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Maintenance and transfer of academic behavior in children with autism: The role of intrinsic motivation

by

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Dedication

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Abstract

Educational programs for children with autism rely on the use of extrinsic rewards to increase children's motivation to participate. However, maintenance and transfer of intervention gains remains problematic. Research with typically developing children and adults has shown that extrinsic rewards can have differing effects on intrinsic motivation. Research has shown that ways in which rewards are administered (reward contingency, interpersonal context) can increase, decrease, or leave an individual's intrinsic motivation unaffected. The present research examined whether these characteristics would increase the intrinsic motivation of children with autism, and whether observed increases maintained and generalized to novel contexts. In two different studies, children with autism were given performance-based rewards for engaging in academic activities in both choice and no-choice conditions. Each correct response earned the children one token that was exchangeable for one minute of time with their preferred reward. In some conditions, children were offered opportunities to make choices during the activity, whereas in other conditions, choice making was not allowed. Results indicated that children's intrinsic motivation for the academics was neither undermined nor enhanced following the receipt of the reward. Further, children showed a clear preference for the academic subject associated with enhanced choice. These results were discussed in terms of Skinner's behavioral theory and cognitive evaluation theory. The limitations, as well as the practical implications, are also discussed.

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Chapter 1

Children with autism often show a lack of motivation to engage in academic activities. Educational programs rely on the use of programmed instruction and explicit reinforcement contingencies to establish children's academic performance (e.g., Charlop, Schreibman, & Thibodeau, 1985; L. K. Koegel, Koegel, & Carter, 1999; Lovaas, 1987). However, the long-term maintenance of performance gains has been problematic. This may be due to a lack of attention to motivational aspects of training. Research examining the effects of rewards and motivation has shown that the manner in which reinforcers or rewards are arranged affect an individual's level of motivation (Cameron, Banko, & Pierce, 2001; Deci, Koestner, & Ryan, 1999). Thus, it may be that the reinforcement contingencies in programs for children with autism are set up in a manner that inadvertently reduces the children's long-term motivation to engage in target activities. Researchers have also suggested that motivation may be affected by the context in which children are taught (Ryan & Deci, 2000). Coercive contexts are said to decrease individuals' motivation for activities; whereas, contexts that are supportive of an individuals' feelings of autonomy may increase motivation. The proposed studies examine the effects of reward contingencies presented in different social contexts on the motivation for academic activities of children with autism. The research is also designed to assess the long-term impact of gains or losses of motivation on the maintenance of student performance and on the transfer of performance to novel environments.

Background

Autism is a debilitating neurological disorder characterized by impairments in the ability to communicate, to relate socially to others, and to behave adaptively (American Psychiatric Association, 2000). It is a disorder that presents largely as a deficit in language and social skills. As a result of these deficits, effective interventions are based on teaching children language and social skills necessary for successful independent functioning. With a prevalence of approximately 1 in 166 children being diagnosed with autism (Fombonne, 2003), providing effective intervention to remediate the impairments is of primary importance.

Early in our understanding of autism, researchers posited that children often have repeated experiences of failure, resulting in low self-efficacy and low motivation (Clark & Rutter, 1979; MacMillan, 1971). Because children with autism are known to be less willing to engage in educational activities in comparison to typically developing peers, external motivators (e.g., reinforcement) are used to promote engagement, ensuring children's participation in intervention activities (Koegel & Egel, 1979). Thus, by providing positive consequences in response to particular behavior, clinicians are able to develop in children with autism those abilities that increase the potential for successful intervention outcomes.

There are a variety of effective intervention methodologies available for children with autism (Dawson & Osterling, 1997). Although no one intervention approach can guarantee a successful outcome for a child with autism, the most robust outcome data follow interventions that are based upon a behavioral model (Schreibman, 2000). Behavior-based interventions focus on teaching children those skills necessary for independent functioning on a skill-by-skill basis. The premise of these interventions is that when behavior is followed by positive consequences, the behavior is more likely to occur again in the future (Skinner, 1953). This form of structured teaching may occur as structured table-top activities targeting discrete skills (e.g., learning to label numbers or letters, McEachin, Smith, & Lovaas, 1993) or by embedding educational goals into naturalistic activities (e.g., teaching children to request their preferred food during mealtimes, L. K. Koegel, Koegel, & Carter, 1998).

Despite their participation in intervention programs, children with autism continue to suffer from difficulties with skill maintenance and transfer of intervention gains (Schreibman, 2000). One possible solution to the problem of maintenance and transfer of intervention gains may be found by examining the literature concerned with the effects of rewards on students' intrinsic motivation. Most research in this area has been conducted with typically developing individuals. However, given that the basic principles of learning hold for children with autism, there is strong reason to believe that the results from studies on rewards and intrinsic motivation may offer insight into the issue of generalization and transfer for children with autism.

Research on rewards and intrinsic motivation indicates that rewards can have a positive, neutral, or negative effect on participants' intrinsic motivation depending upon how the rewards are administered. In a meta-analytic review of over 100 experiments, Cameron et al. (2001) found that rewards led to negative effects on people's intrinsic motivation when the rewards were tangible (e.g., money, gold stars, etc.), expected (promised to the individuals beforehand), and not contingent upon meeting any performance standard. On the other hand, positive effects were found when rewards were delivered contingent upon achieving a specific level of performance. The analyses by Cameron et al. have also shown that the effects of rewards on intrinsic motivation are not transitory; that is, they have a lasting effect. Thus, given the motivation problems that have been noted in children with autism, the pervasive use of reinforcement procedures in educational programs, and the difficulties with skill maintenance and transfer that children experience, it may be important for researchers to investigate how extrinsic rewards impact intrinsic motivation of children with autism. Ultimately, the goal of this research was to ascertain whether rewards can be used to increase intrinsic motivation for academic tasks and whether increased intrinsic motivation could improve task maintenance and transfer.

Of further interest was how the interpersonal context impacted performance and motivation. Ryan and Deci (2000) have suggested that autonomy-supportive environments (that is, environments that offer students choice and provide opportunities for self-direction), lead individuals to feel self-determined and autonomous resulting in high intrinsic motivation. In contrast, environments that are highly authoritarian (i.e., limited opportunities for choice, use of directives or threats by those in authority) make people feel controlled and reduce intrinsic motivation. The present research also aims to determine how rewards presented in autonomy-supportive versus more coercive contexts impact the intrinsic motivation for academic activities of children with autism.

Theoretical Considerations

There are two distinct theoretical perspectives that are pertinent to the present investigation: cognitive evaluation theory (Deci & Ryan, 1985) and theories based on the tenets of operant learning (Skinner, 1969). Although the theories will be described in greater detail in Chapter 2, their relevance will be briefly described below.

Cognitive evaluation theory (CET) is part of a larger theory – self-determination theory (SDT) (Deci & Ryan, 1985). According to CET, intrinsically motivating activities are those that are inherently enjoyable. Stated differently, activities are thought to be intrinsically motivating if people engage in them in the absence of external rewards. According to CET, intrinsic motivation is the product of the needs for competence and self-determination (Deci & Ryan). When people engage in activities that enhance their sense of competence, and offer the perception of increased personal causality, individuals are most interested or motivated to do these activities. In contrast, when individuals receive extrinsic rewards for engagement in an activity that was initially intrinsically motivating, the result is a reduction in perceived competence and personal volition – reducing interest in the activity (Deci & Ryan). Individuals come to believe that their engagement in the behavior is due to the extrinsic reward rather than intrinsic interest. Further, the perception that one's behavior is the result of extrinsic reward leaves the individual feeling controlled by the reward contingencies.

CET focuses on how rewards affect motivation and performance. SDT – the broader theory is concerned with how different conditions and environments support or hinder an individual's perceptions of competence, self-determination, and autonomy. In a controlling environment, individuals' performance is monitored and evaluated by authorities, deadlines are imposed, and rewards are used to manage performance. SDT posits that such a context leads people to feel pressured and controlled, and self-determination and intrinsic motivation are undermined. In autonomy-supportive environments, choices are given and controlling aspects of the situation are removed. In this context, individuals are said to experience strong feelings of competence and autonomy and high intrinsic motivation. From the perspective of CET and SDT, rewards are part of a controlling context and will result in less autonomy and intrinsic motivation. Although rewards presented in a more autonomy-supportive context will still be experienced as controlling, the negative effects may be reduced. That is, the assumptions of CET and SDT would predict that children with autism, while participating in an intervention program (either in an autonomy-supportive or more controlling context), will experience a net loss of intrinsic motivation due to the use of rewards, and subsequent performance on the target activity would be reduced in a free-choice setting.

In contrast to CET and SDT, behavioral theories offer a different view on how rewards/reinforcers may impact people's sense of autonomy and intrinsic motivation. In *Beyond Freedom and Dignity*, Skinner (1971) wrote that people from Western cultures are taught to value freedom and to oppose or escape coercive control. Part of the social learning of freedom involves identifying the situations or contexts that display the signs of freedom and other contexts that signal coercive control. People value those contexts that signal freedom and devalue those situations identified with coercive control.

Building upon Skinner's (1971) writings, the ways in which people interpret the value of rewards is impacted by the context in which the rewards are administered. When people receive rewards in coercive-controlling environments, the reward contingency should be interpreted as aversive; it should not support behavior, or motivate performance when the contingency is withdrawn (i.e., free choice). Further, it is expected that people will report lower feelings of self-determination and autonomy when rewards are used in a coercive context. In contrast, when the environment in which people find themselves elicits signals of freedom (autonomy-supportive context), the corresponding reward contingency should have reinforcing value, support behavior, and motivate performance even when the reward contingency is not in effect (free-choice). In addition, reward contingencies arranged in autonomy-supportive contexts are expected to promote high feelings of self-determination and autonomy.

The major difference between CET and a behavioral view is that for CET rewards are coercive and reduce intrinsic motivation. Although context can imbue rewards with informational value, the perception of control and loss of self-determination that is associated with rewards could never be completely offset. Behavioral theories, on the other hand, predict that rewards produce negative effects on measures of intrinsic motivation in a controlling (i.e., coercive) context, but positive effects on these measures in an autonomy-supportive environment. Thus, the effects of reward contingencies on intrinsic motivation depend on the context (coercive-controlling vs. autonomy-supportive) from a behavioral viewpoint.

The Proposed Research

This set of research studies investigated the impact of reward contingencies and interpersonal context on intrinsic motivation for academic tasks for children with autism. The research was also designed to determine whether increases in motivation lead to subsequent improvements in skill maintenance and transfer.

The studies involved a sample of children with high functioning autism or Asperger's disorder, using a within-group, repeated measures research design. Consistent across the studies, there were two experimental manipulations of interpersonal context that were interspersed among a variety of baseline (free-choice) conditions. Throughout the studies, children performed academic tasks regulated by explicit reward contingencies. During some experimental conditions, children were asked to work for rewards in an adult-directed educational context characterized by limited opportunities for choice and self-direction (coercive context). In other conditions, the same children engaged in the academic activities for rewards, but the interpersonal context allowed increased opportunities for choice and self-direction (autonomy-supportive context). Thus, these studies investigated how interpersonal context changes the motivational impact of reward contingencies for academic performance for children with autism.

In both studies, all of the children participated in both experimental settings. Participants' initial intrinsic motivation (IM) for two subject areas (math and language arts) was assessed in a free-choice format where participants choose to engage in one of three options; do the academic task, to look at a picture book, or nothing. Participants received rewards for attaining a specific level of performance on the academic tasks (e.g., math) throughout the experimental phases. The reward contingencies were then removed and free-choice sessions were arranged to detect changes in the children's IM for the academic subjects. The math and language arts procedures were carried out across two interpersonal contexts (coercive or autonomy-supportive). Post-intervention motivational differences for math and language arts were tested in a free-choice session with both activities as options; the test measures preference for one activity relative to the other, and was expected to reflect which activity occurred in the autonomy-supportive versus coercive context. Additional sessions were arranged to measure endurance of the motivational effects (maintenance of behavior), as well as transfer of motivation to novel setting. Changes in motivation were determined by assessing children's performance based on time on task, accuracy, child affect, task preference, self-reported interest, and instances of disruptive behavior.

Significance of the Proposed Research

Previous investigations have not considered children's intrinsic motivation for intervention tasks as a mediator in intervention outcomes, particularly with respect to maintenance and transfer of intervention gains. The proposed research was the first investigation of this kind for children with autism and sought to offer new strategies to promote skill maintenance and generalization. With dependence on the use of rewards in children's intervention programs, the findings of this research may have implications for education-based intervention programs for children with autism. If, as predicted, there are specific environmental characteristics (i.e., interpersonal contexts) that promote intrinsic motivation, which in turn enhance maintenance and transfer of intervention gains, evidence supporting this conclusion will contribute to the definition of best practice (National Research council, 2001) in intervention for children with autism.

Chapter 2

Review of Rewards and Motivation Literature

Included in this chapter is a review of the research on the effects that rewards can have on human motivation. Once an explanation is presented of how the line of research was initiated, the constructs of intrinsic and extrinsic motivation are described. Following this, the common research paradigms are compared and contrasted. Finally, the major findings from research conducted within each of the paradigms are summarized.

Introduction

When people receive rewards for engaging in a task that is initially interesting DeCharms (1968) claimed that their motivation for engaging in the task shifts from internal to external motivation. That is, the rewards for behavior shift people's perception to an external locus of causality rather than one based on self-determination and personal interest (DeCharms). The result of this perceptual shift is that people lose interest in the rewarded activities.

In 1971, Deci conducted a study to investigate this claim. Participants were asked to complete a series of puzzles; half of the participants were rewarded for puzzle solving and the other half were not. Deci found that those who received rewards for completing puzzles spent less time working on the puzzles in a free-choice period (with no reward). Deci interpreted his results as evidence that extrinsic rewards were harmful to intrinsic motivation (the detrimental effect of reward hypothesis). From an attribution point of view, the detrimental effects of rewards involve a perceived shift in the locus of causation from internal factors to external factors (Lepper, Greene, & Nisbett, 1973). From the perspective of cognitive evaluation theory (Deci & Ryan, 1985), the claim is that when external rewards are received for engaging in behavior that was originally intrinsically motivating, individuals experience a loss of perceived competence and self-determination leading to decreased intrinsic motivation for the task or activity.

Intrinsic and Extrinsic Motivation

Intrinsic motivation is said to be the product of innate drives for competence and self-determination (Deci & Ryan, 1985). These drives are said to motivate people to seek optimal levels of challenge based on their interests and activate creativity and resourcefulness. In contrast, extrinsic motivation occurs when people engage in behavior for external reasons rather than for the inherent enjoyment of the activity. Extrinsic motivators are considered to be any external variable that asserts influence on behavior. According to Deci and Ryan, extrinsic rewards sap the reserve of intrinsic motivation because the person no longer infers competence and self-determination from doing a rewarded activity.

Theoretical Perspectives

Cognitive evaluation theory.

Self-determination is rooted in the “experience of choice, … the experience of an internal perceived locus of causality” (Deci & Ryan, 1985, p. 38). To be self-determined people must be able to freely choose from among alternatives and not be controlled by elements of external influence. According to Deci and Ryan, when individuals demonstrate that they are in control of their own actions, they are satisfying their innate need to be self-determined. To be self-determined is the essence of healthy psychological functioning according to SDT. This is in contrast to those actions that are motivated by some external obligation or pressure. Cognitive evaluation theory (CET) was presented “as a subtheory within SDT that had the aim of specifying factors that explain the variability in intrinsic motivation” (Ryan & Deci, 2000, p. 70). The tenets of CET predict that when people feel that they are free to engage in any activity, they will select those activities that are optimally challenging because engagement in such activities satisfies an innate need to feel competent and self-determined (Deci & Ryan). Deci and Ryan state that the need for competence is rooted in the desire for effectiveness in one’s interactions with the environment. It is this drive for effective action that leads people to seek out challenges that are optimal given an individual’s capacities.

From the CET perspective, when individuals engage in an activity for its own sake, feelings of competence and self-determination are promoted, resulting in increased intrinsic motivation. Increased intrinsic motivation for an activity serves to maintain people’s engagement in optimally challenging tasks. People engage in behaviors that are intrinsically motivating because the activities themselves are inherently interesting; such behavior has an internal locus of control. In contrast, when people receive an external reward as a consequence for engaging in a behavior, the motivation for the behavior shifts toward an external locus of control. That is, people believe that they are engaging in the behavior in order to obtain “an external reward or to comply with an external constraint” (Deci & Ryan, 1985, p. 49). Following the receipt of an external reward, people perceive a loss of their internal locus of control and a loss of opportunity to be self-determined. It is the loss of autonomy that reduces people's intrinsic motivation. Thus, activities that are externally motivated reduce perceptions of self-determination, resulting in a loss of intrinsic motivation (Deci, Koestner, & Ryan, 1999).

CET predicts how extrinsic rewards will impact intrinsic motivation. According to Deci and colleagues (Deci et al., 1999), extrinsic rewards can be interpreted as either informational or controlling. When rewards provide feedback about competence, they are more likely to be interpreted as informational and are less likely to undermine intrinsic motivation. In contrast, when rewards do not signal competence, they are perceived as mainly controlling. The rewards then reduce an individual's self-determination and sense of autonomy, and lead to an undermining of intrinsic motivation. Thus, rewards can be perceived as controllers of behavior or as indicators of competence (Deci et al., 1999). However, given that extrinsic rewards ultimately signal external control, CET predicts that even informational rewards are likely to undermine an individual's sense of autonomy resulting in a loss of intrinsic motivation. In other words, informational rewards may signal competence but overall, the rewards are perceived as controlling and autonomy and self-determination are reduced leading to a loss of intrinsic motivation.

CET is not without its limitations. The actions that CET claims as intrinsically motivated may actually be the result of social learning (Cameron & Pierce, 2002). Not all activities begin as intrinsically motivating. Behavior that is not initially interesting can become so once it has been paired with reinforcement. As interest in the task develops, and less reinforcement is necessary to maintain the behavior, it may appear that the behavior is occurring in the absence of extrinsic reward. Thus, an individual may have a reinforcement history with respect to the behavior, anticipate possible future benefits for doing it, or be immersed in a culture that supports the action (Bandura, 1986, pp. 240-242). Moreover, the construct of intrinsic motivation lacks explanatory power when it is inferred from behavioral effects. According to CET, an individual is said to be intrinsically motivated when the person does an activity for its own sake. The person now does the activity for no apparent reason and we say she does it because of intrinsic motivation. This is circular reasoning and does not clarify the relationships between the intrinsic motivation and behavior (Cameron & Pierce, p. 40). Nonetheless, these terms continue to be employed in experimental investigations.

