-subjects effect for treatment days, with students completing more problems accurately on the third than the first treatment day. Students did show increases in performance after receiving bonus credit, but students in no bonus conditions also showed a net, but inconsistent, improvement

from the first to third treatment day, possibly due to practice. Ultimately, bonus points produced a significant between-subjects effect during the treatment period, indicating that students working for bonus points (overall mean = 109.72) performed better than those not working for points (overall mean = 97.27). Based on visual analysis of Figure 8, both the Choice/Bonus condition and the No Choice/Bonus condition were associated with accuracy scores at least 10 digits higher across all three treatment days than either of the No Bonus conditions. These results are consistent with the Oliver and Williams (2006) findings that a bonus point condition was superior to a control condition in producing higher levels of performance during treatment.

Math performance across time periods (treatment, post-treatment, and followup) was not significantly affected by choice or bonus conditions. Figure 7 suggests that while treatment conditions were in place the No Choice/Bonus condition led to the highest levels of adjusted math performance (mean = 107.58), followed by the Choice/Bonus condition (mean = 103.12). One tentative hypothesis that can be drawn from the performance data is that bonus points may have been a more important factor than choice in determining math performance while treatment conditions were in place. The No Choice/Bonus condition was also (non-significantly) higher than the three other conditions on the math performance posttest measure. The No Choice/No Bonus condition was associated with the lowest scores on almost all performance measures, particularly the followup measure. All conditions except for the No Choice/No Bonus condition led to at least some performance maintenance (and were relatively equal to one another) in the math performance followup phase, whereas performance of students in the No Choice/No Bonus condition dropped substantially. Schunk (1983) proposed that the

informational aspect of performance-contingent rewards is likely to be more salient than the controlling aspect and would therefore have a positive net effect on skill development. The fact that students in Bonus conditions completed an average of roughly 8.5 more digits in the followup phase than students in No Bonus conditions (regardless of choice condition) is consistent with Schunk's proposal.

Figure 7 illustrates that the greatest drop (15.05 digits correct) from the treatment to posttest phase was seen under the Choice/Bonus condition as compared to decreases of 5.63 or less in the other three conditions. The least variable pattern of performance was seen for students working under the Choice/No Bonus condition, whose scores across performance phases ranged only 3.82 digits correct compared to a range of 13.35 or more digits for the other three conditions across phases. One interesting point is that performance in both No Choice conditions decreased during the followup phase, whereas performance in both Choice conditions increased from the posttest the followup phase. We can cautiously hypothesize that the provision of choice may have contributed to longer-term effects than the No Choice conditions. In terms of the followup measure of performance, all treatment combinations except the No Choice/No Bonus produced nearly equivalent levels of performance. This suggests that for the most part, any differences in performance between treatment groups as seen on treatment and posttest measures were not maintained in followup measures.

Voluntary Engagement

Voluntary engagement (as measured by digits attempted and digits correct) also was not significantly affected by choice or bonus point conditions after treatment conditions were removed. One interesting note is that students in Choice conditions

completed an average of 32.75 more digits correct during the continuous-choice posttest and 21.96 more during the continuous-choice followup activity than students in No Choice conditions, although this difference was not significant. These results are consistent with previous research demonstrating positive outcomes for student choices on voluntary engagement and on-task behavior (Hautau & Williams, 2007; McLoyd, 1979; Zuckerman et al., 1978). Students in Bonus conditions did not score significantly differently on voluntary engagement measures than students in No Bonus conditions after treatment conditions were removed. However, students in Bonus conditions completed an average of 21.13 more digits correctly on the voluntary engagement posttest and slightly more digits correctly on the followup measure than students in No Bonus conditions. These data are inconsistent with the overjustification and control hypotheses of motivation, as well as with the Oliver and Williams (2006) findings that bonus conditions were more likely to undermine intrinsic motivation than no bonus conditions.

Although no significant interaction was found between the choice and bonus points, visual examination of the raw data depicted in Figure 2 indicates a distinct pattern for students in the Choice/Bonus condition in comparison to students in the other three conditions, with the raw number of digits completed accurately during continuous-choice periods roughly doubling from the pretest measure to the posttest measure of voluntary engagement. After the pretest was added as a covariate, patterns seen in Figure 9 still indicate non-significantly higher levels of voluntary engagement during the posttest phase for students who received both the provision of choice and performance-based rewards. Students in the Choice/Bonus condition completed more digits accurately during the voluntary engagement posttest than students in Choice/No Bonus (29.79 more), No

Choice/Bonus (41.41 more), and No Choice/No Bonus (53.88 more) conditions. One might hypothesize that the combination of choice and bonus points may have produced an additive effect on voluntary engagement. Because higher scores were associated with both Choice conditions, the provision of choice seems to have been more important than the provision of bonus points in positively affecting levels of voluntary engagement. Students in both No Choice conditions displayed lower levels of voluntary engagement in both continuous-choice posttest and followup periods than other groups.