Behavioral theories.

Behavioral theories speak to two aspects of the present research. The first concerns the effects of various reward contingencies, and the second concerns the contexts in which the rewards are administered. The following discussion will outline the behavioral position on each of these issues.

First, it has been suggested that the effects of rewards on intrinsic motivation are dependent upon whether the rewards are tied to performance (Eisenberger & Cameron, 1996). When rewards are administered non-contingently (not tied to a performance standard) behavior decreases. However, rewards that are contingent on meeting a performance standard reinforce behavior, leading to an increase in behavior. According to Eisenberger and Cameron (1996), performance-contingent rewards may lead to greater feelings of competence and autonomy (this is in direct opposition to the position forwarded by CET), whereas non-contingent rewards provide no information to people about their competence.

Second, Skinner (1971) put forth the notion that the culture in which one finds himself or herself is a product of social contingencies of reinforcement. According to Skinner, culture is simply a collection of behaviors that, to the group, have important value. When individuals engage in the valued behaviors, the group rewards these individuals using social contingencies of reinforcement. By reinforcing values that have socio-cultural significance, the group is able to perpetuate the uniqueness of the culture. What constitutes a valued behavior varies widely across cultures. In Western cultures, people are socialized to value freedom (Skinner, 1971). Although freedom is not a tangible product or behavior that itself can be reinforced, individuals have been culturally conditioned to value signals of freedom (such as opportunities to exercise choice-making), and environments that contain such signals are associated with a socially conditioned positive reinforcement. Alternatively, environments that are typically devoid of signs of freedom lack the same history of positive reinforcement and are less likely to be satisfying. When people are offered reinforcers in contexts that contain signals of freedom, due to the context, the reinforcers are more likely to function as indicators of achievement. Conversely, if those same reinforcers are administered in contexts without signs of freedom, the reinforcers are more likely to function as an attempt at coercion by some external authority.

For the present research, Skinner's thesis can be extended to predict children's performance and intrinsic motivation. When children receive rewards in autonomous contexts (i.e., contexts that contain signs of freedom), the magnitude of the reinforcing property of the rewards will be enhanced and their subsequent performance (IM) will increase. Whereas, when children receive rewards in traditional, adult-directed, contexts (without signs of freedom), the contexts will be experienced as coercive and the children's intrinsic motivation for the tasks will decrease, leading to reduced performance or oppositional behavior (i.e., counter-control, Skinner, 1971). In sum, when rewards are presented in contexts that signal freedom, the reinforcing properties of the reward will be greater than when the same rewards are presented in contexts without signs of freedom as evidenced by increased performance on the target tasks.

Despite the similar socialization experiences of people in western societies, there remains variability in the degree to which people are exposed to characteristics of society (e.g., signs of freedom). Similarly, differences in the amount of exposure that people receive to various rewards affect the reinforcing properties of the reward. "Motivating operations" is the term that is used to refer to any stimulus, item, or event that has two effects; first, to alter the value of the reinforcer, and second, to alter the frequency of all behavior that has been previously reinforced by that reinforcer (Cooper, Heron, & Heward, 2007). To further explicate, an "establishing operation" refers to a motivational operation

(MO) that increases the reinforcing value of a reward, as well as increases the frequency of all behavior that has been previously reinforced by that reward. Alternatively, an “abolishing operation” is an MO that decreases the reinforcing value of a reward, as well as decreases the frequency of all behavior that has been previously reinforced by that reward (Laraway, Snycerski, Michael, & Poling, 2003, Michael, 1982). Building on Skinner’s (1971) thesis regarding choice making as a signal of freedom, in the present study, the autonomous (choice) context will serve as an establishing operation that will increase the value of the reinforcer, making the reward that is offered in the choice context be experienced as more reinforcing and increase the frequency of academic behaviors. Thus, it is expected that children’s IM will increase as a result of experiencing the autonomous-reward. In contrast, the traditional (no choice) context will serve as an abolishing operation that will decrease the value of the reinforcer, making the reward that is offered in the no-choice context be experienced as much less reinforcing (coercive control) and it will decrease the frequency of academic behaviors. It is expected that children’s IM will decrease as a result of the traditional-reward. Moreover, when children experience the traditional-reward, they will experience the rewards as an attempt at coercive control spending less time engaged in the target task, as well as possibly engaging in counter control (Skinner, 1971).

Summary of theoretical perspectives.

The major problem for the present investigation is to specify how rewards can be used to promote intrinsic motivation. It is useful therefore to inquire when

CET and behavioral theories expect positive effects following the administration of rewards. CET states that rewards conveying information about accomplishments are less likely to undermine intrinsic interest. However, given the inherently controlling aspects of reward, the overall result will be a general decline in intrinsic motivation. Behavioral perspectives, in contrast, do speak to the circumstances that lead to positive effects and such effects have been observed in the literature (e.g., Harrington, 2004; McGinnis, Friman, & Carlyon, 1999). According to behavior theories, performance-contingent and completion-contingent rewards, as well as verbal rewards, can promote higher levels of intrinsic motivation. In addition, behavioral theories speak to the impact that reinforcement histories and intermittent schedules of reinforcement have in maintaining behavior, as well as differences in motivation that influence the reinforcing properties of rewards (i.e., establishing operations).

Rewards and Intrinsic Motivation: Research Designs and Measures

Most researchers in the area of rewards and motivation use between-groups experimental designs. These designs involve randomly assigning participants to one of two groups. One group is exposed to an experimental manipulation (i.e., rewarded for engaging in the task) and the other is not. Both groups are then given a free-choice period (without reward) where they are free to engage in the experimental task or in other available activities. The groups are compared to one another to determine if the experimental manipulation led to differences in performance on the task during the free choice period, differences in free time spent on the target task, and differences in self-reports of task interest.

If the rewarded group spends more time on the task in the free-choice period, performs at a higher level and/or reports greater task interest than the non-rewarded group, rewards are said to enhance intrinsic motivation. In contrast, if the rewarded group spends less time on the task in the free-choice period, exhibits reduced performance and/or reports less task interest than the non-rewarded group, rewards are said to undermine intrinsic motivation.

Another approach to assessing the effects of rewards on intrinsic motivation is based on within-subjects repeated measures analyses (a basic ABA design). Within-subject designs require fewer participants but their levels of intrinsic motivation and exposure to the experimental manipulations are measured over a number of sessions. Repeated measurement is advantageous because multiple measures on the same participant assess trends in responding and transition states (Feingold & Mahoney, 1975) that are not obtained in the between-group designs. Moreover, each participant in a within-subject design serves as his or her own control (Kazdin, 1982). That is, analysis involves examining how behavior or attitudes change between pre-intervention, intervention, and post-intervention phases within the same participants. Between-group designs usually involve a single session of rewards for doing the task; within-subject designs use multiple administrations of reward across many sessions. Observing the effects of multiple sessions of reward administration allows researchers to assess the effects of the experimental manipulation at the level of the individual, and to assess whether the effects of exposure to the reward impacts behavior over time.

To explicate further, with respect to the rewards and intrinsic motivation research, the within-subject experiment begins with baseline measures of participants' performance on the target task in a free-choice phase. Baseline performance (Kazdin, 1982) is used as the indicator of initial task interest or intrinsic motivation for the target activity. Next, each participant is exposed to several sessions of reward for engaging in the target activity. The goal is to demonstrate that the reward is reinforcing by observing the designated behavior increase and maintain at high rates throughout the reward sessions. Following the reward phase, the contingency is removed and participants' performance is assessed in a second free-choice phase. The return to the free-choice condition is used to determine experimental control (i.e., that the observed changes in responding during the experimental phase are due to the manipulation rather than some extraneous variable). Moreover, reward and motivation theorists are also interested in observing the effects of the removal of the reward contingency. Specifically, their interest lies in whether there is a change in performance (IM) between the initial baseline free-choice period and the post-reward free-choice phase. If an individual spends less time on the task (or performs at a lower level) during the post-reward phase in comparison to the pre-reward phase, researchers claim that reward reduces IM. Whereas, if the individual spends more time on the task (demonstrates greater performance) during the post-reward phase in comparison to the pre-reward phase, it is claimed that reward increases IM.

There have also been research designs that combine between-group and within-subject methodologies (Greene, Sternberg, & Lepper, 1976; Mynatt, Oakley, Piccione, Margolis, & Arkkelin, 1978; Vasta, Andrews, McLaughlin, Stripe, & Comfort, 1978). “Mixed designs”, or within-group designs, are similar to between-group designs in that they also make comparisons between the average scores of rewarded groups versus non-rewarded groups. They are similar to within-subject designs in that they include repeated measurement of the initial free-choice period, the experimental conditions, and the withdrawal conditions. A distinct advantage of within-group designs is that they allow for analysis of temporal trends and transition states (Feingold & Mahoney, 1975). However, like the between-group designs, within-groups do possess some limitations. Each of these investigations reported an average score obtained by a group of participants in each repeated-measures condition rather than reporting on the impact of the manipulation on the individual. The effect of the manipulation on the individual is indeterminable. Thus, even though the investigators were able to offer comparisons of the effects of rewards on IM in single-exposure versus repeated-exposure research design, the impact of the experimental manipulation at the individual level is masked. Direct comparisons of between-group versus within-subject research designs remains problematic. Thus, more research is needed using within-group designs to enable analyses at both levels, and ultimately bridge the interpretation gap between within-subject and between-groups designs.

A Review of Between-Groups Research: Meta-analytic Findings

A meta-analysis is a statistical analysis of a large collection of quantitative research (Glass, 1976). It offers a standardized and systematic way to integrate many individual analyses to better understand the impact of a body of research.

Well over one hundred and fifty experiments have been published on rewards and intrinsic motivation and meta-analyses have been conducted to assess the size and direction of effects. As previously discussed, the literature on the effects of rewards on intrinsic motivation has utilized two research designs; between-group and within-subject methodologies. The meta-analyses that have been conducted on this literature have largely involved only those studies using between-group research designs. The discussion to follow outlines the overall results of the between-groups meta-analyses on the rewards and motivation literature.

To date, there have been several attempts to analyze the rewards and motivation literature (Rummel & Feinberg, 1988; Tang & Hall, 1995; Wiersma, 1992). In the early 1990s, Cameron and Pierce (1994) and Eisenberger and Cameron (1996), began a comprehensive, hierarchical meta-analysis of the literature. Analyzing almost 100 studies, Cameron and colleagues determined that overall rewards did not lead to an undermining of intrinsic interest. In an analysis of moderators, Cameron and Pierce found that verbal rewards (e.g., praise and positive feedback) increased measures of intrinsic motivation. Negative effects were found with tangible rewards when they were expected (promised beforehand) and given without regard to any level of performance. Importantly, tangible rewards produced positive effects on intrinsic motivation when the rewards were given for meeting or surpassing specific performance standards. Based on their findings, Cameron and Pierce argued that negative effects of rewards are minimal and can be easily avoided.

Those who support the position that rewards usurp the control of intrinsically motivated behavior challenged the methodology employed by Cameron and colleagues, suggesting alternative strategies that would lead to a methodologically stronger analysis (Deci et al.,1999). To account for the methodological shortcomings leveled at Cameron and colleagues, Deci et al.'s (1999) conducted another meta-analysis. They: a) added studies missed in the previous analyses (including unpublished doctoral dissertations); b) assigned those studies with insufficient information to calculate an effect size an effect size of 0.00; c) included one other measure of intrinsic interest (along with free-time performance); and d) focused on the effects of rewards for high-interest tasks only (as only high-interest tasks are susceptible to undermining effects according to CET). With this new focus, Deci et al. found numerous negative effects of the various reward contingencies. Specifically, when individuals were rewarded for engaging in interesting tasks, rewards that were expected, task contingent, and tangible, undermined intrinsic interest as measured by free-choice behavior (however, not on self-report measures). Deci et al. found variable effects when comparing performance on self-report measures to measures of free-choice behavior, when rewards were verbal, and when the rewards were performance-contingent; meaning that although self-report measures also captured an undermining effect, the effect was much more limited. Based on this evidence, Deci and associates concluded that the research supported the assertion that rewards do undermine intrinsic motivation.

In response to Deci et al. (1999), Cameron, Banko, and Pierce (2001) addressed the concerns raised and noted limitations of Deci et al.'s analysis. Whereas Deci and colleagues organized their analysis based on the tenets of CET (Deci & Ryan, 1985), the Cameron group focused their new analysis on the specific procedures implemented in the experiments. Based on a procedural analysis of the studies, Cameron and colleagues (2001) concluded that rewards do not have the overall, detrimental effect on intrinsic motivation as claimed by Deci et al. (1999). Rather, rewards are capable of producing a positive, neutral, or negative effect depending upon specific moderating conditions.

Overall, what the meta-analyses have shown is that on high interest tasks, rewards undermine intrinsic motivation when they are tangible, expected (promised beforehand), and loosely tied to performance. In contrast, tangible rewards maintain or increase intrinsic motivation when they are contingent upon achieving a performance standard or meeting with success. Verbal praise and positive feedback also lead to positive effects on measures of intrinsic motivation. As well, all types of rewards have been found to increase intrinsic motivation on tasks of low initial interest.

In addition to the results from the previous meta-analysis, recent research using between-group designs has shown that intrinsic motivation increases when rewards are offered and given for successfully achieving challenging standards or mastery (Cameron, Pierce, & So, 2004; Cameron, Pierce, Banko, & Gear, 2005; Pierce, Cameron, Banko, & So, 2003).

Maintenance of reward effects on intrinsic motivation.

Of particular interest to the proposed research is the extent to which the effects of the experimental manipulation (i.e., reward) maintain over time. Deci et al. (1999) conducted an analysis of the long-term effects of rewards on intrinsic motivation. Analyzing only those studies that included a no reward control group, they identified 24 experiments that incorporated a one-time, delayed assessment of children's intrinsic motivation as free-choice behavior. Twelve studies assessed intrinsic motivation within one week, and 14 studies assessed after one week. Deci et al. found that the undermining effects they observed immediately following the removal of the reward remained at the final assessment. They concluded that the undermining of intrinsic interest that was observed to follow the administration of rewards is not a transitory phenomenon and that because the negative effects of rewards are durable, rewards should be avoided in applied settings.

Subsequently, Cameron et al. (2001) examined the procedural components of the studies that Deci et al. (1999) analyzed. They pointed out that 12 of the 14 studies that assessed IM after one week involved rewards that were not contingent on meeting a performance standard. Based on these findings, Cameron and colleagues asserted that statements about the durability of the negative effects of rewards are restricted to those situations where individuals do not have to attain any specific level of performance to obtain a reward. In addition, Cameron et al. (2001) evaluated seven between-group studies that used two or more delayed assessments of intrinsic motivation (i.e., studies that evaluated the maintenance of

IM). They found that when multiple measures of intrinsic motivation were utilized, and when rewards were offered strictly for engagement (rather than performance), only two of the seven studies evidenced a significant negative effect on intrinsic motivation. Clearly, more research is needed that uses multiple assessments of IM before one can make definitive statements about the durability of reward effects when rewards are tied to meeting a performance standard; however, engagement-contingent rewards given for doing or spending time on an activity do not show durable negative effects on IM and most studies have used engagement-contingent rewards.

Rewards, context, and intrinsic motivation.

Researchers today generally accept that rewards have positive, neutral and negative effects on intrinsic motivation. Current research is focused on specific moderating conditions to clarify how rewards can be most effectively used in applied settings (Cameron & Pierce, 2002; Harackiewicz & Sansone, 2000).

For example, the work of Cameron and colleagues (Cameron et al., 2004; Cameron et al., 2005; Pierce et al., 2003) has shown that task difficulty and rewards for progressive achievement moderate the effects of performance-based rewards on intrinsic motivation. According to Deci and Ryan, one of the most salient aspects of the reward contingency is the demeanor of the person administering the rewards. They suggest that how the rewards are delivered is as important as the offer of reward itself. The interpersonal context provides the reward recipient with the “metamessage” (Deci & Ryan, 1985, p. 88) that can further undermine the effects of rewards on intrinsic motivation. The following sections will review the between-group research that has investigated rewards and other aspects of interpersonal context.

To disentangle the effects of rewards and interpersonal feedback on intrinsic motivation, Ryan, Mims, and Koestner (1983) used a 3 x 3 factorial design, with 3 levels of reward contingency (performance-contingent, task-contingent, and no reward) and 3 levels of interpersonal feedback (informational, controlling, and neutral/no feedback). However, as the authors acknowledged, their study was not a complete design (cells were missing). That is, the authors reported data for only six of nine possible conditions. Data was provided for each level of interpersonal feedback under the no reward condition. However, for the performance-contingent feedback conditions, data was reported for the informational and controlling feedback contexts only; and for task-contingent rewards, data were only provided in the neutral/no feedback context. Thus, the analysis of the resulting 3 x 3 design was without three cells: 1) performance-contingent reward with neutral/no feedback, 2) task-contingent reward with informational feedback, and 3) task-contingent reward with controlling feedback. Unfortunately, with this incomplete design they could not disentangle the combined effects of rewards and feedback.

Participants in the Ryan et al. study were presented with a hidden figures task and the interpersonal feedback manipulation was embedded in the evaluation they received from the experimenter. For the informational feedback condition, participants were told, “You did very well on that one.” In contrast, for the controlling feedback condition, the researchers added a should-related phrase. Participants were told, “You did very well on that one, *just as you should*.” This manipulation is based upon the hypothesis that performance feedback can either be interpreted as informational or controlling in the same way that rewards are interpreted. When interpersonal evaluations convey competency information (informational) people are less likely to feel controlled and show reduced IM. In contrast, controlling evaluative feedback decreases IM as the participant infers external control of behavior and low self-determination (Ryan, 1982). Ryan et al. found that groups that received rewards showed less intrinsic motivation than those in the no reward groups. Also, controlling feedback reduced intrinsic motivation relative to informational feedback. However, intrinsic motivation did not differ between performance-based rewards given with controlling evaluative feedback versus the same rewards without feedback. That is, controlling evaluations did not further reduce the effects of rewards on intrinsic motivation. Thus, rewards were the main aspect of context reducing IM and the interpersonal feedback from the evaluator did not further contribute to the detrimental effects.

A study by Houlfort, Koestner, Joussemet, Natel-Vivier, and Lekes (2002) also tested the moderating effects of interpersonal feedback on performance-based rewards for intrinsic motivation. Following the work of Ryan et al. (1983), Houlfort et al. argued that rewards for performance do not undermine intrinsic motivation if participants perceive the rewards as informational. When rewards are perceived as controlling, however, intrinsic motivation was expected to decrease. Houlfort et al. hypothesized that performance-based rewards delivered in an informational manner would maintain intrinsic motivation, but the same reward contingency would reduce intrinsic motivation when presented in a controlling manner (accomplished by adding a "should" phrase such as "…as you should").

In their study, Houlfort et al. (2002) asked 85 undergraduate participants' to engage with a computer-based Find-the-Difference (FTD) puzzle-solving program, where half of the participants were rewarded, and the other half not, then both provided with a free-choice period. In the free-choice period, participants who received performance-based rewards and informational feedback felt less autonomous (i.e., greater pressure and tension) but more competent than those receiving controlling feedback under the same conditions. The interpersonal evaluation manipulation, however, did not affect measures of IM even though the experimental manipulations altered the senses of autonomy and competence.

Joussemet, Koestner, Lekes, and Houlfort (2004) examined the effects of rewards and autonomous contexts to promote children's self-regulatory behaviors (evidenced as ratings of positive affect, perception of the task's value, and free-choice engagement). There were 106 elementary-aged children who participated in a 2 x 2 factorial design, with two levels of reward (reward, no reward) and two levels of interpersonal context (autonomous, controlling). The experimental task was a computerized vigilance task and those children in the reward conditions received rewards that were engagement-contingent; that is, without regard to meeting a performance criterion. Interpersonal context manipulations were accomplished in two ways. First, "should" phrases, along with similar statements were used to be more directive or controlling. Second, empathetic statements were used along with offers of choice to enhance the sense of support for the individuals' autonomy. Following the manipulation, participants were given a 5-minute free-choice period. Joussemet et al. found that although participants reported feeling happier in the autonomous contexts, there were no differences between the autonomous and controlling contexts on free-choice measures of engagement or IM (see below for Children's Academic Intrinsic Motivation Inventory, Gottfried, 1986).

In a second study, Joussemet et al. (2004) sought to determine if the results found in Study 1 "would generalize to a longer and more tedious activity" (p. 153). Seventy-six children were divided into three groups where instructions were delivered in one of the following manners, autonomous-reward, controlling-reward, and controlling no-reward. Where Study 1 utilized a 15-minute computer game, Study 2 extended the length of the game to 30 minutes. Joussemet et al. found no significant effects for children's affect toward the experimental tasks, or for free-choice behavior. Following the results of reward and autonomous manipulations, Joussemet et al., found non-significant effects on both measures of affect and free-choice behavior (see below for attitude measures).

As part of a doctoral dissertation, Katherine Banko (2007) at the University of Alberta conducted two studies that manipulated reward contingencies and interpersonal context to determine the effects on IM. In both studies, participants received rewards in either an autonomous interpersonal context or a coercive-controlling context. Autonomy support was characterized by limited surveillance, opportunities for choice, an absence of performance evaluation, and freedom from time pressures. In contrast, the coercive-control was characterized by high surveillance, no opportunities for choice, performance evaluation, and an adherence to strict time deadlines.

Using Find-the-Difference (FTD) puzzles as the target task in both experiments, in Experiment 1, Banko found a significant main effect of engagement-contingent reward (that is, participants who were rewarded spent more time solving puzzles during a free-choice period than those in the no-reward group). In Experiment 2, Banko found a statistically significant interaction; participants who received performance-contingent rewards in autonomous contexts spent the most time solving puzzles in comparison to all other conditions.

A summary of the six studies of rewards and interpersonal contexts on measures of IM is presented in Table 2.1. A total of 571 individuals participated in these studies. The studies included as participants both children (n = 182) and adults (n = 389). The designs used both engagement-contingent and performance-contingent reinforcers, balanced relatively equally across studies. Four of the six studies used puzzles as their target task (e.g., hidden figures tasks, find-the-difference), and two studies used a vigilance task (i.e., Joussemet et al., 2004). The vigilance task involved a computerized “if/then” activity that required participants to press a key when certain letters appeared on screen.

Table 2.1 Summary of studies assessing rewards and context manipulations on IM.

Study	N	Reward	Target Task	Manipulations
Ryan et al., 1983	96 (A)	E, P	Puzzles	• Should statements • Money
Houlfort et al., 2002 (Exp 1)	85 (A)	P	Puzzles	• Should statements • Money
Joussemet et al., 2004 (Exp 1)	106 (C)	E	Vigilance	• Should statements • Choice • Toys
Joussemet et al., 2004 (Exp 2)	76 (C)	E	Vigilance	• Should statements • Choice • Decorative pencils
Banko, 2007 (Exp 1)	102 (A)	E	Puzzles	• Must statements • Surveillance • Deadlines • Performance evaluation • Choice • Money
Banko, 2007 (Exp 2)	106 (A)	E, P	Puzzles	• Must statements • Surveillance • Deadlines • Performance evaluation • Choice • Money

Note. A = adults, C = children; E = engagement-contingent, P = performance-contingent.

In Table 2.1 the procedures used to manipulate reinforcement contingencies and interpersonal context are given under the heading, “Manipulations”. The interpersonal contexts were classified as either autonomous or controlling. Autonomous contexts were created by providing participants with opportunities for choice (e.g., “if you *choose* to continue…” Joussemet et al., 2004) or positive evaluations of performance (e.g., “you did very well on that one…" Ryan et al., 1983). In contrast, controlling contexts were created by providing evaluations that indicated the performance was required (e.g., "You *should* try hard", or "You did well at puzzle solving, as you should", Houlfort et al., 2002), as well as by increased surveillance, and imposing time deadlines to complete the task (Banko, 2007). The reward manipulation included money for four out of the six studies. The remaining two studies (Joussemet et al., 2004) rewarded doing the task with small toys (e.g., yo-yos, comic books) and decorative pencils.

As observed in Table 2.2, under the heading, "Measures of IM", with the exception of Houlfort et al. (2002) who used number of errors as a performance measure of IM, the remaining five studies used the amount of time that participants spent engaged in the target task during the free-choice period. In addition, these studies also incorporated a self-report measure of interest in the target task.

With regard to the effects that the manipulations had on participants' IM (see Table 2.2, column titled, "Effect on IM"), two studies found a significant main effect of reward on IM. Ryan et al., (1983) found that rewards undermined IM relative to no reward conditions on measures of free-choice performance. Whereas, in the first experiment by Banko (2007) rewards were found to enhance IM relative to no reward conditions on measures of free-choice engagement.

The reward contingencies had different effects across the six experiments (see Table 2.2, column entitled, "Main Effect Reward"). Performance-contingent rewards were associated with a negative effect (Ryan et al., 1983), whereas engagement-contingent rewards were associated with both a negative effect (Ryan et al.) and a positive effect (Banko, 2007).

Table 2.2 Summary of effects on measures of intrinsic motivation.

Study	Measures of IM	Effect on IM		
		Main Effect Reward	Main Effect Context	Interaction
Ryan et al., 1983	Time on task	R+ undermined (E & P)	Controlling undermined	Autonomy-supportive, R+ enhanced (P)
	Interest	ns	ns	ns
Houlfort et al., 2002 – Exp 1	Number of errors	ns	ns	ns
Joussemet et al., 2004 – Exp 1	Time on task	ns	ns	ns
	Interest	ns	ns	ns
Joussemet et al., 2004 – Exp 2	Time on task	ns	ns	ns
	Interest	ns	ns	ns
Banko, 2007 – Exp 1	Time on task	R+ enhanced (E)	ns	ns
	Interest	ns	ns	Autonomy-supportive, R+ enhanced (E)
Banko, 2007 – Exp 2	Time on task	ns	ns	Autonomy-supportive, R+ enhanced (P)
	Interest	ns	ns	ns

Note. IM = intrinsic motivation; R+ = reward, E = engagement-contingent, P = performance-contingent; ns = non-significant.

A main effect for context was found in only one study (see Table 2.2, column titled, “Main Effect Context”). Ryan et al. (1983) found that controlling contexts undermined IM relative to autonomous contexts on participants’ free-choice performance.

Also of concern in the present analysis is whether there were any reported interaction effects. A statistical interaction is reported when one independent variable is differentially affected by variations in another independent variable (Howell, 1999). There were three studies that reported interaction effects (see Table 2.2). The experiment by Ryan et al. (1983) and the two experiments by Banko (2007), both found that interpersonal context moderated the effect that rewards had on participants' IM. That is, participants spent more time engaged in the target task during the free-choice period when they had received performance-based rewards in an informational context relative to other reward contingencies and contexts. These results were especially germane to the present experiment as it was expected that when performance-contingent rewards were delivered in an academic task that was characterized as being autonomy-supportive, an increase in IM was expected.

Of further interest to the present experiment is the effect of increased IM on the maintenance and transfer of academic abilities. In addition to manipulating reward contingencies and interpersonal context, none of the six studies investigated the long-term effects of their manipulation. Nor did they determine whether the effects of the manipulations would transfer to other academic material, settings, or people. The effects that manipulations of reward and interpersonal context had on the maintenance and transfer of children's abilities was studied in the present investigation.

Five of the six studies used additional measures to assess the participants' attitudes regarding their perceptions of competence, feelings of autonomy, and/or the extent to which they believed the task to be of positive value (see Table 2.3). Specifically, the researchers assessed whether rewards impacted participants' feelings of autonomy, competence, and the extent to which they valued the task. The experiments conducted by Houlfort et al., 2002 and Banko (2007) both reported effects on participants' feelings of competence and autonomy due to the administration of rewards. Regarding perceptions of competence, Houlfort et al. and Banko both found that participants reported increased feelings of competence following the administration of rewards. Regarding perceptions of autonomy, Houlfort et al. further reported that rewards led to a decrease in participants' perceptions of autonomy, Banko found that autonomous contexts led to increased feelings of autonomy. Moreover, in Experiment 2, Banko found that autonomous contexts led to both increased feelings of autonomy and perceived competence. Finally, Joussemet et al., (2004) assessed task value. Task value was the extent to which the participants perceive the task to be of importance and of inherent value. Joussemet and colleagues found that task value could be enhanced or reduced as a result of autonomous versus controlling contexts.

In Experiment 1, Joussemet and colleagues found that children in controlling contexts reported a reduction in their perception of the value of the target task in comparison to all other conditions. Further, in Experiment 2, these authors found that autonomous contexts led to an enhanced perception of the value of the target task in comparison to the reward condition.

Table 2.3 Measures of participants' attitudes toward target task.

Study	Attitudinal Measure	Effects
Houlfort et al., 2002 – Exp 1	• Competence • Autonomy	• Rewards increased competence • Rewards reduced autonomy
Joussemet et al., 2004 – Exp 1	• Task value	• Controlling contexts reduced task value
Joussemet et al., 2004 – Exp 2	• Task value	• Autonomous contexts increased task value
Banko, 2007 – Exp 1	• Competence • Autonomy	• Autonomous contexts increased competence • Autonomous contexts increased autonomy
Banko, 2007 – Exp 2	• Competence • Autonomy	• Rewards increased competence • Autonomous contexts increased competence • Autonomous contexts increased autonomy

For the purposes of the present study, those variables that helped to enhance participants' feelings of autonomy and competence are of interest (i.e., performance-contingent rewards and autonomous contexts). To sum, participants' feelings of competence were enhanced due to performance-contingent rewards (Banko, 2007; Houlfort et al., 2002) and by autonomous contexts (Banko, 2007). Second, participants' feelings of autonomy were enhanced as a result of participating in autonomous contexts (Banko, 2007). In the present investigation, performance-contingent rewards delivered in autonomous contexts was expected to increase participants' feelings of autonomy and competence resulting in increased IM.

A Review of Within-Subject Research: Reinforcement and Intrinsic Motivation

As previously noted, within-subject methodology allows researchers to determine the effects of rewards on intrinsic motivation from the level of the individual and assess reinforcement effects. A search of the literature revealed 12 independent studies that form the basis of the review for within-subject experiments. Included in the 12 studies are four unpublished dissertations.

Basic characteristics of within-subject experiments.

There were a total of 47 participants across 12 studies ranging from preschool-aged children to adulthood. The activities that served as target tasks included completing dot-to-dot connections, teaching machines, leisure activities, such as using playground equipment, video games, and math tasks (see Table 2.4).

Table 2.4 provides a basic summary of the research designs along with information regarding the number of participants, target tasks, reward type and use of tokens. As noted earlier in the chapter, within-subject (i.e., ABA) designs are characterized by three phases: a non-reinforced free-choice period (A), the reward or intervention phase (B), and a second non-reward free-choice period (A). Some within-subject designs may also incorporate a follow-up non-reward free-choice period (A). Within-subject research designs may employ a simple ABA design, or a more complicated, multi-element design with multiple levels of reward as indicated by additional letters (e.g., C, D, E, etc.). As can be seen in Table 2.2, 9 out of the 12 studies used a standard ABA design. However, three studies used variations of the design, including an ABAB (reversal), ABCDA/ABABCDA, and ABCDEB designs.

Table 2.4. Basic characteristics of within-subject studies of reward and intrinsic motivation.

Study	N	Design	Number of Conditions & Sessions per Condition.	Session Length	Task	Reward Conting.	Reward Expected	Reward Exposure
Feingold et al. (1975)	5	ABA	8:4:8:10	15 min	Dot-dot	P	Y	4
Davidson et al. (1978)	3	ABAB	Ins/I	Ins/I	Teaching machine	E	Y	Ins/I
Vasta & Stirpe (1979)	4	ABA	Ins/I	20 min	Math	P	Y	7
Mawhinney et al. (1989)	3	ABA	10-12:1:7-5	Ins/I	Video games	E	Y	1
Skaggs et al. (1992)	8	ABA	6-10:5:5	75 min	Video games	E	Y	5
McGinnis et al. (1999)	2	ABCDA & ABABCDA	6:6:2:2:4:2 & 4:3:3:3:2:2:4:2	15 min	Math	P	Y	10
Akin-Little (1999)	6	ABA	4:4:4:3	30 min	Compliance	P	Y	4
Martens et al. (2002)	3	ABCDEB	Ins/I	15 min	Math	P	Y	8-11
Mintz (2003) – Exp. 1	3	ABA	14:20:12; 10:8:37; 14:16:10	5 - 10 min	Leisure	P	Y & N	8-10
Mintz (2003) – Exp. 2	3	ABA	6:11:8; 10:10:8; 14:10:8	5 min	Math	P	Y & N	10-11
Harrington (2004)	3	ABA	3:8:6:2; 5:14:6:2; 7:8:6:2	8 min	Leisure	E	Y	8-14
Weaver (2004)	4	ABA	3:8:1; 3:8:1; 5:6:1; 5:6:1	20-60 min	Math	P	Y	6-8

Note. N = number of participants; Y = yes, N = no; reward type, T = tangible, V = verbal; reward contingency, P = performance-contingent, E = engagement-contingent; initial task interest, H = high, M = moderate, L = low; Ins/I = insufficient information..

Number and length of sessions.

There was great variation in the number of sessions that each participant received in each experimental condition (see column titled "Number of Sessions" in Table 2.5). In the table, the data are presented as ratios; that is, the numbers of each session in each condition is presented as A:B:A, or 2:2:2. That means that there were two sessions each of baseline, intervention, and withdrawal, respectively.

As summarized in Table 2.4, the length of experimental sessions ranged from 5 minutes to 75 minutes. Two studies that failed to provide sufficient information to determine the length of the experimental sessions. However, of the remaining 10 studies the modal session length was 15 minutes.

Reward contingencies and characteristics used in the studies.

A summary of reward contingency is also provided in Table 2.4. Performance-based rewards were offered to participants in six of the 12 studies. The remaining eight studies used engagement-contingent rewards; that is, participants were rewarded for doing the task, not for performing to a specified criterion. Almost all of the studies created an expectation of reward for the participants. However, Mintz (2003, Exp. 1 and 2) created expected and unexpected conditions of reward for each of the participants.

One of the major advantages of within-subject methodology (typically) is the repeated exposure to conditions. Also summarized in Table 2.4 are the numbers of exposures to the reward contingencies that the participants received. The levels of exposure ranged from as few as one to as many as 14.

Unfortunately, the study that exposed their participants to only one session of reward (Mawhinney et al., 1989) cannot speak to the effects of reinforcers on IM.

Rewards and reinforcers used in experiments.

In the rewards and motivation literature, researchers often select a variety of consequences such as gold stars, school supplies, or games and expect that these rewards will be reinforcing for the participants. There are two ways that the current studies attempt to account for the difference between rewards and reinforcers. First, to maximize the likelihood that a reward will in fact be reinforcing to the participant, researchers must include a reinforcer preference assessment. As observed in Table 2.5, under the column "Reinforcer Test" only six of the 12 studies included some form of preference assessment to help to ensure that the reward would be reinforcing. To conduct a preference assessment, experimenters collect a variety of possible rewards and pair each reward against the others. With each pairing, participants are asked which of the two items they prefer. This forced-choice format is continued until a clear preference hierarchy is established. The item that is found to be the most preferred (i.e., the item on the top of the hierarchy) is then selected as the reinforcer. This format helps to ensure that the participant will be receiving a reward that is likely to be highly reinforcing. It is interesting to note that only one study conducted before 2002 (i.e., Davidson & Bucher, 1978) and each study after 2002 conducted a test of reinforcer preference.

The second way to determine the reinforcing properties of a reward is to observe the effect it has on the target behavior during the experimental manipulation. Once baseline levels of the target behavior are ascertained, and the reinforcement contingency is initiated, only then can the effects of the reward on the target behavior be observed. If the rate at which the participant engages in the target behavior increases, that is taken as evidence of a reinforcement effect. Otherwise, it is assumed that the reward is not reinforcing. In the studies reviewed, only one study failed to demonstrate a reinforcement effect by the participants (i.e., Weaver, 2004). In addition, three other studies showed differential effects. A reinforcement effect was demonstrated by two of the three participants in Davidson & Bucher's (1978) study. In the first experiment conducted by Mintz (2003), only one participant demonstrated a reinforcement effect. And lastly, 50% (3 out of 6) of the participants in Akin-Little's (1999) study demonstrated a reinforcement effect. Akin-Little's results must be interpreted with caution, however, because the failure to show a reinforcement effect was only evidenced by the participants in the "high initial interest" group. Given that baseline observations for this group of participants were at ceiling levels prior to the initiation of the reward phase, the measurement system employed by Akin-Little was not sensitive enough to allow for detection of a reinforcement effect.