Regarding the percentage of students in each condition who attempted one or more math problems during the continuous-choice periods, all conditions except for the Choice/Bonus condition were associated with a decrease in this percentage from the pretest to the posttest, and then either a slight increase or steady performance from the posttest to the followup activity. Students in the Choice/Bonus conditions, however, showed an increase in the proportion of students who attempted any math from the pretest to the posttest, although the higher percentage was not maintained during the followup measure. During the continuous-choice posttest, a higher percentage of students in the Choice/Bonus condition completed one or more math problems than students in the other three conditions (29.3% more than the Choice/No Bonus condition, 32.3% more than the No Choice/Bonus condition, and 40.6% more than the No Choice/No Bonus Condition). During the voluntary engagement posttest, 22.80% more students in Choice conditions completed one or more math responses than students in No Choice conditions, and 18.90% more students in Bonus conditions completed any math than students in No Bonus conditions.

Overjustification Effect

Because of the lack of statistically significant voluntary engagement results, this study cannot provide conclusive evidence for or against the existence of an overjustification effect resulting from performance-contingent rewards. The findings also do not provide direct support for whether informational or controlling properties of bonus points are more salient. The competency hypothesis proposes that intrinsic motivation is affected by the receipt of competency information (Karniol & Ross, 1977). Cameron et al. (2001) concluded that performance-contingent rewards contribute to intrinsic motivation because they convey this competency information. Conversely, the control hypothesis predicts that the more the reward contingencies exert control over behavior, the greater the decrements in free-choice behavior (Deci, 1975). According to this theory, the performance-related contingency should have been perceived as more controlling than the no bonus condition, especially given that both Bonus and No Bonus groups earned feedback that provided information regarding competency (or incompetency).

Deci et al. (2001) contend that “by far the most detrimental type of performance-contingent rewards – indeed, the most detrimental type of rewards – is one... in which rewards are administered as a direct function of people’s performance. If people do superlatively, they get large rewards, but if they do not display optimal performance, they get smaller rewards (p. 644).” In their meta-analysis on the effects of extrinsic rewards on intrinsic motivation, Deci et al. found that this specific type of performance-contingent rewards was associated with the largest undermining effect of any category used in the entire meta-analysis, indicating that rewarding people as a direct function of performance can have serious negative affects. Presumably, the fact that the bonus points in the current

study were expected rather than unexpected would further contribute to the controlling aspects of the reward (Deci, et al.). Oliver and Williams (2006) also found an accuracy contingency to have a more adverse effect on voluntary engagement than a completion contingency and a no-reward contingency. Therefore, under these assumptions, the Bonus contingency should have led to lower levels of posttest and followup voluntary engagement than the No Bonus condition, especially with choice conditions held constant. However, patterns of results from the current study do not support this hypothesis. With choice conditions held constant, students in the Bonus conditions displayed higher levels of voluntary engagement than their counterparts, although these differences were not significant.

According to the control hypothesis, students who received choice combined with expected, performance-contingent rewards for math activity would have been less likely to select that activity later than students who received choice combined with feedback only. However, under the Choice/Bonus conditions (1) students displayed the highest levels of posttest and followup voluntary engagement as measured by digits correct, and (2) the highest percentage of students attempted any math during the posttest, signifying a possible additive effect of choice and bonus points on voluntary engagement, especially on the posttest measure. Overall, the fact that students in Bonus conditions did not perform more poorly than students in No Bonus conditions during voluntary engagement posttest or followup periods is inconsistent with the contention that external performance-contingent rewards are detrimental to intrinsic motivation.

Theorists who support the cognitive evaluation theory would predict that the performance-contingent rewards have the potential to positively affect intrinsic

motivation if the rewards are interpreted as informational, or negatively if they are perceived as controlling (Deci et al., 2001). It is difficult to say how students in the current study interpreted the performance-contingent rewards because their perceptions of control were not directly measured. The perception of choice question was used primarily as a measure of treatment validity rather than a method of determining whether choice conditions translated into higher levels of perceived control over the activity. Results of previous research studies have shown that perception or sense of control over activities can be improved by providing students choices (Flowerday & Schraw, 2003; Zuckerman et al., 1978).

Results did not show lower posttest and followup levels of voluntary engagement for all conditions in which students were rewarded with bonus points, as would be evident if an overjustification effect had occurred. Instead, results were mixed for students in Bonus conditions; those also receiving choice displayed the highest levels of performance during voluntary engagement posttests, whereas those receiving no choice showed lower levels. The data provide some evidence that the provision of choice added to the provision of bonus points may positively contribute to voluntary engagement in math activity. The pattern of scores across voluntary engagement periods indicates overall positive effects for the provision of choice. It seems that not providing choices may be more detrimental than providing external performance-contingent rewards.