As can be seen in Table 2.5, all 12 experiments employed tangible rewards. However, two of the studies combined tangible rewards with verbal praise. Half of the studies gave children tokens that were redeemable for rewards (such as school supplies, small toys, etc.) either during the session, the end of the day, or saved for a later date. The remaining five studies did not employ token procedures. In these studies, participants received reinforcers while engaging in the target task (e.g., edibles at 30-second intervals), or at the end of each session (e.g., money).

Initial task interest and interpretation of reward effects.

Initial task interest within the studies reviewed varies to account for both theoretical and methodological concerns (see earlier sections). From a theoretical perspective, evaluating the effects of rewards on tasks of high initial interest is central to cognitive evaluation theory (CET, Deci & Ryan, 1985). Although, Deci and Ryan have acknowledged that extrinsic rewards have a long history of effectively increasing individuals' performance on low interest tasks, according to CET, extrinsic rewards will undermine individuals' intrinsic motivation when administered for high interest tasks. The theory predicts that when extrinsic rewards are given for engaging in tasks of high initial interest, the external properties of the reward will usurp control of the behavior and ultimately reduce individuals' motivation resulting in a task that is of little interest. Thus, testing the effects of rewards on tasks of high initial interest, in an attempt to test the assumptions of the CET, is of theoretical importance.

Using high interest tasks, however, is methodologically problematic for within-subject designs because the effects of reinforcers cannot be determined when the target behavior is already occurring at ceiling levels. To account for this, rather than using a task with a high rate of occurrence, a task may be selected because participants have rated it as high interest. However, this is still problematic. Unfortunately, because correlations between free-choice behavior and self-report measures tend to be low, the reliability of self-report measures is unknown. Moreover, self-report measures are subject to influence from demand characteristics (Deci et al., 1999). Thus, researchers are often left to evaluate the effects of reinforcers on tasks of moderate or low initial interest, which according to CET, is less theoretically relevant. However, behavioral theories support the use of tasks that are of moderate or low initial interest because it allows researchers to determine whether the rewards serve as reinforcers as evidenced by an increase in performance on the target task. Alternatively, researchers could also select tasks that participants have rated above the neutral point on a scale of interest, but not at ceiling levels.

In Table 2.5, the column titled "Task Interest" refers to whether participants found the target tasks to be of high, moderate, or low initial interest. Moreover, this refers to whether or not the participants are intrinsically motivated to engage in the target task. Thus, those studies that list initial interest are describing the extent to which the participants have high, moderately, or low intrinsic motivation for the target task. As observed in Table 2.5, six studies reported high initial interest, two studies reported moderate interest, and one reported low interest. Two studies used tasks of varying levels of initial interest, including high, moderate, and/or low.

Effects of reward contingencies on intrinsic motivation: within-subjects.

On performance measures of intrinsic motivation, of the 31 participants who were given rewards for engaging in a high interest task, 13 individuals showed an increase in the measure of IM, the IM of 18 was left unaffected, and none of the participants showed a decrease in IM. Taken together, the findings from the within-subject literature fail to support CET's assertion that when high interest tasks are rewarded, a decrease in IM will result.

Problems with the assessment of intrinsic motivation.

In the studies reviewed, intrinsic motivation was measured as a function of time on task (e.g., percentage of intervals engaged), accuracy, number of responses, and/or number of tasks completed. Table 2.5 provides the reader with a summary of the characteristics of the experiments that relate to participants' intrinsic motivation (IM). As observed in Table 2.5, only seven of the studies explicitly discussed conducting a pretest of participants' IM. To best determine whether performance is intrinsically motivated, it must be measured in a free-choice period. Nine out of the twelve studies measured participants' motivation to engage in the target task in a (non-reinforced) free-choice period. Two studies continued to reinforce their participants across all conditions (Davidson & Bucher, 1978; Martens et al., 2002) and one study (Weaver, 2004) did not conduct repeated measurement during the post-reinforcement condition which does not allow for evaluation of temporal trends and transition states (Feingold & Mahoney, 1975). As other investigations have shown (i.e., Mintz, 2003), analysis of the first data point following the withdrawal of the reinforcement contingency can demonstrate idiosyncratic effects.

Table 2.5 Characteristics of within-subject experimental conditions.

Study	Reinforcer Test	Reward Type	Tokens	Task Interest	Pretest of IM	Measured as FC	Trend from FC	Change Pre to Post	Dif at FU
Feingold et al. (1975)	N	T	Y	H	Y	Y	Y	2 ↑, 3 —	3↑, 2 —
Davidson et al. (1978)	Y	T & V	Y	Ins/I	N	N	Y	1 ↑, 2 —	N/A
Vasta & Stirpe (1979)	N	T	Y	H	N	Y	N	4 —	3↑, 1 —
Mawhinney et al. (1989)	N	T	N	H	Y	Y	N	3 —	N/A
Skaggs et al. (1992)	N	T	N	H	Y	Y	N	6 ↑, 2 —	N/A
McGinnis et al. (1999)	N	T	Y	H	N	Y	Y	2 —	2 —
Akin-Little (1999)	N	T & V	Y	H, L	N	Y	Y	2 ↑, 4 —	6 —
Martens et al. (2002)	Y	T	Y	L	N	N	N	1 ↑, 2 —	N/A
Mintz (2003) – Exp. 1	Y	T	N	M	Y	Y	Y	1 ↑, 2 —	N/A
Mintz (2003) – Exp. 2	Y	T	N	M	Y	Y	N	3 ↑	N/A
Harrington (2004)	Y	T	Y	H	Y	Y	N	3 ↑	3 ↑
Weaver (2004)	Y	T	N	H, M, L	Y	N	N	4 —	N/A

Note. IM = intrinsic motivation; Ins/I = insufficient information; Y = yes, N = no; FC = free-choice period; FU = follow-up; ↑ = above baseline, — = no difference from baseline.

To sum, only six studies in the review (n = 25) included a pre-test of participants' IM for the target activity and measured participants' IM in a free-choice setting. Thus, given the small number of participants and the methodological differences across the studies (e.g., measures of IM) drawing definitive conclusions regarding the effects that reward contingencies have on participants' IM is problematic.

Practice, trend, and intrinsic motivation.

Deci and Ryan (1985) have stated that intrinsic motivation is based on the innate drive for competence; that is, increased competence leads to increased IM. However, with repeated exposure to an activity, individuals' ability to perform the activity is likely to increase simply as a function of practice. Moreover, increased exposure (i.e., practice) to an activity is likely going to result in a corresponding increase in competence.

Following from Deci and Ryan's argument that increased IM is the result of increased competence, it would be expected that practice effects could also lead to increased IM. Thus, when evaluating the impact of reinforcement contingencies in individuals' IM it is important for researchers to attempt to disentangle the effects of increased IM that is the result of simple exposure and increased competence, versus observed increases in IM resulting from the experimental manipulation.

The most straightforward way to attempt to assess whether there has been an artificial increase in IM is to examine whether there is an increasing trend in baseline performance toward the participants' observed performance during the reward condition. Table 2.5, under the heading "Trend from FC" (i.e., trend in performance from free-choice period toward experimental phase), lists studies that provided data showing baseline performance that is increasing toward the performance observed during the experimental condition. Of the 12 studies, 16 participants generally demonstrated increasing rates of performance from baseline to the reward condition; which included all of the participants in two studies (i.e., Feingold & Mahoney, 1975; Mintz, 2003, Exp 1). In contrast, 31 participants showed evidence of either a decreasing trend in performance, or no obvious trend. Only three studies evidenced no trend for all of their participants. Given that seven out of 12 studies showed differing response patterns (increases, decreases, and no trend) between participants, the notation provided in Table 2.5 indicates the response of the *majority* of the participants in each report. That is, if all, or the majority, of the participants in the study demonstrated an increasing trend, the study was assigned a rating of “Yes” as evidencing a trend. If all, or the majority, of participants did not show a trend, or showed a trend in the opposite direction of the expected performance, a “No” was assigned. For the reasons previously noted, it is problematic to make any conclusions regarding changes to participants’ IM when performance during baseline was increasing toward that which was observed during the subsequent conditions (i.e., reward).

Conclusions about the effects of reward contingencies on IM should only be inferred from the results of those participants who showed no trend, or a trend in opposition to the reward condition. To ascertain the effects of reward on IM for the 31 participants who did not show a trend in performance in favor of the rewarded performance, the observed performance during the withdrawal phase should be compared with their performance during baseline. One of the primary questions in this review is whether or not exposure to a reward led to a decrease in IM following the removal of the reward contingency. Of those 27 participants who did not show evidence of an increasing trend, 13 participants experienced an increase in IM in relation to baseline levels. In comparison, of the 20 participants who did show evidence of an increasing trend toward the reward phase, six participants experienced an increase in IM over baseline measures.

Analysis of each participant revealed that not one of the 47 participants showed an undermining of IM following the removal of the reward contingency [Vasta and Stirpe (1979) reported an undermining effect for two participants although responding increased to baseline levels within two to three sessions]. Participants experienced either no difference in IM following the reward contingency (n = 28) or an increase in IM (n = 19). These results also run contrary to the predictions of CET (Deci & Ryan, 1985) and add support to the assertion that examination of temporal trends reveals that rewards do not necessarily lead to an undermining of IM. It also suggests that methodological differences in research design may lead to differential effects, wherein between-group designs obtain detrimental effects more readily than what is observed in within-subject designs.

Long-term effects of reinforcement on intrinsic motivation.

To evaluate the long-term effects of reinforcement on IM, several studies incorporated a follow-up period. Follow-up conditions involved a period of no experimental contact, ranging in time from two to three weeks in length, where baseline conditions were reinstated (see Table 2.5). Under the heading Difference at Follow-Up (noted as “Dif at FU”), it can be seen that 20 participants were evaluated at follow-up. In comparison to performance at baseline, the IM of nine participants remained above, and the IM of 11 participants remained unchanged, at follow-up. Deci et al. (1999) claimed that any observed increase in IM was a transitory phenomenon, and that ultimately IM would eventually be undermined. However, the current results highlight that the positive, and neutral, effects that reinforcement have on IM are anything but transitory.

The best evaluation of the effects of reinforcement on IM would be to determine whether those participants who did not show evidence of a trend in baseline performance, and who participated in a long-term evaluation experienced a change in their IM over time. Thirteen participants met these criteria. Of those 13 participants, comparison of baseline performance to the performance during the first withdrawal condition revealed that six participants experienced in increase in IM, whereas, seven experienced no difference. For those six who experienced increased levels of post-reinforcement IM, levels maintained at follow-up. For the seven participants whose levels of IM did not differ from the pre-reinforcement levels, their IM also remained unchanged at follow-up. This evidence runs contrary to the predictions of CET (Deci & Ryan, 1985). Also, Deci et al. (1999) showed long-term detrimental effects of reinforcement contingencies and the studies reviews here show long-term increases in IM. A major difference is that rewards were reinforcers in the within-subject experiments reported here, but where not shown to be reinforcers in the between-group experiments.

Summary of effects of reinforcement on intrinsic motivation.

Overall, the effects of the manipulations (reinforcing intrinsically motivated behavior) could have three possible effects on intrinsic motivation. Once the reinforcers are withdrawn, IM could increase, remain unchanged, or decrease. However, of the 47 individuals that participated in the current review of within-subject research, 19 demonstrated an increase in IM, IM remained unchanged from baseline levels for 28 individuals. Thus, the general conclusion that can be drawn from this review is that contrary to the predictions of CET, IM is not negatively affected following the administration of reinforcement.

Interpersonal context, reinforcement and within-subject designs.

Of importance to the present review is to determine the extent to which interpersonal context (Deci & Ryan, 1985) was addressed in the within-subject research. Unfortunately, none of the studies explicitly addressed the issue of context. However, following Deci and Ryan's (1985) characterization of interpersonal context, and other variables associated with increased intrinsic motivation, such as autonomy (i.e., opportunities to exercise choice), within the present review an attempt was made to identify elements within the 12 studies that could impact interpersonal context. Specifically, the studies were analyzed to determine whether the experimental contingencies were presented in either autonomy-supportive or coercive-controlling contexts.

Evidenced by offering choice to participants (see Table 2.6), three studies provided enough detail to ascertain that their contexts were autonomy-supportive. Specifically, Harrington (2004) offered participants $50.00 to purchase whichever toys they wished from a local toy store that would serve as their reinforcers throughout the study. In addition, his investigation took place at a local playground where participants were told they were free to play with whatever activities they wished. Moreover, if their preferred activity was not found at the park (e.g., rollerblades), they were encouraged to bring the activity from home. Both McGinnis et al. (1999) and Vasta and Stirpe (1979) offered participants choice between three types of worksheets throughout their experiments. There were nine participants across the three studies. In total, of the nine participants that received procedures that met Deci and Ryan's (1985) criteria for autonomy supportive, six of the participants evidenced an increase in IM, whereas three evidenced no difference in IM from baseline to withdrawal contrary to the predictions of CET.

Table 2.6. Summary of context, maintenance, and transfer.

Study	Context	Test of Maintenance	Latency
Feingold et al. (1975)	Ins/I	Y	2 wks
Davidson et al. (1978)	Ins/I	N	n/a
Vasta & Stirpe (1979)	Y	Y	2 wks
Mawhinney et al. (1989)	Ins/I	N	n/a
Skaggs et al. (1992)	Ins/I	N	n/a
McGinnis et al. (1999)	Y	Y	2 wks
Akin-Little (1999)	Ins/I	Y	3 wks
Martens et al. (2002)	Ins/I	N	n/a
Mintz (2003) – Exp. 1	Ins/I	N	n/a
Mintz (2003) – Exp. 2	Ins/I	N	n/a
Harrington (2004)	Y	Y	2 wks
Weaver (2004)	Ins/I	N	n/a

Note. Ins/I = insufficient information; Y = yes, N = no.

It is interesting to note that the studies varied in the reward contingencies they implemented. Harrington employed engagement-contingent reinforcers, whereas McGinnis et al. and Vasta and Stirpe both administered performance-contingent reinforcers. These results are consistent with the between-group research design by Ryan et al. (1983) and Banko (2007). They are consistent with Banko (2007) in that engagement-contingent rewards presented in an autonomous context enhanced IM. They are consistent with Ryan et al. (1983) and Banko (2007) whereby performance-contingent rewards presented in autonomous contexts also led to an increase in IM. Although Harrington, McGinnis, and Vasta and Stirpe did not set out to manipulate participants' autonomy as an independent variable, like Ryan et al. (1983) and Banko (2007), their results provide evidence that when rewards are administered in an autonomy-supportive context, IM is enhanced.

Maintenance and transfer.

The present review classified the studies in terms of the maintenance and transfer of performance and IM. Forty-two percent (5 of 12) of the studies examined the maintenance of the experimental manipulation (see Table 2.6). The period between the withdrawal conditions and the reinstatement of the baseline conditions ranged from two weeks to three weeks. What researchers found was that children's intrinsic motivation for target tasks either increased at follow-up or remained at baseline levels. Of the 20 children included in the corresponding investigations, at follow-up, nine children experienced an increase in IM, IM remained unchanged from baseline levels in 11 children.

A subsequent analysis was conducted to determine whether any of the authors addressed the transfer of intervention effects from the target task to other similar tasks. Transfer was not included in Table 2.6 because none of the studies employed procedures that explicitly tested transfer.

One goal of this review is to determine the characteristics of those studies that manipulated reward contingency (performance- or engagement-based), interpersonal context, and took measures to assess the maintenance and transfer of the effects of the experimental manipulations. Since none of the studies addressed transfer, subsequent analyses focused only on reward contingency, interpersonal context, and maintenance. As such, there were only three studies that examined the effects of reinforcement on participants IM and whether the effects maintained over time. Coincidentally, the three studies (N = 9) that examined rewards in autonomous contexts are also the only studies that examined the long-term effects of their manipulations (maintenance). Although, as previously noted, the extent to which the studies addressed autonomy-support had to be inferred from their procedures.

Examination of these three studies that investigated interpersonal context, reward contingency, and maintenance, revealed results consistent with the analysis above. That is, after the two – three week latency period, all nine participants evidenced IM that was either increased and stable (n = 6) or unchanged from baseline (n = 3). These data compliment the findings offered from Banko (2007) and Ryan et al. (1983) in that when either performance- or engagement-contingent rewards are administered in autonomous contexts, IM is generally left unaffected or enhanced. Because so few studies have either implicitly or explicitly investigated the impact of reward contingencies, autonomous contexts, and maintenance of these manipulations, further research is warranted to dissect these interrelationships.

Comparison of Between-Group and Within-Subject Research: Rewards and Intrinsic Motivation

The previous review served to highlight the contributions that have been made to the rewards and motivation literature using between-group research designs, but more specifically, the contributions of within-subject designs.

Examining the literatures using both the between-group and within-subject research designs for the impact of rewards on IM has revealed both consistencies and inconsistencies. The most apparent inconsistency is that between-group designs are capable of demonstrating undermining effects, whereas within-subject designs do not. This may be attributable to one of two methodological considerations. First, between-group designs tend to assess IM in one experimental session, a limitation that does not allow for examination of trends in responding. Second, these designs do not evaluate whether the reward acts as reinforcement. Observed changes in performance during the “reward” phase may be attributable to some unknown variable rather than due to the independent variable. Further, the use of a non-reinforcing stimulus may elicit post-reward behavior consistent with Skinner’s (1971) description of counter-control. Thus, it is possible that participants’ decreased performance in between-group designs is the result of these characteristics acting either independently or additively rather than a true decrease in levels of IM.

The present investigation is most concerned with those factors that promote IM. One of the most compelling findings is that research designs that incorporate multiple exposures to baseline, experimental, and withdrawal conditions, as well as ensure that the rewards function as reinforcers, show only positive, or neutral, effects on IM. Moreover, the follow-up data (ranging over two to three weeks) demonstrates that the positive and neutral effects of rewards are not transitory, contrary to the claims of those who support an undermining phenomenon (i.e., Deci et al., 1999). That is, across the within-subject research, regardless of whether the reinforcement contingencies were engagement-contingent or performance-contingent, IM either increased or remained unchanged from baseline levels.

Interpersonal context is another moderator variable that impacts IM. In the between-group literature, few studies explicitly examined the impact of context. Those who did (n = 6), found both undermining and enhancement effects. Interestingly, only one study found a main effect of context (i.e., controlling interpersonal feedback undermined, Ryan et al., 1983), whereas, three of six studies found an interaction effect between the reward contingency and autonomous context that enhanced IM (see Table 2.2). It is possible that of those studies that did not explicitly manipulate interpersonal context as independent variable, and who reported a negative effect of reward on IM, may have unknowingly administered their rewards in a controlling context thereby clouding the independent effects of reward on IM. In the within-subject literature, three studies inadvertently offered enhanced autonomy-support. Within those three studies, six out of the nine participants experienced an increase in IM (three remained unaffected). As previously noted, all of the within-subject studies found either positive or neutral effects. However, across research designs, it remains to be understood whether the observed increases in IM following the administration of rewards in autonomous contexts are due to additive or multiplicative effects.

To conclude, what the results of these investigations have shown is that reinforcement is capable of increasing participants' IM. Further, IM can also be increased when rewards are offered in autonomy-supportive environments.

Critics (e.g., Deci et al., 1999; Kohn, 1993) have warned against the use of rewards in applied settings such as the classroom. However, it has been noted that in typical classroom environments, when reward systems are put into effect, rarely if ever are rewards administered only once as done in the laboratory experiments from which critics attempt to generalize (Cameron & Pierce, 2002). Most often, reward systems are an ongoing set of procedures. The utility of reward systems lies not in the effects that are observed in the laboratory, but rather how they can be used to motivate behavior in applied settings. Until now, the theoretical assumptions forwarded by CET and behavioral theories have only been tested on typically developing children and adults. What remains to be seen is whether the assumptions of the various theoretical positions hold true for atypical populations. The present research offers an attempt to investigate whether these theoretical assumptions can be applied equally to an atypical group of children. Children with autism have been selected for three reasons. First, they are atypical learners. Second, their educational programs rely heavily on the use of reward systems. Third, children with autism have deficits in their ability to relate socially to others, so the ways in which interpersonal context impacts IM may be markedly different from the ways in which it impacts IM in the typically developing. The following chapter introduces the reader to children with autism, the research that has been conducted on motivation in this population, and predicts how children with autism may be impacted by the theoretical assumptions of the rewards and motivation literature in order to offer greater understanding of CET, behavioral theories, and how IM for children with autism may be enhanced.

Chapter 3

Introduction to Autism and Motivation, and Choice Making Interventions

Autism and Motivation

Autism is a neurological disorder under the umbrella of Pervasive Developmental Disorder (PDD) as defined by the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2000). Autism is characterized by three core areas of impairment. The first involves a qualitative impairment in the ability to relate socially to others (e.g., failure to use eye-to-eye gaze and body posturing to regulate social interactions). The second concerns a qualitative impairment in the ability to communicate effectively (e.g., repetitive use of language, impairments in pragmatics, and failure to develop socially and contextually appropriate alternate methods of communication). The third impairment concerns children's patterns of behavior. Children with autism demonstrate repetitive and stereotypical behaviors and restricted interests (e.g., including motor mannerisms, preoccupation with parts of objects, and adherence to non-functional routines). The characteristics of autism range from relatively mild to profound, and often there is present comorbid mental retardation also ranging from mild to profound (American Psychiatric Association, 2000). Epidemiological surveys have reported that as many as three quarters (70%) of children with autism have associated mental retardation (Chakrabarti & Fombonne, 2001). Given this variability, autism is often referred to as a spectrum disorder.

Similar to autism is a disorder known as Asperger's disorder (AS). Children with AS display behavioral characteristics consistent with those observed in children with autism with regard to social deficits and the presence of repetitive stereotypical patterns of behavior. Children with AS differ from those with autism only in that children with AS do not suffer from the language and cognitive deficits that characterize autism (American Psychiatric Association, 2000).

Autism has been shown to affect greater numbers of males than females, at a rate of approximately four or five to one (American Psychiatric Association, 2000). In the general population, prevalence rates for autism and AS combined have reached as high as 60 children per 10 000 population (Fombonne, 2003). This translates to as many as 1 in every 166 children being diagnosed with a PDD (Chakrabarti & Fombonne, 2001). Although it is considered a "low-incidence" disorder (Winzer, 2005), at a prevalence rate of 1 in 166, understanding of PDD (autism and AS) is incredibly important for service providers and the general education system. To avoid confusion, for the remainder of the document, the term ASD (autism spectrum disorder) will be used to refer to both children with autism and children with Asperger's disorders.

There is no known cause for ASD, nor is there a cure. However, research has shown that educational interventions can be successful at remediating many of the behavioral characteristics associated with ASD (Dawson & Osterling, 1997: National Research Council, 2001; Rogers, 1998). Although there is no guarantee that any particular intervention will improve children's outcomes (Dawson &

Osterling; National Research Council), those educational interventions that are founded in behavioral methodology, which focus on teaching observable and measurable skills, have the most robust results (Schreibman, 2000). Behavior-based educational interventions teach students by providing positive consequences following demonstrations of desirable behavior (Skinner, 1953). The success of behavior-based educational interventions is rooted in two fundamental aspects of how ASD is currently understood. First, as previously discussed, ASD is defined behaviorally. Since the biological or neurological basis for ASD remains undiscovered, the construct can only be described based on the observable characteristics demonstrated by those with the disorder. Two of the three core impairments that discriminate ASD from other disorders (i.e., social interaction and communication) are defined in terms of skill deficits. As such, educational interventions are successful because they focus solely on teaching discrete skills to remediate those areas of deficit.

The second reason behavior-based interventions have met with such success has a great deal to do with the use of extrinsic motivators. Researchers have posited that repeated experiences of failure in individuals with general developmental disabilities (MacMillan, 1971), as well as children with ASD (Clark & Rutter, 1979), result in reduced motivation for testing and teaching contexts. Koegel and Egel (1979) reported that when children routinely experience failure, the result, in turn, is low motivation for the situation associated with failure. Koegel and Egel have further asserted that the low motivation for task engagement can be corrected in the same way that the phenomenon of learned helplessness can be corrected (Seligman, Maier, & Geer, 1968). Koegel and Egel demonstrated that when children showed evidence of low motivation (i.e., reduced attempts at task completion, low levels of enthusiasm), merely providing prompts to continue (in the form of verbal encouragement) inspired children to respond and facilitated task completion. This simple intervention was interpreted to have enhanced children's motivation.

In the ASD literature, the construct of motivation is discussed in terms of how children interact with the environment. That is, children are said to be motivated when an increase in the characteristics of responding are observed (L. K. Koegel, Koegel, & Carter, 1999). Conversely, children are thought to be unmotivated when a decrease in responding is evidenced. Thus, researchers began to focus on ways in which motivation within intervention sessions could be increased. The rationale for this line of research was grounded in the idea that if children were more motivated, they would likely profit to a greater extent from the intervention.

There have been many investigations into motivation in children with ASD. Antecedent interventions have been shown to be highly effective at increasing children's motivation to respond during intervention (National Research Council, 2001). Offering children opportunities to make choices within an intervention program is one of those antecedent strategies. Offering children opportunities to engage in choice making within intervention sessions has been shown to greatly improve children's rate of responding (L. K. Koegel, Koegel, Shoshan, & McNerney, 1999). It has been thought that by providing individuals with choice-making opportunities within intervention sessions (e.g., order of activities, choice of implements, etc.) serves to empower individuals, inspires them to act, and results in a generalized increase in motivation to engage in intervention (e.g., R. L. Koegel, Tran, Mossman, & Koegel, 2006). Along with several other motivational variables, the impact of incorporating choice into an intervention program has been well documented (see R. L. Koegel, Koegel, & Brookman, 2003 for a review of empirical support).

The present investigation was concerned with the impact that motivation has on children's performance. Particularly with how within-session choice-making opportunities affect children's motivation outside of session and the extent to which changes in motivation impact the maintenance and transfer of children's performance. The following review will evaluate the literature examining choice making and it's impact on academic performance.

Choice-Making Interventions

The Koegels and their colleagues have demonstrated that providing children with opportunities to exercise choice within an activity has helped to facilitate motivation (Dyer, Dunlap, & Winterling, 1990; Dunlap, Kern-Dunlap, Clarke, & Robbins, 1991; Kern et al., 1998; L. K. Koegel, Carter, & Koegel, 1998; Moes, 1998; Vaughn & Horner, 1997; Yoder, Kaiser, Alpert, & Fischer, 1993). Changes in motivation have been evidenced by response rate, response latency, accuracy, engagement, and changes in participants' affect (Kern et al., 1998).

In these investigations, researchers have offered autonomy support (i.e., choice) by allowing children to choose stimulus materials, writing implements, order of tasks, which tasks to complete, and where to sit during the completion of the tasks. This research is especially germane as the use of choice as a manipulation of autonomy-support was the foundation upon which the present study was based. In the discussion that follows, analysis of the research involving choice-making as an independent variable will provide insight into the extent to which effects of choice-making has been evaluated with academic activities.

In a review of the literature on choice making, Kern et al. (1998) examined studies that manipulated choice as an antecedent intervention. Fourteen studies were reviewed that included children and adults, as well as a range of disability groups (including ASD). Dependent measures included individuals' performance in three broad areas; academic activities, vocational activities, and recreational and social activities. Only those studies that focused on academic activities will be discussed in the present review because children's IM for academic activities was of primary interest in the present research.

Table 3.1 contains a summary of participant characteristics for the nine studies that met the inclusion criteria for the present review (i.e., choice-making as a manipulation). As observed a total of 21 children participated in the nine studies, ranging in age from 4 to 13 years. The participating children had a variety of disorders including emotional behavioral disorder, developmental disability and/or mental retardation, and ASD. There was one child who was without disability.

Table 3.1. Summary of participant characteristics

Study	Participants' Characteristics		
	#	Age	Disability
Cosden et al., 1995 – Exp 1	3	11-13	SED
Cosden et al., 1995 – Exp 2	Same		
Dunlap et al., 1991	1	12	SED/mild MR
Dunlap et al., 1994 – Exp 1	2	11	EBD
Dunlap et al., 1994 – Exp 2	1	5	Non-disabled
Dyer et al., 1990	3	5-11	DD/PDD, severe MR
Harding et al., 1994	5	4-6	Average-mild MR
R. L. Koegel et al., 2006	2	8	ASD
Moes, 1998	4	5-9	ASD

Note. SED = Severe emotional disability, EBD = Emotional behavioral disorder, MR = Mental retardation, DD = Developmental disability, PDD = Pervasive developmental disorder, ASD = Autism spectrum disorder.

Each of the nine investigations employed a within-subjects research design (see Table 3.2). The sessions alternated between choice versus no-choice conditions (e.g., ABAB, BABA, etc.). During experimental conditions participants were offered opportunities to make choices, whereas during baseline or withdrawal conditions, no opportunities to engage in choice making were permitted. The only exceptions to the typical withdrawal designs (i.e., ABAB) were those used by Dunlap et al. (1991) and R. L. Koegel et al. (2006). These two studies employed simple AB designs; where baseline data was collected and used to create an intervention that was implemented continuously, without a withdrawal phase.

Outlined in Table 3.2 are the choice-related independent variables that were manipulated across the nine studies. As shown in Table 3.2, two studies gave the children choice of potential reinforcers. Six studies gave participants a choice of task. Three studies offered choice of stimulus items (e.g., crayons, pencils, markers). Two studies gave participants the choice of the order in which the tasks could be completed.

In order to assess the impact of providing choice during academic activities, four of the nine studies measured the accuracy of children's performance (see Table 3.2). Other dependent measures included problem behaviors or disruptions, task engagement, rate of correct responses, rate of completion, number of positive statements, and child affect.

The results of the nine studies revealed that providing choice within academic activities led to increased accuracy for nine out of nine children (see Table 3.2). Task engagement improved for four out of four children. Instances of disruptive behavior decreased, or were eliminated altogether, for 14 out of 17 children. Appropriate behavior increased for five out of five children. Rates of task completion increased for four out of four children. Numbers of positive statements increased for two out of two children. And, improvements in child affect were reported for six out of six children. Overall, this research has demonstrated that providing choice in academic contexts led to improvements on a variety of behavioral measures for 18 out of 21 participants. Thus, it can be stated with a high degree of confidence that providing choice in academic settings is beneficial to students' outcomes.

Table 3.2. Summary of choice-making studies*

Study	Research Design	Target Task	IV (Choice of)	DV	Results
Cosden et al., 1995 (Exp 1)	ABC	Academic	Reinforcers, tasks	• Accuracy	• Increased accuracy with both choices • Decreased accuracy with no choice
Cosden et al., 1995 (Exp 2)	ABC	Academic	Reinforcers, tasks	• Accuracy	• Increased accuracy with both choices • Accuracy decreased in no choice
Dunlap et al., 1991	AB	Academic	Tasks	• Engagement • Disruptions	• Increased on-task behavior • No disruptions
Dunlap et al., 1994 (Exp 1)	ABA, ABAB	Academic	Tasks	• Engagement • Disruptions	• Increased engagement • Decreased disruptions
Dunlap et al., 1994 (Exp 2)	ABAB	Academic	Tasks	• Engagement • Disruptions	• Increased engagement • Decreased disruptions
Dyer et al., 1990	BAB, ABAB, BABAB	Pre-academic	Reinforcers, tasks	• Problem behavior • Rate of correct responses	• Decreased problem behavior • No difference in response rate
Harding et al., 1994	ABCBC, ABCDCD	Activities	Stimulus items	• Appropriate • Inappropriate behavior	• Increased appropriate behavior • Decreased inappropriate behavior for 2/3 participants
R. L. Koegel et al., 2006	AB	Academic	Tasks, stimulus items	• Accuracy • Disruptive behavior • Number of positive statements • Affect	• Increased accuracy • Increased positive affect • Increased positive statements • Decreased disruptive behavior
Moes, 1998	ABAB, BABA	Academic	Tasks (between and within), stimulus items	• Accuracy • Disruptive behavior • Rate of completion • Affect	• Increased on-task behavior • Increased rate of completion • Increased accuracy • Decreased disruptive behavior

*Adapted from Kern et al., 1998. *Note.* IV = Independent variable, DV = Dependent variable; A = no-choice phase or baseline, B = choice phase, C = choice phase and additional manipulation, D = choice phase and additional manipulation.

Research targeting the extent to which choice has been used *exclusively* with children with ASD in an effort to enhance motivation for academics is much more limited. As observed in Table 3.2, although each study targeted academics, only two of the nine studies were conducted using children with ASD (N = 6) (i.e., R. L. Koegel et al., 2006; Moes, 1998). The participants in the remaining studies ranged from non-disabled to severely disabled. Thus, only those conclusions that are being forwarded by R. L. Koegel et al. and Moes can be taken as evidence regarding outcomes associated with offering choice in academic programs for children with ASD. The discussion to follow will evaluate the methodology of these two studies.

In the study by R. L. Koegel et al. (2006), data is offered for three children. However, procedures are only discussed for two children. It is unclear whether the third child served as a control or was an equal participant in the investigation. Therefore, in the following discussion the third child will not be included.

R. L. Koegel et al. recorded baseline measures of twin brothers' homework performance (see Table 3.1 for a summary). Using a parent training model, parents were instructed to offer their children choice in the order in which the children's homework tasks would be completed. Also, children were offered choice of implements in the completion of their homework. Baseline sessions were conducted for the brothers for two and three sessions, respectively. Intervention sessions were conducted for thee sessions each. Results demonstrated that for both boys, percentage of correct performance (i.e., accuracy) increased, measures of positive affect increased, disruptive behaviors decreased, and the number of positive statements made by the boys during their sessions increased.

Unfortunately, the study reported by R. L. Koegel et al. is limited in several regards. First, although the authors are making claims about the positive impact the providing child choice has on increasing motivation, the exact impact that choice had on students' behavior is unclear. Providing child choice was not the only independent variable. Along with the choice manipulation, other motivational variables were also manipulated (e.g., reinforcing attempts). The implementation of additional motivational variables (L. K. Koegel et al., 1999) clouds the interpretations of the independent effects of choice. Second, there was no discussion regarding whether the reward was in fact reinforcing. It can be surmised, however, that the reward (an M&M™ candy) was, in fact, reinforcing due to the observed increase in, and maintenance of, performance. Third, little discussion was provided regarding the specific reinforcement contingencies that were implemented. The authors discussed "reinforcing (the child's) good attempts" (R. L. Koegel et al., 2006, p. 86), which is an example of providing a looser shaping criteria (L. K. Koegel, Koegel, Harrower, et al., 1999). Reinforcing attempts is more consistent with an engagement-contingent reward as discussed in the previous chapter. Some acknowledgement of the reinforcement contingency was provided anecdotally for one participant. When explaining the reinforcement contingency, the child's mother stated, "I get to eat this (M&M™) because I got it (math question) right" (R. L. Koegel et al., 2006, p. 88). This statement implies that the reinforcement contingency was performance-contingent. This apparent contradiction in reinforcement procedures warrants further clarification as previous research has shown that the literature on the effects that rewards have on intrinsic motivation is impacted based on the reward contingency (Banko, 2007; Cameron et al., 2001; Pierce et al., 2003). Fourth, baseline and follow-up phases were not presented as free-choice periods. Rather, baseline phases were an assessment of academic performance simply without the addition of the choice manipulations. As well, the follow-up phase did not incorporate a withdrawal of the choice manipulation and children continued to receive reinforcement and choice-making opportunities throughout the follow-up. Given that children's motivation was not assessed both before and after the manipulation in a free-choice period, it is impossible to discern whether the increased performance observed during the choice manipulation, as well as at follow-up, were the result of increased intrinsic motivation for academics. The increased performance resulting from the manipulations (contextual and reinforcement) speak only to within-session motivation and not to the long-term impact of choice on children's intrinsic motivation for academic activities.

Further research is needed to ascertain whether children's motivation for the target tasks (i.e., academics) would maintain in the absence of the choice manipulation. Moreover, it is important to determine whether the effect of increased motivation for academics would maintain and generalize outside of the educational context. In sum, with respect to the present study, although R. L. Koegel et al. were not evaluating the effect of performance-contingent reinforcers on students' intrinsic motivation per se, or the independent effect of choice as a manipulation, their findings do offer preliminary support for the hypothesis that performance-based reinforcement contingencies delivered in an autonomous contexts, have the potential of increasing intrinsic motivation for academics in children with ASD within academic activities.