Limitations and Future Research

The statistical power in this study (probability that the test will reject a false null hypothesis) was adversely affected by the very small sample size and large within-group variation (Cohen, 1988). The likelihood of detecting an effect, given that an effect

possibly existed, was limited in this case. The small sample size was affected by the nature of repeated measures designs, in that students who were absent for any of the measures were deleted from the analyses. Additionally, students who did not agree to the student assent form or return the parent consent form also were deleted from the pool of cases used in the analysis. Larger sample sizes will be needed to reach statistically significant patterns in future research. The large range of possible scores for both performance and voluntary engagement measures led to large variability in measurements. This is true especially for the continuous-choice worksheet, in that students could choose to work on math for the entire 10-minute period or not at all. Students could complete anywhere from 0 up to 396 digits in this case (although few students reached the higher end of the range), contributing to very large within-group differences and to very large standard deviations within groups.

The random assignment of treatment conditions to classrooms, versus individual students, also may have limited the study. This arrangement does not allow for control over external variables such as teacher characteristics or other classroom arrangements. The structure of the classrooms made the potential random assignment of students to conditions a logistical challenge. Because students remained in the same classroom for all subjects (except “specials” such as art and physical education), it would have been difficult to pull students into a different classroom for the 10- to 20-minute period required each day to administer the treatment conditions. Also, the option of delivering varying treatment conditions to students within the same classroom could have potentially contributed to conversation or information sharing among students that blurred the distinctions between the treatment conditions. Furthermore, instructors and

students may have negatively regarded providing bonus points to only some students within a classroom. A possible solution to this obstacle may be to type individualized instructions for each treatment combination on a cover sheet over the worksheet activities and distribute the different packets to students within the same classroom. This arrangement would allow researchers to avoid reading various sets of instructions within the same classroom and may help eliminate effects of external variables associated with different teachers and classrooms.

The treatment conditions were applied only once per day for a 5-minute time frame over three consecutive days. The brevity of the study, particularly the treatment phase, surely limits the conclusions that can be drawn. In an effort to be unobtrusive in the classroom and school setting, the entire study was conducted over a 3-week period, with the pretest, treatment, and posttest activities all administered within a 1-week time period. The followup activities, only 2 weeks removed from the treatment phase, may not be indicative of long-term effects of the conditions. Flowerday et al. (2004) suggested that more long-term and systematic programs involving choices may result in more powerful outcomes.

Another limitation of the study lies in the lack of interrater reliability data for worksheets scored during treatment days. Primary raters scored the treatment worksheets immediately after completion on each of the three treatment days and provided immediate feedback to the students. For the sake of efficiency, raters marked directly on the worksheets and provided the students with their graded worksheets to review. The ratings of the primary and secondary raters during treatment could have been compared had they been graded at a time removed from the treatment activity. However, the

researcher believed that providing immediate feedback to students regarding their performance (and bonus points earned, if in Bonus conditions) was more critical than confirming interrater reliability on those treatment days. Future research could address this issue by having more researchers on hand to rapidly rate and re-rate all assignments.

The limited number of activity options during continuous-choice activities presents another limitation of the findings. This arrangement was limited in that students were expected to work on one, two, or all three of the assignments during the period. Therefore the voluntary engagement (interest) measures are relative to the students' interest in word-search and word-jumble activities. Although this arrangement potentially limits the conclusions that can be drawn regarding effects of choice and bonus conditions on voluntary participation, it is a reasonable representation of choices that may be accessible to students in a classroom setting.

There were several concerns that arose with respect to the math activity during the treatment days. One consideration is how well students understood the expectations and feedback regarding the scoring of the treatment worksheets. It is improbable that students regularly receive feedback on math activities in terms of digits correct. However, students are likely familiar with the concept of partial credit given for math problems, which is a similar concept. Another concern relates to directions given during the treatment phase. Worksheets type A and B were created to contain identical numerical operations as worked from left to right across each row. Despite clear directions to work the problems in order without skipping around, some students did not comply with this request and worked the problems in a different order, or skipped problems. One reassurance is that problems did not increase or decrease in difficulty level as problems were worked from

beginning to end. Rather, problems on one row were designed to be very similar to the next row, and so forth.