Following the work of the Koegels, Moes (1998) investigated the extent to which choice-making opportunities would facilitate performance on homework tasks. Four children with ASD participated in this ABAB, reversal design. Children completed teacher-assigned homework in a university laboratory with trained research assistants. Conditions were counterbalanced across children; two children received ABAB, and two children received BABA (A representing baseline/no-choice conditions; B representing choice conditions). In the choice conditions, children were allowed various opportunities to exercise autonomy (i.e., choice); the order of the homework activities, the order of the specific items or problems within those activities, and the stimulus material. Sessions were conducted twice per week for a total of 20 sessions, and each phase (i.e., A, B) lasted for five consecutive sessions. Moes measured children's motivation for academics by observing percent of correct responding (i.e., accuracy), disruptive behavior, rate of homework completion, and child affect.

Moes (1998) reported that children consistently performed better in choice conditions. That is, children's motivation increased on measures of accuracy, rate of task completion, and child affect. Also, during choice conditions, children demonstrated fewer instances of disruptive behavior. Although Moes' data offers convincing evidence for the impact that enhancing autonomy can have on students' motivation, his study suffers from similar methodological flaws as noted about the research conducted by R. L. Koegel et al. (2006). First, student motivation for homework was not assessed in a free-choice condition. Nor were levels of motivation assessed in a withdrawal condition following the experimental manipulation. Conclusions drawn regarding the impact of choice on student motivation are stronger than those of R. L. Koegel et al. because choice was the only experimental manipulation. However, like R. L. Koegel et al., the reinforcement contingency was in effect throughout the duration of the experiment, and the extent to which that impacted students' motivation beyond the choice manipulation is indeterminable. Second, Moes did not provide an explicit description of the reinforcement contingency. This is problematic because previous research with typically developing individuals has shown that it is possible to obtain an interaction effect between the reward contingency and the contextual manipulation (Banko, 2007) so the observed effects may be additive or multiplicative. Third, throughout children's sessions the number of choice-making opportunities varied (ranging from one to seven), resulting in differences in autonomy support across academic tasks. It is plausible that the children may have interpreted this inconsistency as a qualitative difference between contexts differentially affecting their performance. Fourth, like R. L. Koegel et al. (2006), Moes assessed children's motivation strictly within-session, long-term maintenance and generalization was not considered. Thus, caution is warranted in any inferences that are made from Moes' research regarding the effects of offering choice only as an intervention technique to increase children's motivation for academics.

Despite these limitations, Moes' (1998) research does serve to inform the present research. Moes compared a traditional (i.e., adult-directed) educational context, wherein the tutor chose the order of the homework activities and the stimulus materials (implements), to an autonomy-supportive educational context, wherein the student chose the order of the homework activities and chose from a variety of stimulus materials. As previously noted, Moes found that in conditions that supported student autonomy, performance increased in comparison to more traditional contexts. The results demonstrate that supporting student autonomy during academic activities can enhance student motivation within those corresponding activities.

In summary, the findings from the two reports (R. L. Koegel et al., 2006; Moes, 1998) offer preliminary evidence that when students with ASD have the opportunity to exercise choice within academic activities, the increase in student autonomy is associated with an increase in within session student motivation. Although the evidence provided is compelling, the small sample size (N = 6), difficulties discerning the reinforcement contingencies, lack of free-choice assessment of intrinsic motivation, lack of complete withdrawal of all experimental manipulations, and lack of consideration for long-term effects on motivation, warrant considerable caution in generalizing their results. Research is needed that will extend these findings to ascertain whether supporting the autonomy of students with ASD within academic activities will lead to generalized improvements in intrinsic motivation for those activities outside of the educational contexts, and whether changes in intrinsic motivation, as evidenced by academic performance, maintain over time. The present investigation aimed to answer these questions. By combining the two lines of research presented in this review (i.e., the results from the typically developing, as well as children with ASD), a greater degree of clarity may be brought to our understanding of rewards, motivation, and academic performance in children with ASD.

Research Hypotheses

The present research aimed to test whether the administration of performance-based rewards during academic tasks that offered increased opportunities for choice-making resulted in increased intrinsic motivation for the rewarded tasks. Further, whether increased intrinsic motivation would maintain over time and transfer to novel situations.

Based on the two major theoretical positions outlined in Chapter Two, there were several specific predictions that could be made about the effects of performance-based rewards and increased choice on children's behavior. Cognitive evaluation theory (CET) asserts that although an increase in children's performance will be seen during the reward administration phases, during the subsequent withdrawal phases, children's intrinsic motivation will decrease below baseline levels (i.e., will be undermined). CET goes further to predict that the increased opportunities for choice making offered during the autonomous condition will help to reduce the extent to which children's intrinsic motivation is undermined. According to CET, the undermining of intrinsic motivation that would be observed will maintain over time and transfer to novel environments.

Behavioral theories forward that performance-based rewards will increase children's intrinsic motivation during the reward administration phases, and the informational aspects of the performance-based reward contingency will increase their sense of competence, and ultimately increase their intrinsic motivation. As a result, children's performance would be equal to, or greater than, what was observed during baseline levels. It was expected that the increased choice making opportunities found in the autonomous condition would enhance the reinforcing properties of the reward resulting in enhanced intrinsic motivation. In contrast, during the no-choice condition, the rewards would be experienced as an attempt at coercive control resulting in oppositional behaviors or non-compliance and a possible decrease in intrinsic motivation. Further, whether or not children have had recent exposure to choice making opportunities would impact the extent to which they find the reward experiences reinforcing and whether it will impact their intrinsic motivation. That is, recent exposure would lessen how reinforcing the contingency will be experienced, whereas, a lack of exposure would increase the reinforcing aspects of the contingency. Behavioral theories also predict that the effects will maintain over time and generalize to novel environments.

Chapter 4 - Study One

Method

The purpose of this study was to test whether performance-based rewards presented in contexts with enhanced autonomy support (i.e., choice) would increase intrinsic motivation for academic tasks. Moreover, would the effects of performance-based rewards and enhanced autonomy-support maintain and transfer to novel settings in the absence of rewards?

Participants

Three participants were recruited through the local autism society using a general recruitment letter that was disseminated through the mail to its membership (see Appendix A for Letter of Informed Consent). Participants were eligible to participate if they had an existing diagnosis of autism or Asperger's Syndrome (American Psychiatric Association, 2000), and were between the ages of 9 and 12 years. Vincent was a 9-year old male in Grade 4. He was diagnosed with Asperger's Syndrome. Academically, he was an average student. Socially, however, like all children with an autism spectrum diagnosis, he struggled with reciprocal social interactions. Evan was a 10-year old male in Grade 5. He had a diagnosis of autism. Academically, he was slightly behind his peers. Many of his restricted and repetitive interests interfered with the development and maintenance of friendships. John was a 9-year old male in Grade 3. John had a diagnosis of autism. Academically and socially he was behind his peers. All three children had received their diagnoses from a major diagnostic centre that served central and northern Alberta. In school, all three children received special educational supports based on a "Student Eligibility Code 44" of autism spectrum disorder (ASD) and their school programs were based upon individualized program plans. Participants were enrolled in the order in which they were recruited, once eligibility was determined.

Setting

The experiments were all conducted in the children's homes. Experimental sessions were conducted either in the families' kitchen (Vincent), the child's bedroom (Evan), or in the basement family room (John). These locations were selected as they corresponded to the locations where students were typically asked to complete homework assignments. Most of the sessions occurred after regular school hours. However, for Vincent, some sessions were scheduled in the mornings during regular school hours. All of the sessions were conducted at a table where the researcher sat across from the participant. As was noted in the informed consent, all sessions were video recorded.

Materials

The experimental activities were mathematics and language arts (LA) worksheets and activities (see Appendix B for examples of experimental activities). Math activities have previously been used in research on rewards and intrinsic motivation (e.g., McGinnis et al., 1999) and LA was selected as the alternate activity to ensure that observed differences in motivation were not due to subject area. Additional materials included an assortment of writing implements (e.g., pencils, pens, crayons, markers), tokens (poker chips), and a variety of distracter books (Where's Waldo, Eye Spy) and rewards (e.g., favorite toys, books, computer games, and music).

Families were asked to allow the researcher access to recent Individualized Program Plans (IPPs) developed by the children's school programs to gain insight into their child's developmental level (e.g., developmental assessments, previous IPPs, etc., that were on file). Based on this information, as well as consultation with each child's parent(s), the experimenter prepared the academic workbooks (math and LA) appropriate to each participant's skill level. The workbooks were composed of relatively easy problems and questions. Workbooks contained approximately 15 pages of problems with approximately 10 problems per page. The academic activities in the math content area included standard equations (i.e., addition and subtraction), decoding, or money-related activities. In the LA content area, the academic activities included letter identification, word spelling, or printing activities. Depending upon the experimental condition, children may have had the option of selecting from one of two different math or LA content areas worksheets.

Design and Phases of Experiment

This experiment was a repeated measures design that was characterized by two experimental conditions; each was preceded by a baseline and followed by withdrawal (i.e., A-B-A-A-C-A). The A phases were presented as free-choice periods that allowed the children the opportunity to spend time on an academic activity, an alternate activity (i.e., looking at a picture book), or do nothing. The experimental manipulations occurred during the "B" and "C" phases. The B Phase represented a social/interpersonal context characterized by enhanced autonomy support (i.e., increased opportunities for choice making; from here on referred to as “autonomous-reward”). The C Phase was characterized as a traditionally adult-directed educational interpersonal context as described by Lovaas (1981; 1987; 2002) with no opportunities for child choice (from here on referred to as “traditional-reward”). The main independent variable was the exposure to autonomous-reward versus traditional-reward contexts (see below for descriptions of autonomous-reward versus traditional-reward contexts). In both conditions, autonomous-reward and traditional-reward conditions, children’s performance was rewarded according to a set criterion. That is, all children received rewards for correct responding during both experimental conditions (see below for discussion regarding reward contingency).

In the present experiment, children received math presented in the traditional context first, followed by LA in the autonomous-reward context. Following the baseline and withdrawal conditions, a series of additional baseline-type phases were initiated (A5, A6, and A7). In these sessions, the two experimental tasks (math and LA) were presented simultaneously as a free-choice session, and children were asked to choose with which of the tasks they would prefer to engage. This served to assess which of the two tasks the children were more intrinsically motivated to perform, the task associated with enhanced autonomy-support, or the task associated with the traditional interpersonal context. These extended baseline-type phases served to assess maintenance and transfer effects. Refer to Table 4.1 for a graphic representation of the research design.

Table 4.1 Representation of experimental design for Study One.

A1	Trad	A2	A3	Auto	A4	A5	A6	A7
FC	Math	FC	FC	LA	FC	M & LA	M & LA Novel	M & LA F-U

Note. Children experienced the traditional-reward, or "C" phase first, followed by the autonomous-reward, or "B" phase; Trad = traditional-reward; Auto = autonomous-reward; M = math; LA = Language arts; FU = Follow-up.

As shown in Table 4.1, phase A5 was the first time that Math and LA were presented together. This phase was initiated immediately after the cessation of A4. Phase A6 was identical to A5, but tested children's intrinsic motivation for the two tasks in novel environments. The final phase, A7 occurred following a one-month period of no experimental contact.

Procedure

Assessment of proficiency in target area.

To establish children's level of proficiency, the experimenter first referred to each child's Individualized Program Plan (IPP) and recent samples of children's schoolwork. The purpose of this review was to determine at what level of difficulty the students were currently operating. Further, because the purpose of the experiment was not to teach new curriculum, but rather to assess the interpersonal context in which rewards are delivered, the material that was selected needed to have already been mastered (e.g., 100% correct, two or more times in a row). Material that had been recorded as mastered was selected and a probe of children's fluency with materials was conducted. The experimenter sat down at a table with the child and presented examples of the mastered curriculum. Children were asked to complete several questions in order to identify material that they were able to complete independently and without mistakes. Each child was given the opportunity to complete the various tasks without feedback from the experimenter. This provided an indication of the children's proficiency with the material and provided a "baseline" assessment of each child's capabilities (i.e., problems completed without errors). Based on the assessment, the experimenter selected academic material for workbooks that was relatively easy for each individual child to complete. Once children demonstrated that they could complete the task and that they understood what was expected, they were introduced the Children's Academic Intrinsic Motivation Inventory (CAIMI, Gottfried, 1986). The CAIMI was explained and children were asked to rate their degree of liking and proficiency for both math and LA as subject areas (see below for a thorough description of the rating scales).

Token training.

All of the children had previous experience receiving tokens exchangeable for rewards. However, for the purpose of the present study, effort was taken to ensure that the children understood what the tokens represented, and how they could be used to obtain the desired rewards. Before baseline data was collected, children were shown how to collect and exchange tokens in order to obtain prizes. Using simple mazes (see Appendix C for example mazes), children were given tokens for correct responding. At the end of the activity, the tokens were exchanged for the desired prizes. During this token training phase, children received tokens on a continuous schedule; that is, each correct response earned the child a token. Once the children achieved 10 tokens in a row, they were allowed to exchange the tokens for time to engage with a favored activity. Following five correct exchanges in a row (i.e., children had received 50 tokens in total), it was deemed that the children understood the token system.

Assessment of reward preference.

As part of the introductory session, each child was asked to list some favorite activities, games, and rewards. Once the list was compiled, it was shown to one of the child's parents who verified the items as a possible reward, and added the name of any potential item that the child has previously found rewarding. Included in the list of potential rewards (but not limited to) were free time and favorite activities (e.g., Lego, music, books). The items from the list were purchased for use as rewards for the present study.

At the individual level, children's preferences were established using a forced-choice paired assessment. Each of the rewards noted on the general list was paired against the others until a clear hierarchy was established of which rewards were most desirable for each child. Although the rewards that each child originally suggested as a favorite activity, and were likely to be ranked highest in that individual child's list of most preferred rewards, all of the children had equal access to any potential reward that was purchased as part of this research project.

Assessment of subject preference.

In the same way that children's preferred rewards were established, a forced-choice paired assessment of academic subject matter was conducted. Each subject was paired against the other until a clear hierarchy was identified. This enabled identification of the extent to which math and LA were of higher or lower initial interest. Although the list of possible 'subjects' was inclusive (i.e., also included science, gym, library, lunch, recess, etc.) children's rankings of math and LA were of interest.

Reward contingencies.

Research has shown that intrinsic motivation is enhanced when people receive performance-based rewards (Cameron, Pierce, Banko, & Gear, 2005). In children with ASD, when rewards are delivered based on performance, as opposed to mere engagement with the task, increases in motivation have also been observed (Koegel, Koegel, Shoshan, & McNerney, 1999). In the current investigation, for experimental sessions (Auto and Trad phases) all children received tokens (i.e., rewards) based on meeting a performance standard. Children were instructed to work for as many tokens as they could achieve in a 10-minute period. Children were told that each token was exchangeable for one minute of time with one of their preferred rewards. Specifically, children were told "Today, if you try really hard, you can earn tokens. Each token will get you one minute of time with your reward (name)". Because the children had already demonstrated mastery levels (100% correct) with their selected curriculum, each child was virtually guaranteed to earn at least some time with a reward. The academic activity was arranged based on the children's performance during the initial performance assessment. Tokens were only delivered following each correct response and a response was deemed correct if the answer corresponded to the question.

Description of experimental phases.

All children in the study participated in nine experimental phases (eight phases during the intervention component, and one follow-up phase). In order to ensure that each phase allowed for an adequate sampling of behavior to enable analysis of potential trends in responding (Kazdin, 1982), students experienced three 10-minute sessions within each experimental phase. Sessions lasted between one to one and a half hours and occurred multiple times per week. Children participated in 27, 10-minute sessions over the duration of the experiment [i.e., nine separate phases (e.g., A1, Auto, A2, etc.), three sessions per phase, each lasting 10 minutes], for a grand total of 270 minutes of experimental time.

The free-choice (FC) phases (i.e., A phases in the design) were used to assess the effects of the experimental manipulation (Auto versus Trad). During the FC periods, children were always presented with two tasks: an academic task and an alternative activity (i.e., picture book), or two academic tasks (Math and LA) during the last three phases of the experiment (i.e., A5, A6, and A7). When the picture book was presented, it was randomly selected from a collection of books and placed on the table along with the academic activity. Children were informed that they could engage with whichever activity they so wished (academic or alternative), for as long as they wished, or for the duration of the session. The experimenter turned away and pretended to be completing other work. There was no interaction with the children unless a child initiated with specific questions. In such cases, the experimenter answered the question without evaluative feedback. If the children persisted (i.e., initiated more than once), the experimenter restated the initial instructions and told them that he had to complete his work. During the experimental (Auto or Trad) phases, children were presented with the academic task only (i.e., Math or LA), and were rewarded for correct responding. With each correct response, children received a token that was exchangeable for time with a prize or activity reward. Children were allowed to engage with their reward for the number of minutes that corresponded to the number of correct responses / tokens they received before the end of the experimental session.

Phase 1: Initial free-choice session (A1).

The first FC phase (A1) allowed for the assessment of children's intrinsic motivation for the target and another novel activity. Once the experimenter escorted the child to the "experimental room", the two sat down at the table and the experimenter said to the child, "You can work on some math worksheets or look at the book. You can do whatever you like for 10 minutes". Available to the children were the target task (i.e., math) and an alternative activity (looking at a picture book). During this FC period, children were free to engage with the material or do nothing.

Phase 2: Experimental manipulation (traditional-reward).

The second phase exposed children to the experimental manipulation: performance-contingent reward presented in an adult-directed academic context. In this phase, children also received the manipulation of interpersonal context; that is, the traditional interpersonal context (i.e., traditional-reward). Children were informed that, "Today you get to work for tokens. Each correct answer will earn you a token. Each token is worth one minute of time with your activity (labeling the reward)." The reward was placed on the table just out of the child's reach. "The more tokens you get, the more time you get. So you need to try your best". At that moment, the experimental manipulation began. Children experienced the math activity in the traditional-reward context (context manipulations will be described later).

Phase 3: Free-choice session (*A2).*

The third phase (A2) was an FC phase designed to assess the children's intrinsic motivation for the target activity with the reward contingency withdrawn. At the beginning of each session during phase three, participants were told, "Today, there are no tokens available and no activity (labels the reward). You can do the math worksheets or you can look at the book. You can do whatever you like for 10 minutes". Children chose among the target activity, looking at a book, or doing nothing.

Phase 4: Free-choice session (A3).

The fourth phase (A3) introduced children to the other subject (LA) and an alternative activity (i.e., book) presented as FC sessions. Children chose between the academic material, the book, or doing nothing. As in the previous FC sessions, children were reminded, “Today, there are no tokens available and no activity (label the reward). You can do the LA worksheets or you can look at the book. You can do whatever you like for 10 minutes”.

Phase 5: Experimental manipulation (autonomous-reward).

The second experimental phase (Auto) exposed the children to the alternate experimental manipulation: performance-contingent reward presented in an autonomy-supportive context (i.e., autonomous-reward). For these sessions, children were escorted into the experimental room and to the table. The experimenter introduced the activity and children were told that, “Today you get to work for tokens. Each correct answer will earn you a token. Each token is worth one minute of time with your activity (labeling the reward).” The reward was placed on the table just out of the child’s reach. “The more tokens you get, the more time you get. So you need to try your best”. At that moment, the experimental manipulation began; that is, children experienced the LA academic material in the autonomous-reward context (context manipulations will be described later).

Phase 6: Free-choice session (A4).

The sixth phase (A4) was the final free-choice phase (no reward) and children again chose between doing the academic activity (LA) or engage with the alternative activity (book). Upon entering the activity room they were told, “Today, there are no tokens available and no activity (label the reward). You can do the LA worksheets or you can look at the book. You can do whatever you like for 10 minutes”.

Phase 7: Free-choice session (A5).

The seventh (A5), eighth (A6), and ninth (A7) phases were also conducted as free-choice (FC) phases. In contrast to earlier FC phases when the children were offered the choice between an academic activity and a picture book, in these phases children were given the choice between the LA and math tasks only. No other options were provided. However, children could still have chosen to do nothing during the sessions. Phase seven (A5) was designed to assess which of the two experimental tasks the children were more intrinsically motivated to perform. Both activities were placed on the table in front of the child at the start of the session. Children were instructed, “Today, there are no tokens available and no activity (label the reward). You can do either these math worksheets or the LA worksheets. You can do whatever you like for 10 minutes”. Children were then given the opportunity to choose between the two target activities (math or LA). Children were free to engage in either academic activity, or do nothing.

Phase 8: Free-choice session - transfer (A6).

The eighth phase (A6) was identical to the previous seventh phase, however the FC period was introduced in novel settings. The purpose of this phase was to assess transfer of motivation from one situation to another. Before beginning the sessions, the children were escorted to a different setting within their home that was not associated with academics or the completion of homework. Consistent with all previous FC phases, children were told, “Today, there are no tokens available and no activity (label the reward). You can do either these math worksheets or the LA worksheets. You can do whatever you like for 10 minutes”. Children were then given the opportunity to choose between the two target activities (math or LA). Children were free to engage in either academic activity, or do nothing.

Phase 9: Free-choice session – maintenance (A7).

The final phase (A7) was identical to Phase A5, however it was presented following a one-month period of no experimental contact. The purpose of this phase was to assess the long-term maintenance of the impact of the intervention. Consistent with all previous FC phases, children were told, “Today, there are no tokens available and no activity (label the reward). You can do either these math worksheets or the LA worksheets. You can do whatever you like for 10 minutes”. Children were then given the opportunity to choose between the two target activities (math or LA). Children were free to engage in either academic activity, or do nothing.

Experimental manipulations: Autonomous-reward versus traditional-reward.

The traditional educational context was characterized by a high degree of adult direction, and no opportunities for child choice. In addition, in the traditional context, explicit instructions were given to children as to when to start and stop each activity. In contrast, the autonomous-reward environment was characterized by providing the children with options for choice within each academic activity, including when to start and stop.

In both contexts, the experimenter's demeanor was friendly across all conditions, and throughout the study. Children were asked to join the experimenter at the table. The experimenter sat across the table from the child. The child was asked, "What do you want to work for today?" and was presented with potential rewards from the list obtained during the initial reward preference assessment. The child selected the reward with which he wished to engage and it was placed within view at the far corner of the table. The remaining back-up rewards were placed in a plastic bin on the floor, but within view in the event that the child wished to make another choice between rewards at the time of token exchange.

In the traditional context, the experimenter placed the required activity on the table and said, "Today, these are the math worksheets you must do" and stipulated the reward contingency. Once the reward contingency was stated, the experimenter placed a pencil on the table and told the child to begin. Timing began unobtrusively as soon as the experimenter said "Begin".

For the autonomous-reward context there were four opportunities to exercise choice making. First, two randomly selected workbooks from the target subject area (LA) were placed in front of the child, and the child was offered a choice of activities ("Which do you want to work on?"). Second, with the workbook on the table in front of the child, the experimenter subsequently asked, "What do you want to use?" while offering the child the choice between possible implements (e.g., pencil, pen, or marker). Third, the experimenter asked the child, "Where would you like to work? At the table, on the floor, or at the desk on the other side of the room (while pointing to each in turn)?" Finally, the experimenter said, "You can begin whenever you like" and unobtrusively started the timer. Once the 10-minute session was completed, the experimenter interrupted the child by saying, "Let's see what you've worked on". This point marked the end of the experimental manipulation. The subsequent scoring of children's performance and administration of tokens and rewards was identical.

Once the experimental manipulation had ended, the experimenter quickly reviewed the child's work and delivered a token for each correct response. The experimenter delivered the tokens with enthusiasm and after the delivery of the last token encouraged the child to count the tokens to tally their performance. Children were asked to give their tokens to the experimenter in exchange for their reward. Children were permitted to engage with their reward for the amount of time that corresponded to the tokens earned during the session.

Children were required to exchange their tokens at the end of each session; tokens were not carried over to subsequent sessions. Children were given immediate access to their preferred activity and allowed to engage with the activity for the amount of time that they earned. The experimenter was cautious to ensure that the children received the amount of time that they earned and did not initiate another 10-minute session if there was a chance that the children would not have enough time to engage with the reward that they earned.

Dependent Measures

Children's intrinsic motivation was measured in six ways: time on task, accuracy, affect, task preference at follow-up, disruptive behavior, and a self-report measure. Below is a description of each of these measures.

Time on task.

The most widely used estimate of intrinsic motivation is the amount of time that individuals engage with a target task (Cameron et al., 2001; Deci et al., 1999). Each session lasted for 600 seconds (i.e., 10 minutes). Children were considered 'on task' if they were looking at the academic material, writing, or gave the appearance that they were actively solving one of the tasks. Children were considered 'off task' if they were looking away from the academic material or engaging in any behavior that impeded the completion of the task (e.g., singing, asking off-topic questions, staring). In order to be scored as 'off task', children had to demonstrate this behavior for greater than three seconds. Time on task (TOT) was calculated for each session completed.

Accuracy.

According to Deci and Ryan (1985) intrinsic motivation is based in competence and feelings of self-determination. As noted in Chapter 2, self-determination is rooted in the experience of choice making. However, competence is reflected in accuracy. Accuracy, or percentage of correct responding, has been used as a measure of intrinsic motivation in a variety of studies (Von Mizener & Williams, 2009). Each question was considered one opportunity for a correct response. Children received credit for their responses if they correctly answered the questions being asked. At the end of each session, the completed worksheets were collected. Accuracy was recorded as a percent correct and calculated by dividing the number of correct responses by the total number of responses that were attempted, multiplied by 100.

Child affect.

The child affect scale was first administered by Koegel & Egel (1979) to determine whether children's affect and enthusiasm for the academic material were correlated with performance. As shown in Table 4.2, children received a rating from 0 indicating negative affect, avoidance of the task, and/or withdrawal from the situation to 5 indicating high levels of interest, engagement with the task, and positive affective response. The authors found that the rating scale was positively correlated with children's performance. That is, when children were actively engaged in their target activities, with high response rates, and high levels of accuracy, children received higher ratings of positive affect by a naive observer. The child affect scale continues to be used as an additional dependent measure of children's level of motivation for engagement in educational activities (e.g., Koegel, Bimbela, & Schreibman, 1996; Koegel, Werner, Vismara, & Koegel, 2005; Schreibman, Kaneko, & Koegel, 1991). Following every session, children received a rating reflecting their level of enthusiasm (i.e., intrinsic motivation) for the target academic activity (see Table 4.2 for the operational definitions of the items on the scale).

Table 4.2. Description of the items on the Child Affect Scale (Koegel & Egel, 1979).

	Description	Rating
Negative Enthusiasm	Tries to leave the room, throws tantrums, screams, throws material, pushes task away, or refuses to perform the task.	0
	Remains in chair, but generally does not comply with instructions; behavior consists primarily of vocalizations and motor behavior unrelated to the task – yawning, rocking, loud tapping, etc.	1
Neutral Enthusiasm	Generally complies with instructions, but tends to get fidgety; there are moments of staring or inattention, “toying” with stimulus materials, wiggling feet, etc.	2
	Complies with instructions, but does not perform the task readily; exhibits neutral behavior by occasionally focusing on (watching) experimenter or stimulus materials between trials.	3
Positive Enthusiasm	Performs task readily and frequently attends to experimenter or stimulus materials between trials.	4
	Attends to task quickly, laughs or smiles while working on the task, predominantly watches experimenter and stimulus materials intently, performs extra behaviors related to the task, and performs appropriate creative behaviors with stimulus material.	5

Task preference.

During the two follow-up phases, children were allowed to engage in either the task previously associated with autonomous-reward or the task previously associated with traditional-reward. Task preference was evaluated by determining whether the proportion of times that children selected the autonomous-reward post-intervention differed from chance levels. That is, this measure was used to evaluate whether children favored the task associated with autonomous-reward.

Disruptive behavior.

Previous studies have shown that when children are highly motivated, incidents of disruptive behavior decrease (Koegel, Koegel, & Surratt, 1992;

Koegel, Tran, Mossman, & Koegel, 2006). In these studies, disruptive behavior was used as a proxy measure of IM, as disruptive behavior was an indicator of low intrinsic motivation. In the present study, disruptive behavior was defined as any behavior that explicitly interfered with task completion. This behavior included yelling, swearing, hitting, kicking, throwing or destroying materials, as well as oppositional behavior. Also included in this category were repetitive and/or stereotypical behaviors that interfered with task completion (e.g., reciting scripts from movies). Each incident of disruptive behavior was recorded per session (frequency).

Self-report measure.

Self-report measures have been used in research with university students (e.g., Pierce, Cameron, Banko, & So, 2003), as well as with children (Harrington, 2004). In the current study, the self-report measure was a modified version of the Children's Academic Intrinsic Motivation Inventory (CAIMI, Gottfried, 1986) similar to the one used by Harrington (2004). It consisted of nine questions, each with a corresponding 7-point Likert-type scale. The response options ranged from 1 ("No! Not at all.") to 7 ("Yes! Very much."), with the middle response option being 4 ("A little bit."). It was adapted to include cartoon faces with exaggerated facial expressions that corresponded to the scale number above it (e.g., Harrington, 2004). Children were asked to circle or point to the face that best described how they felt about the target activity and their responses were recorded (see Appendix D for self-report measure). At the end of each session, children were administered the paper and pencil-based questionnaire.

Data Analysis

For the training phases in the study, on the measures of time on task, accuracy, and affect, a repeated measures one way ANOVA was first conducted with six levels of phase (A1, autonomous-reward, A2, A3, traditional-reward, and A4).

Time on task, accuracy, and affect, were also analyzed during the maintenance (A5), transfer (A6), and follow-up (A7) phases. Repeated measures ANOVAs with two levels of reward context (task done in autonomous-reward context and task done in a traditional-reward context) and three levels of phase (A5, A6, and A7) were conducted.

The values that were obtained for time on task, accuracy, and affect ranged from zero to maximum, with very few scores in between. As a result, the post-ANOVA tests of significance that involved means and standard deviations (i.e., *t* statistics) were unreliable and were not reported. Means and standard deviations are reported for information only. Subsequently, median tests (signed-rank tests; Seigel, 1956) were conducted. Given that median values were zero, and probabilities were equal to 1.00, these tests were also not reported.

For task preference at follow-up, two separate analyses were conducted. First, the proportion of times that children selected the task associated with autonomous-reward was calculated. A one-sample *t*-test was used to determine whether the proportion of times children selected the autonomous-reward task exceeded chance levels (i.e., $p \leq 0.05$). Second, the proportion of times that each child selected the task associated with the autonomous-reward was individually converted into log scores. When the log scores were summed, along with their corresponding degrees of freedom, the resulting score distributed as a chi-square statistic and the result was compared to the corresponding critical level. If children chose the task associated with autonomous-reward more often than chance, this was taken as evidence of increased IM.

There were very few instances of disruptive behavior throughout the study. For the majority of those that did occur, although they met the criteria for being disruptive (i.e., it interfered with the ability to complete tasks), the behavior largely consisted of repetitive and stereotypical behaviors that encompassed children's desire to receive tokens and rewards. The behaviors did not appear to serve one of the typical functions of problematic behavior (cf. Iwata, Dorsey, Slifer, Bauman, & Richman, 1994). Overall there were too few disruptive behaviors to permit statistical analysis.

The Children's Academic Intrinsic Motivation Inventory (CAIMI, Gottfried, 1986) was used to assess children's reported level of interest for the two academic activities. During the initial phases of the study, children responses appeared consistent with their observable behavior. However, over the course of the study, it became apparent that children's responses no longer matched their behavior; their response pattern was undifferentiated (e.g., responding tended to be unaffected by questionnaire items that were reverse coded). The CAIMI was deemed unreliable.

Inter-Observer Agreement

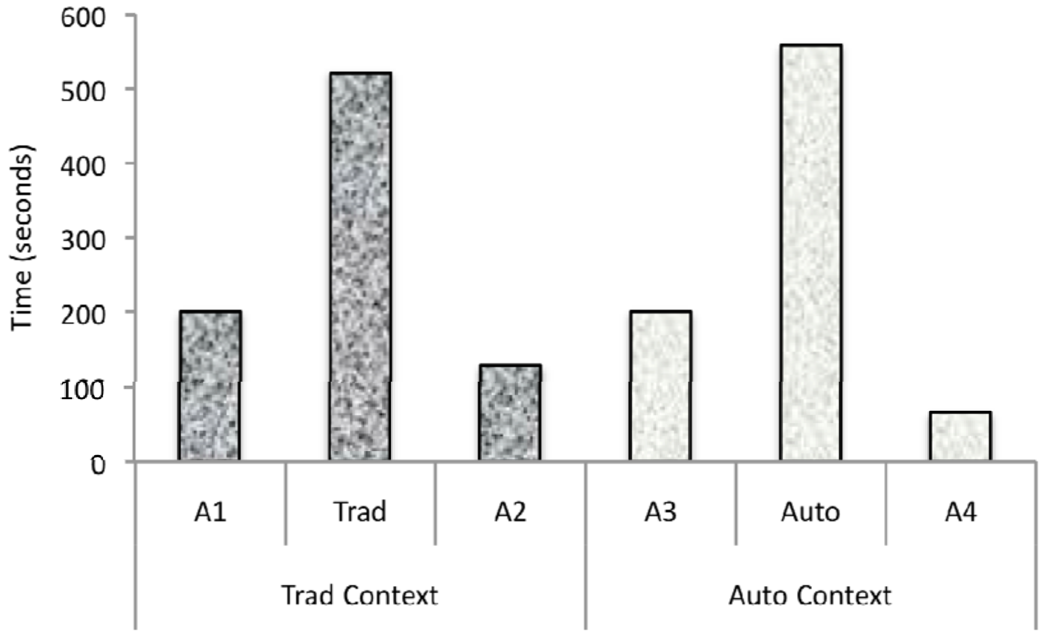
A second observer co-scored each of the dependent variables (i.e., time on task, accuracy, affect, and instances of disruptive behavior). The observer was a doctoral-level graduate student in psychology who was naïve to the conditions to which the children were assigned. Approximately 20 percent of all of the sessions were co-scored. Each child participated in 27, 10-minute sessions. Thus, five sessions for each of the three children were independently scored by the second rater and compared to the experimenter's scores. Percentage of agreement was calculated by dividing the number of agreements by the total number of judgments. Disagreements were resolved through discussion. For time on task, agreement was 82.50 percent, for accuracy, agreement was 92.25 percent, for affect, accuracy was 87.75 percent, and inter-rated agreement for problem behavior was 96.25 percent.

Results

Time on Task: Training Phases of the Study

A repeated measures one way ANOVA on time on task revealed a significant effect of phase, $F(5, 10) = 6.405$, $p = 0.006$, $r^2 = .762$. As noted in the Data Analysis section, the data did not allow for follow-up comparisons. However, the means and standard deviations were A1 (*M* = 200.00, *SD* = 300.00), Traditional-reward (*M* =559.22, *SD* = 60.78), A2 (*M* = 66.67, *SD* = 200), A3 (*M* = 200.00, *SD* = 300.00), Autonomous-reward (*M* = 520.89, *SD* = 103.99) and A4 (*M* = 128.44, *SD* = 254.90). Nonetheless, this finding indicates that children spent more time on task when the reward contingencies were in place. Figure 4.1 presents children's mean time on task across the six phases.

Figure 4.1. Children's mean time on task during the training phases.