An external validity issue is whether the findings of the current study would generalize to students of other age groups. Boggiano and Ruble (1979) found that the effects of rewards on intrinsic interest might vary according to age group. In their study, social-comparison information mediated the negative effects of task-contingent rewards on intrinsic interest for older but not for younger children. Furthermore, external validity issues could be addressed by measuring the effects of similar bonus and choice contingencies on performance and interest in other content areas, such as reading or writing. Additionally, Pallak et al. (1982) stressed the importance of an individual's prior experience with rewards as a possible variable in terms of the relative salience of the informational versus controlling aspects of rewards. The students' current or previous teachers may have differed with respect to the use of various types of verbal, symbolic, and tangible rewards within the classroom, although there was no indication that this was the case.

Previous research (e.g., Loveland & Olley, 1979; Oliver & Williams, 2006) has demonstrated that initial interest level may mediate a reward's effects on intrinsic motivation. The methodology in the current study was limited in that any influence of initial performance level or interest level on the effects of the treatment conditions was not measured. Because both the performance and continuous-choice pretests were used as covariates in their respective analyses, they could not also be used as between-subjects variables.

In order to accurately study the effects of performance-contingent rewards,

Eisenberger et al. (1999) contended that the reward group should be compared to an unrewarded control condition that operates under the same performance objective(s) and provides the same performance feedback. In the current study, participants in all conditions were given feedback regarding their performance on treatment activities in terms of digits correct. Although the stated performance objective for all conditions was for students to work the problems in order and to try their best, students in Bonus conditions may have perceived the additional objective of meeting a high performance standard in order to earn bonus points.

One important issue embedded within the predicted effects of performance-contingent rewards is whether the information conveys competence or incompetence. Students receiving information that indicates poor performance may respond differently to performance-contingent rewards than those receiving information that conveys exemplary performance (Deci et al., 2001). In the current study, receiving bonus points for high levels of performance should convey competence, whereas receiving no bonus points for poor performance should convey incompetence. Whether the performance feedback received is positive may differentially affect how rewards are interpreted and subsequent levels of performance and voluntary engagement. The current study failed to distinguish effects of the treatment conditions on students receiving positive versus negative feedback.

One unresolved question is how the saliency or value of a reward affects the likelihood of an overjustification occurrence. Does a salient reward distract from the intrinsic value of an activity or underscore the value of the activity? Presumably, the overjustification effect is most likely to occur when a reward produces a reinforcement

effect because the perception of the reward as “controlling” should be more likely than if the reward did not change performance (Williams, 1980). One perspective is that highly-valued rewards are more likely than lesser-valued rewards to cause a reinforcement effect, leading to an inverse relationship between a reinforcement effect and an overjustification effect (Williams). This would lead to the proposal that higher-valued rewards are less likely to result in decreases in intrinsic task motivation. In the current study, minimal bonus points were provided for accurate math performance and appeared to produce a moderate reinforcement effect. Future research should address the issue of reward saliency and value by comparing a small bonus-point reward to a larger bonus-point reward to determine whether high- versus low-value rewards differentially affect voluntary engagement in the previously rewarded activity.

Future research may address some of the issues and obstacles that emerged during this study in order to have a greater likelihood of determining effects of performance-contingent bonus points and choice of work assignments on student performance and voluntary engagement in academic activities. Increasing the length of the treatment phase and using random assignment of treatment conditions to individual students rather than classrooms may increase treatment integrity and lead to more conclusive outcomes. Additionally, a larger sample size would increase the power of the statistical analyses. Increasing the specificity of questions related to the perception of choice, as well as adding questions regarding the perception of control would allow for more direct measures of how students perceived the provision of choice.

Because the cognitive evaluation theory asserts that the effects of rewards depend on the perceived salience of informational versus controlling aspects of rewards,

additional supplemental questions could be developed in order to answer more directly research questions pertaining to the perception of these features. Rewording the treatment directions to increase the potency of the worksheet choice may increase the effects of the Choice condition. For example, telling students that one worksheet type was strongly preferred by other students may enhance the perception of choice.

Concluding Remarks

Although the current study showed no statistically significant effects for the provision of choice on math performance or voluntary engagement in math activity, trends in the data are consistent with previous research that has demonstrated that choice of learning activity shows potential for positively affecting voluntary engagement (McLoyd, 1979). Aside from providing choice of study time, which has been shown to decrease time spend studying (Flowerday & Schraw, 2003), providing choices to students while maintaining equivalent opportunity for learning and equivalent level of task difficulty is still a promising technique and should be given consideration in future research.

Eisenberger et al. (1999) stressed the theoretical and practical importance of determining the effects of performance-contingent rewards on perceived autonomy and intrinsic motivation, in that these types of rewards are used regularly in school systems (grades) and work environments (bonuses and pay increases). Although the provision of performance-contingent bonus points in the current study did not significantly affect student performance during post-treatment measures, Bonus appears to be more promising than a No Bonus condition in positively affecting voluntary engagement and performance.

Some concluding observations from the current study are as follows:

- Students in choice conditions were more likely to perceive choice in the math activity than students not given a choice.
- Overall main effect indicated that bonus points had a positive effect on performance during the treatment phase.
- Neither choice nor bonus points significantly affected performance or voluntary engagement across time periods.
- A higher percentage of students in choice conditions attempted one or more math problems during the posttest phase than students in no choice conditions.
- No significant evidence was obtained for the occurrence of an overjustification effect.
- Both control (having a choice of math tasks) and competency information (performance-contingent bonus points) seem to be positively related to voluntary engagement in math activity.

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Appendices

Appendix A

1)
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2)
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3)
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4)
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5)
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6)
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7)
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8)
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9)
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11)
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14)
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16)
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17)
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18)
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19)
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31)
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32)
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$$\begin{array}{r} 63) 79 \\ +36 \\ \hline \end{array}$$

$$\begin{array}{r} 64) 694 \\ +204 \\ \hline \end{array}$$

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70) 164
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71) 89
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74) 638
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84) 547
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92) 412
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Please circle your response to the question below:

* Do you feel you had choice in this activity? Circle YES or NO

Appendix B

WORKSHEET B day 1 Page 1

NAME _____

1) 36 +89	2) 3 +4	3) 0 +5	4) 6 +2	5) 28 +84	6) 4 +1	7) 7 +2	8) 4 +3
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9) 71 +69	10) 7 +2	11) 2 +3	12) 5 +4	13) 98 +87	14) 9 +0	15) 2 +5	16) 6 +3
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17) 47 +86	18) 3 +1	19) 7 +2	20) 2 +6	21) 48 +76	22) 4 +1	23) 5 +3	24) 2 +3
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25) 86 +49	26) 7 +2	27) 4 +3	28) 5 +4	29) 65 +87	30) 1 +5	31) 7 +2	32) 2 +6
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33) 46 +57	34) 6 +3	35) 0 +9	36) 3 +3	37) 74 +57	38) 4 +3	39) 5 +4	40) 2 +1
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41) 94 +28	42) 4 +3	43) 9 +0	44) 5 +3	45) 78 +75	46) 2 +6	47) 2 +7	48) 1 +3
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49) 48 +67	50) 4 +1	51) 3 +6	52) 2 +5	53) 64 +98	54) 1 +2	55) 5 +3	56) 7 +2
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57) 45 +79	58) 1 +3	59) 2 +6	60) 3 +4	61) 85 +57	62) 3 +4	63) 2 +2	64) 6 +3
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WORKSHEET B day 1 Page 2

NAME _____

65) 96 <u>+75</u>	66) 5 <u>+2</u>	67) 1 <u>+5</u>	68) 4 <u>+4</u>	69) 38 <u>+78</u>	70) 2 <u>+4</u>	71) 2 <u>+3</u>	72) 3 <u>+5</u>
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73) 95 <u>+58</u>	74) 4 <u>+5</u>	75) 1 <u>+3</u>	76) 2 <u>+4</u>	77) 27 <u>+87</u>	78) 2 <u>+4</u>	79) 1 <u>+4</u>	80) 7 <u>+2</u>
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81) 68 <u>+49</u>	82) 4 <u>+3</u>	83) 6 <u>+1</u>	84) 5 <u>+2</u>	85) 63 <u>+57</u>	86) 5 <u>+1</u>	87) 2 <u>+5</u>	88) 4 <u>+2</u>
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89) 69 <u>+81</u>	90) 2 <u>+6</u>	91) 6 <u>+3</u>	92) 3 <u>+5</u>	93) 79 <u>+76</u>	94) 5 <u>+2</u>	95) 6 <u>+3</u>	96) 4 <u>+2</u>
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97) 65 <u>+87</u>	98) 7 <u>+2</u>	99) 2 <u>+3</u>	100) 5 <u>+4</u>	101) 79 <u>+38</u>	102) 6 <u>+1</u>	103) 0 <u>+5</u>	104) 3 <u>+4</u>
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105) 95 <u>+25</u>	106) 7 <u>+2</u>	107) 5 <u>+4</u>	108) 3 <u>+2</u>	109) 75 <u>+38</u>	110) 1 <u>+3</u>	111) 3 <u>+4</u>	112) 2 <u>+6</u>
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113) 58 <u>+67</u>	114) 5 <u>+2</u>	115) 3 <u>+6</u>	116) 4 <u>+5</u>	117) 63 <u>+59</u>	118) 4 <u>+2</u>	119) 1 <u>+8</u>	120) 2 <u>+7</u>
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121) 98 <u>+35</u>	122) 4 <u>+2</u>	123) 1 <u>+8</u>	124) 5 <u>+3</u>	125) 36 <u>+79</u>	126) 4 <u>+4</u>	127) 9 <u>+0</u>	128) 6 <u>+2</u>
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129) 86 <u>+59</u>	130) 6 <u>+3</u>	131) 7 <u>+1</u>	132) 3 <u>+2</u>	133) 89 <u>+62</u>	134) 2 <u>+7</u>	135) 5 <u>+2</u>	136) 3 <u>+6</u>
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WORKSHEET B day 1 Page 3

NAME _____

137) 57	138) 4	139) 6	140) 1	141) 87	142) 2	143) 0	144) 5
<u>+67</u>	<u>+4</u>	<u>+3</u>	<u>+2</u>	<u>+89</u>	<u>+2</u>	<u>+3</u>	<u>+3</u>

145) 75	146) 8	147) 3	148) 6	149) 97	150) 5	151) 3	152) 4
<u>+39</u>	<u>+1</u>	<u>+4</u>	<u>+2</u>	<u>+46</u>	<u>+3</u>	<u>+2</u>	<u>+5</u>

153) 97	154) 6	155) 1	156) 2	157) 75	158) 3	159) 2	160) 4
<u>+34</u>	<u>+3</u>	<u>+8</u>	<u>+4</u>	<u>+58</u>	<u>+2</u>	<u>+3</u>	<u>+1</u>

161) 98	162) 6	163) 1	164) 3	165) 58	166) 7	167) 4	168) 5
<u>+36</u>	<u>+2</u>	<u>+5</u>	<u>+4</u>	<u>+74</u>	<u>+2</u>	<u>+4</u>	<u>+2</u>

169) 97	170) 1	171) 2	172) 3	173) 96	174) 1	175) 4	176) 3
<u>+58</u>	<u>+5</u>	<u>+2</u>	<u>+6</u>	<u>+75</u>	<u>+4</u>	<u>+2</u>	<u>+3</u>

177) 65	178) 7	179) 5	180) 2	181) 92	182) 2	183) 1	184) 4
<u>+47</u>	<u>+2</u>	<u>+3</u>	<u>+4</u>	<u>+78</u>	<u>+4</u>	<u>+7</u>	<u>+5</u>

185) 59	186) 3	187) 2	188) 3	189) 65	190) 4	191) 3	192) 6
<u>+85</u>	<u>+5</u>	<u>+7</u>	<u>+4</u>	<u>+87</u>	<u>+1</u>	<u>+3</u>	<u>+2</u>

193) 59	194) 2	195) 8	196) 7	197) 38	198) 2	199) 3	200) 5
<u>+54</u>	<u>+6</u>	<u>+1</u>	<u>+2</u>	<u>+86</u>	<u>+4</u>	<u>+4</u>	<u>+2</u>

Please circle your response to the question below:

* Do you feel you had choice in this activity? Circle YES or NO

Appendix C

Student assent (only for students who turned in parent consent). Read assent form aloud and have students sign.

October 23 (Monday) and 27 (Friday)

Student Directions (first)

CONTINUOUS-CHOICE ACTIVITY – all conditions

Students:

- A. Thank you for working with us today. We will pass out three activities face-down on your desks. Please do not turn over the worksheets until you are given further instructions.
- B. *Distribute worksheets facedown*
- C. We have given you three packets of activities. When we say begin, please work on one, two, or all three of the activities on your desk. You can work on whatever part of any of these three activities you would like for the next 10 minutes. You can work on one the entire time or switch back and forth. Please work on something time until I tell you to stop. You will receive no grade for your performance. Please turn the packets face up at this time and place them side-by-side on your desk so that you can see all of them. Write your name at the top of each assignment. Do you have any questions? You may begin work now.
- D. *Time 10 minutes.*
- E. Please stop work. Make sure your name is written on all three packets, even if you did not work on every one. We will now collect your packets. Thank you.
- F. *Collect worksheets.*

October 23 (Monday) and 27 (Friday)

Student Directions (second)

MATH PRETEST AND POSTTEST – all conditions

Students:

- A. *Pass out worksheets as directions are being read.*
- B. We are now passing out a math activity. Please do not begin until we tell you to. You will have 5 minutes to work on this activity. You will not receive a grade or points for this activity, but please do your best. Work the problems in order as they are numbered and do not skip around. Work left to right across the page. Please write your name on the worksheet now. You may begin.
- C. *Time 5 minutes.*
- D. Please stop work. Make sure your name is on the worksheet. We will now collect your worksheets. Thank you.

Student Directions

CHOICE and BONUS POINTS

Students:

- A. Thank you for working with us today. Please wait for instructions while we distribute two worksheets on your desk.
- B. *Distribute worksheets facedown*
- C. There are two different types of worksheets face down on your desk. You will choose one to work on for the next 5 minutes. As shown on this poster, you will earn bonus points based on your performance. *Show poster*. We will give you partial credit for the problems. ***This poster shows an example of how the partial credit works. Follow example on poster.*** Now please turn over your worksheets and decide which worksheet you would like to work on today. Both worksheets contain the same amount of carrying.
- D. Time 15 seconds
- E. Please keep the worksheet that you have chosen on your desk and pass the other worksheet to the front now. Write your name on the worksheet you have chosen. Do not begin work until I give the signal.
- F. *Collect remaining worksheets.*
- G. When I say begin, please work the problems from beginning to end as they are numbered. Please work the problems in order as they are numbered and do not skip around. Work left to right across the page. If you finish a page, continue on to the next pages. I will tell you to stop in exactly 5 minutes. Please try your best on whichever worksheet you have chosen. Do you have any questions? You may begin.
- H. *Time 5 minutes.*
- I. Please stop work and turn to the last page of your worksheet.
 - a. Please circle YES or NO in response to the question: Did you have a choice in this activity?
 - b. Please make sure your name is on your paper.
 - c. We will now collect and grade your worksheets to give you feedback on your performance and let you know how many bonus points you have earned. While we are grading the worksheets, please *follow your teacher's instructions*.
- J. *Collect and score worksheets*
- K. *Teacher distribute graded worksheets*
- L. Your teacher is passing out your graded worksheets for you to look over. The number correct and the number of bonus points you have earned is on the top of your paper. I will collect your worksheets again in 1 minute.
- M. *Time one minute and then collect worksheets*

Student Directions

CHOICE and NO BONUS POINTS

Students:

- A. Thank you for working with us today. Please wait for instructions while we distribute two worksheets on your desk.
- B. *Distribute worksheets facedown.*
- C. I have two types of worksheets for you to choose from to work on today for 5 minutes. They are both face down on your desk. You will not earn any regular or bonus credit for your performance but we will tell you how many you got correct. ***Follow example on poster to show how we will count “correct”.*** When I give the signal, please turn over both worksheets on your desk and take one minute to decide which worksheet you would like to work on today. Now please turn over your worksheets and decide which worksheet you would like to work on today. Both worksheets contain the same amount of carrying.
- D. *Time 15 seconds*
- E. Please keep the worksheet that you have chosen on your desk and pass the other worksheet to the front now. Write your name on the worksheet you have chosen. Do not begin work until I give the signal.
- F. *Collect remaining worksheets.*
- G. When I say begin, please work the problems from beginning to end as they are numbered. Please work the problems in order as they are numbered and do not skip around. Work left to right across the page. If you finish a page, continue on to the next pages. I will tell you to stop in exactly 5 minutes. Please try your best on whichever worksheet you have chosen. Do you have any questions? You may begin.
- H. *Time 5 minutes*
- I. Please stop work and turn to the last page of your worksheet.
 - a. Please circle YES or NO in response to the question: Did you have a choice in this activity?
 - b. Please make sure your name is on your paper.
 - a. We will now collect and grade your worksheets to give you feedback on your performance. While we are grading the worksheets, please *follow your teacher’s instructions.*
- J. *Collect and score worksheets*
- K. *Teacher distribute graded worksheets*
- L. Your teacher is passing out your graded worksheets for you to look over. I will collect your worksheets again in 1 minute.
- M. *Time one minute and then collect worksheets*

Student Directions

NO CHOICE and BONUS POINTS

Students:

- A. Thank you for working with us today. You will be assigned one of two types of math worksheets to work on for 5 minutes. As shown on this poster, you will earn bonus points based on your performance. *Show poster.* We will give you partial credit for the problems. ***This poster shows an example of how the partial credit works. Follow example on poster.*** We will now pass out the worksheets. Wait to begin work until we give the signal.
- B. Distribute prepared worksheets
- C. When I say begin, please work the problems from beginning to end as they are numbered. Please work the problems in order as they are numbered and do not skip around. Work left to right across the page. If you finish a page, continue on to the next pages. I will tell you to stop in exactly 5 minutes. Please try your best on whichever worksheet you have received. Do you have any questions? You're your paper over and write your name on the front. You may begin work.
- D. *Time 5 minutes.*
- E. Please stop work and turn to the last page of your worksheet.
 - a. Please circle YES or NO in response to the question: Did you have a choice in this activity?
 - b. Please make sure your name is on your paper.
 - c. We will now collect and grade your worksheets to give you feedback on your performance and let you know how many bonus points you have earned. While we are grading the worksheets, please *follow your teacher's instructions.*
- F. *Collect and score worksheets*
- G. *Teacher distribute graded worksheets*
- H. Your teacher is passing out your graded worksheets for you to look over. The number correct and the number of bonus points you have earned is on the top of your paper. I will collect your worksheets again in 1 minute.
- I. *Time one minute and then collect worksheets*

Student Directions

NO CHOICE and NO BONUS POINTS

Students:

- A. Thank you for working with us today on this math worksheet. You will be assigned one of two types of math worksheets to work on for 5 minutes. You will not earn any regular or bonus credit for your performance but we will tell you how many you got correct. ***Follow example on poster to show how we will count “correct”.*** We will now pass out the worksheets. Wait to begin work until we give the signal.
- B. Distribute prepared worksheets
- C. When I say begin, please work the problems from beginning to end as they are numbered. Please work the problems in order as they are numbered and do not skip around. Work left to right across the page. If you finish a page, continue on to the next pages. I will tell you to stop in exactly 5 minutes. Please try your best on whichever worksheet you have received. Do you have any questions? You’re your paper over and write your name on the front. You may begin work.
- D. Time 5 minutes
- E. Please stop work and turn to the last page of your worksheet.
 - a. Please circle YES or NO in response to the question: Did you have a choice in this activity?
 - b. We will now collect and grade your worksheets to give you feedback on your performance. While we are grading the worksheets, please *follow your teacher’s instructions.*
- F. *Collect and score worksheets*
- G. *Teacher distribute graded worksheets*
- H. Your teacher is passing out your graded worksheets for you to look over. I will collect your worksheets again in 1 minute.
- I. *Collect worksheets*

Appendix D

Classroom _____

Date _____

_____ Student assent read and collected

Procedural Integrity Checklist – CONTINUOUS-CHOICE

_____ Read scripted instructions A

_____ Distributed continuous-choice worksheets face down (B)

_____ Read scripted instructions C

_____ Time 10 minutes (D)

_____ Told students to stop working after 10 minutes (E)

_____ Collected worksheets (F)

Procedural Integrity Checklist – PRETEST

_____ Distribute worksheets (A)

_____ Read scripted instructions B

_____ Time 5 minutes (C)

_____ Collected worksheets (D)

Classroom _____

Date _____

Procedural Integrity Checklist – CHOICE/BONUS POINTS

- _____ Read scripted instructions A
- _____ Distributed worksheets facedown (B)
- _____ Read scripted instructions C
- _____ Timed 15 seconds (D)
- _____ Read scripted instructions E
- _____ Collect remaining worksheets (F)
- _____ Read scripted instructions G
- _____ Timed 5 minutes (H)
- _____ Read scripted instructions I
- _____ Collected/scored worksheets (J)
- _____ Teacher distributed scored worksheets to students for 1 minute to review (K)
- _____ Read scripted instructions L
- _____ Collected worksheets (M)

Classroom _____

Date _____

Procedural Integrity Checklist – CHOICE/NO BONUS POINTS

- _____ Read scripted instructions A
- _____ Distributed worksheets facedown (B)
- _____ Read scripted instructions C
- _____ Timed 15 seconds (D)
- _____ Read scripted instructions E
- _____ Collect remaining worksheets (F)
- _____ Read scripted instructions G
- _____ Timed 5 minutes (H)
- _____ Read scripted instructions I
- _____ Collected/scored worksheets (J)
- _____ Teacher distributed scored worksheets to students for 1 minute to review (K)
- _____ Read scripted instructions L
- _____ Collected worksheets (M)

Classroom _____

Date _____

Procedural Integrity Checklist – NO CHOICE/BONUS POINTS

_____ Read scripted instructions A

_____ Distributed worksheets (B)

_____ Read scripted instructions C

_____ Timed 5 minutes (D)

_____ Read scripted instructions E

_____ Collected/scored worksheets (F)

_____ Teacher distributed scored worksheets to students for 1 minute to review (G)

_____ Read scripted instructions I

Classroom _____

Date _____

Procedural Integrity Checklist – NO CHOICE/NO BONUS POINTS

_____ Read scripted instructions A

_____ Distributed worksheets (B)

_____ Read scripted instructions C

_____ Timed 5 minutes (D)

_____ Read scripted instructions E

_____ Collected/scored worksheets (F)

_____ Teacher distributed scored worksheets to students for 1 minute to review (G)

_____ Read scripted instructions I

Vita

Briana Hautau von Mizener, daughter of Gail and Fred Hautau, was born in Oxford, Ohio on December 11, 1980. After completing high school, she attended Miami University and graduated with a Bachelors degree in Psychology and a minor in Family Relationships in 2002. She is currently working on her Ph. D in Education in the School Psychology program at the University of Tennessee, Knoxville.