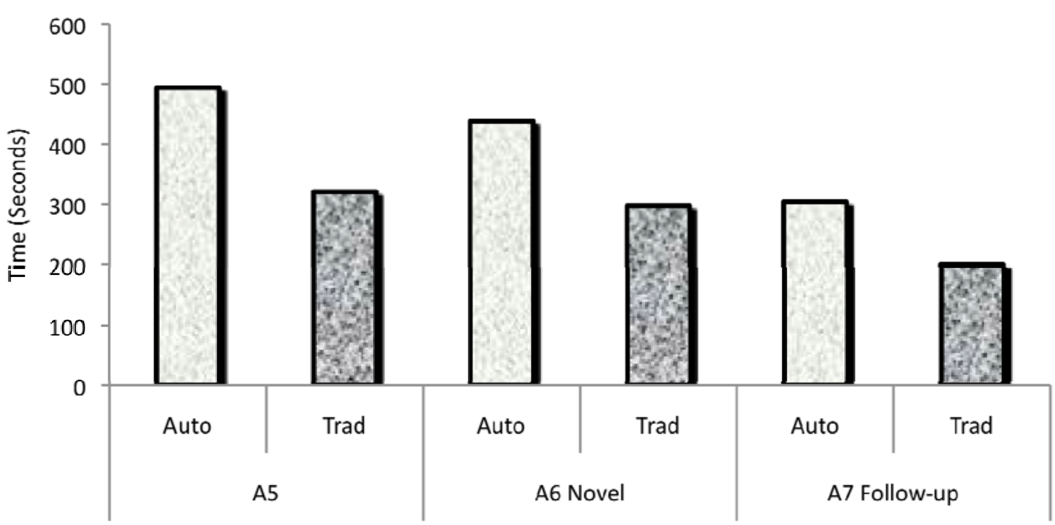
Note. A1 = traditional baseline; Trad = traditional-reward; A2 = traditional withdrawal; A3 = autonomous baseline; Auto = autonomous-reward; A4 = autonomous withdrawal.

Time On Task: Post-Intervention

A repeated measures ANOVA was conducted with two levels of context (autonomous-reward and traditional-reward) and three levels of phase (A5, A6, and A7). The results yielded a non-significant effect for phase, $F(2, 4) = 2.672$, $p = 0.183$, *n.s.*, $r^2 = 0.572$, a non-significant effect for context $F(1, 2) = 0.362$, $p = 0.608$, *n.s.*, $r^2 = 0.153$, and a non-significant interaction, $F(2, 4) = 0.039$, $p = 0.962$, *n.s.*, $r^2 = 0.019$. These results suggest that there were no differences in children's time on task at follow-up by reward context.

As presented in Figure 4.2, children spent more time engaged in the task associated with autonomous-reward rather than the traditional-reward. During the first post-intervention phase (A5), children's mean time on the autonomy-reward tasks was 494.33 seconds (*SD* = 162.35) versus 321 seconds (*SD* = 302.20) on traditional-reward tasks. Phase A6 involved introducing the two academic tasks into novel environments. Children spent an average of 439.00 seconds (*SD* = 250.82) on autonomous-reward tasks versus 297.67 seconds (*SD* = 296.01) on the traditional-reward tasks. During the final post-intervention phase, the one-month follow-up (A7), children spent 304.33 seconds (*SD* = 281.02) on the autonomous-reward tasks versus 200.00 seconds (*SD* = 346.41) on traditional-reward tasks.

Figure 4.2. Children's post-intervention time on task.

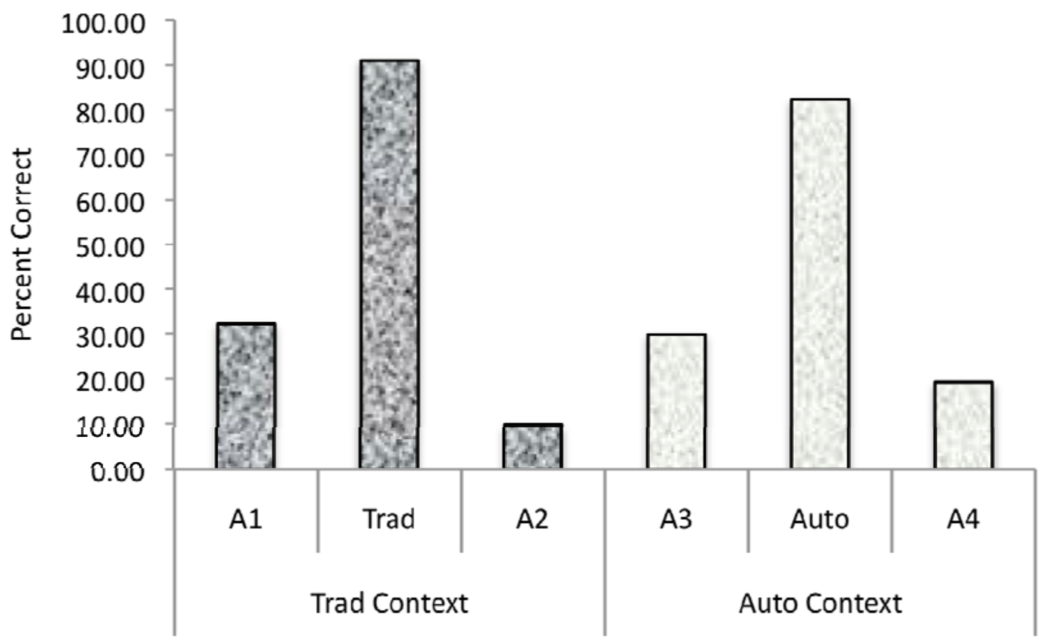


Note. Auto = task associated with autonomous-reward; Trad = task associated with traditional-reward; A5 = free choice session; A6 Novel = free choice session in novel environment; A7 Follow-up = free choice session at follow-up.

Accuracy: Training Phases of the Study

A repeated measures one way ANOVA on children's accuracy during the training phase indicated a significant effect, $F(5, 10) = 6.010$, $p = 0.008$, $r^2 = 0.750$. This finding suggests that children were most accurate when the reward contingency was in effect. Phase means were A1 (*M* = 32.28, *SD* = 55.90), Traditional-reward (M = 91.11, SD = 8.10), A2 (*M* = 9.80, *SD* = 16.98), A3 (*M* = 29.88, *SD* = 51.75), Autonomous-reward (*M* = 82.34, *SD* = 23.18), and A4 (*M* = 19.24, *SD* = 33.32). Presented in Figure 4.3 are the mean percentages that children achieved in each of the six phases.

Figure 4.3. Children's accuracy during the training phases.



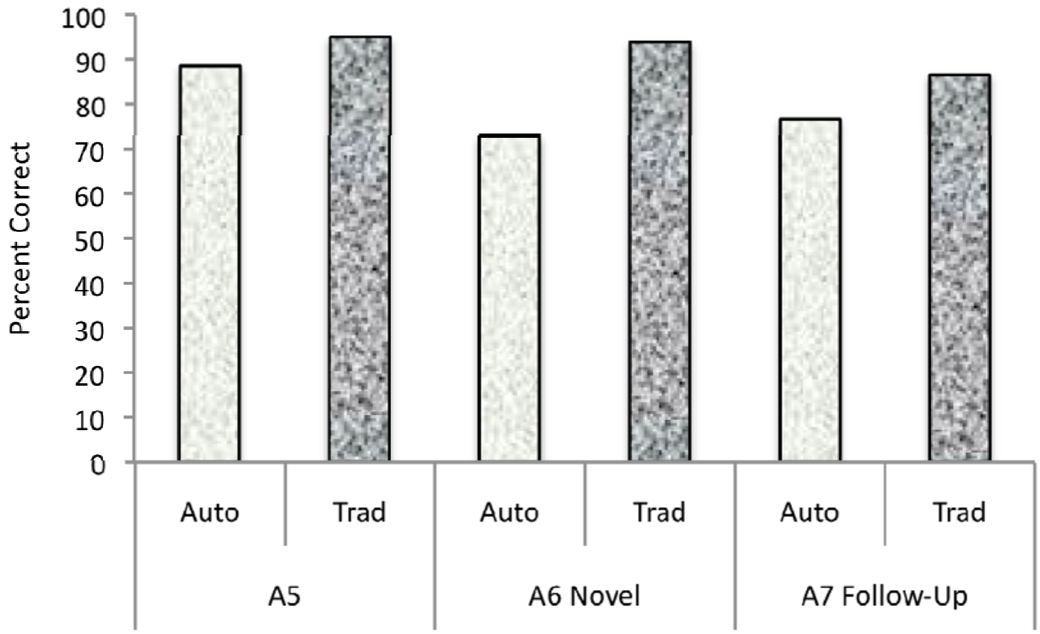
Note. A1 = traditional baseline; Trad = traditional-reward; A2 = traditional withdrawal; A3 = autonomous baseline; Auto = autonomous-reward; A4 = autonomous withdrawal.

Accuracy: Post-Intervention

A repeated measures ANOVA was conducted with two levels of context (autonomous-reward and traditional-reward) and three levels of phase (A5, A6, and A7). The results yielded a non-significant effect for phase, $F(2, 4) = 3.701$, $p = 0.123$, *n.s.*, $r^2 = 0.649$, a non-significant effect for context, $F(1, 2) = 0.385$, $p = 0.598$, *n.s.*, $r^2 = 0.162$, and a non-significant interaction, $F(2, 4) = 0.09$, $p = 0.916$, *n.s.*, $r^2 = 0.043$. These findings indicate that there were no differences in children's accuracy at follow-up despite the fact that children showed evidence of more intrinsic motivation for the task associated with the traditional-reward. The lack of statistical significance likely relates to the low power of the test.

As shown in Figure 4.4, during the first post-intervention phase (A5), children's mean accuracy during the task associated with autonomous-reward was 88.95 percent ($SD = 10.17$) versus 95.00 percent ($SD = 0$) during traditional-reward task. Children's mean level of accuracy for autonomous-reward task during the second post-intervention phase (A6) was 72.85 percent ($SD = 23.62$) in comparison to the traditional-reward task at 93.94 percent ($SD = 5.74$). During the follow-up phase (A7), children achieved 76.56 percent ($SD = 14.93$) on the autonomous-reward task and 86.45 percent (n = 1) on the one instance of engagement with the traditional-reward task.

Figure 4.4. Children's accuracy across post-intervention phases.

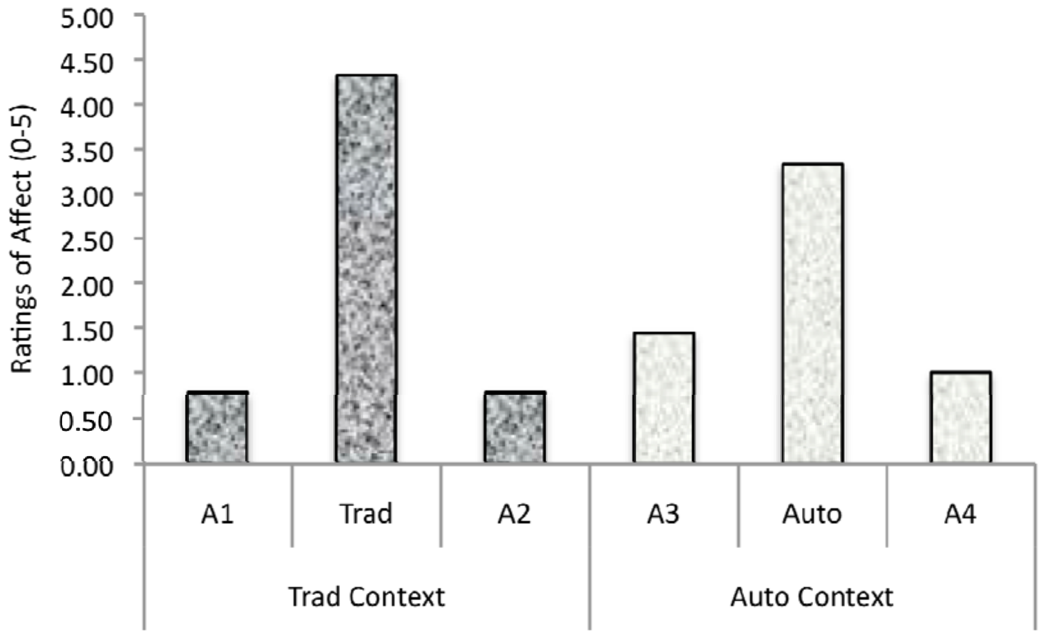


Note. Auto = task associated with autonomous-reward; Trad = task associated with traditional-reward; A5 = free choice session; A6 Novel = free choice session in novel environment; A7 Follow-up = free choice session at follow-up.

Child Affect: Training Phases of the Study

A repeated measures one way ANOVA was conducted on ratings of children's affect during the training phases of the study. Analysis revealed a significant effect, $F(5, 10) = 7.026$, $p = 0.005$, $r^2 = 0.778$. Means and standard deviations were A1 ($M = 0.78$, $SD = 1.33$), traditional-reward ($M = 4.33$, $SD = 1.00$), A2 ($M = 0.78$, $SD = 0.69$), A3 ($M = 1.44$ $SD = 2.31$), autonomous-reward ($M = 3.33$, $SD = 1.50$), and A4 ($M = 1.00$, $SD = 1.73$). These finding suggest, as shown in Figure 4.5, that children were most accurate during the administration of the rewards.

Figure 4.5. Ratings of children's affect during training phases.



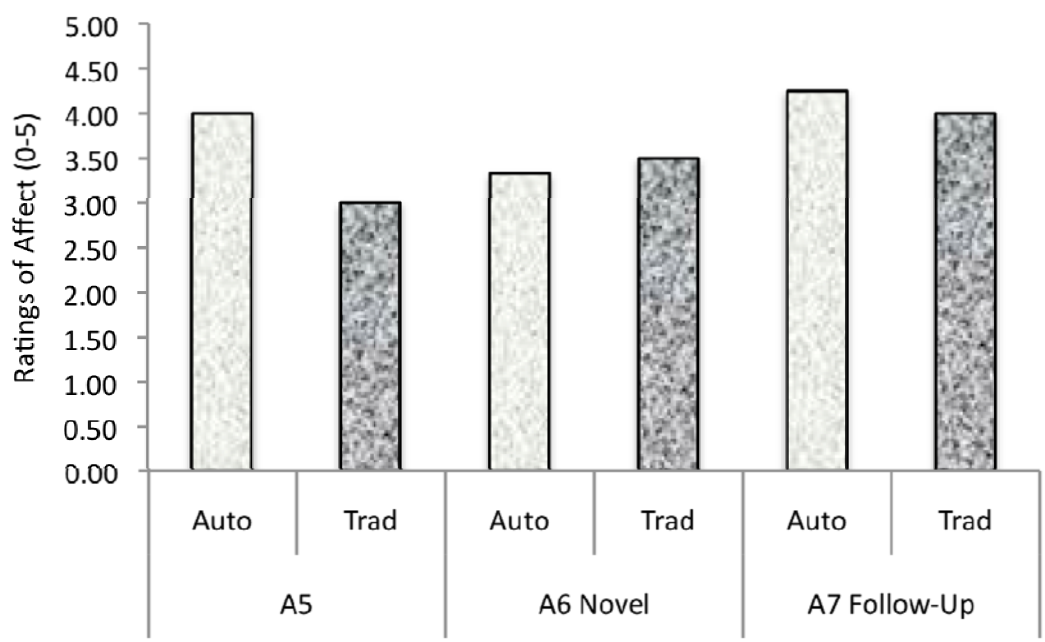
Note. A1 = traditional baseline; Trad = traditional-reward; A2 = traditional withdrawal; A3 = autonomous baseline; Auto = autonomous-reward; A4 = autonomous withdrawal.

Child Affect: Post-Intervention

A repeated measures ANOVA was conducted with two levels of context (autonomous-reward and traditional-reward) and three levels of phase (A5, A6, and A7). The results yielded a non-significant effect for phase, $F(2, 4) = 0.945$, $p = 0.461$, *n.s.*, $r^2 = 0.321$, a non-significant effect for context, $F(1, 2) = 0.651$, $p = 0.504$, *n.s.*, $r^2 = 0.246$, and a non-significant interaction, $F(2, 4) = 0.134$, $p = 0.878$, *n.s.*, $r^2 = 0.063$. These findings indicate that there were no differences in children's affect post-intervention despite the fact that children showed evidence of more intrinsic motivation for the task associated with the autonomous-reward. The lack of statistical significance likely relates to the low power of the test.

Presented in Figure 4.6 are the ratings of children's affect during their engagement with tasks associated with autonomous-rewards versus traditional-rewards for the three follow-up phases (A5, A6, and A7). As shown in Figure 4.6, children's mean affect during Phase A5 was 4.00 when engaged with the task associated with autonomous-reward (*SD* = 1.00) and 3.00 with the traditional-reward (*SD* = 0.00). During the novel context (A6), children's affect for the task associated with autonomous-reward fell to a mean level of 3.33 (*SD* = 2.08) and rose for the traditional-reward to 3.50 (*SD* = 2.12). Finally, during the follow-up phase (A7), children's mean affect for the task associated with the autonomous-reward reached a maximum of 4.25 (*SD* = 1.06). Affect for the traditional-reward tasks remained stable at 4.00 (n = 1).

Figure 4.6. Ratings of children's post-intervention affect.



Note. Auto = task associated with autonomous-reward; Trad = task associated with traditional-reward; A5 = free choice session; A6 Novel = free choice session in novel environment; A7 Follow-up = free choice session at follow-up.

Task Preference

All three children preferred math over LA prior to the intervention. However, following the manipulations, the preferences for two of the three children changed from math (the task paired with traditional-reward) to LA (the task paired with autonomous-reward). During the post-intervention phases, each of the 3 children experienced 3 sessions each of A5, A6, and A7 (thus, each child experienced 9 sessions total), for a total of 27 sessions. The frequency that children selected the autonomous-reward task, when presented with the choice of engaging in either that task or the traditional task, was 6 (Evan), 9 (John), and 3 (Vincent). Presented in Table 4.3 are the proportions of times that the autonomous-reward task was selected, the probabilities corresponding to those proportions, and the probabilities converted to log scores.

Table 4.3. Children's post-intervention preference for the task associated with the autonomous-reward.

Participant	Proportion of Opportunities	Probability	Log
Evan	0.67	0.254	1.370
John	1.00	0.002	6.215
Vincent	0.33	0.910	0.094

To evaluate whether a true difference existed between the frequencies in which children selected the autonomous-reward task over the traditional-reward task, each child's proportion of autonomous-reward choices were compared in a one-sample *t*-test on whether the mean exceeded 0.05. Analyses indicated that the greater frequency with which children chose the autonomous-reward task over the traditional-reward task was approaching significant levels, $t(2) = 3.447$, $p = 0.075$, $d = 1.99$.

Due to the small sample size, many traditional statistical tests may fail to detect subtle differences in performance. In an attempt to reduce some of the noise in the data, the probabilities were individually transformed into logs scores (see Table 4.3). The resulting three log scores (one for each child) were then summed. The sum of the log scores was multiplied by two, as well as their corresponding degrees of freedom, and the result distributed as a chi-square statistic, $\chi^2 = 15.358$, $df = 6$, $p < 0.025$. This finding indicates that during the post-intervention phases children showed an overall preference for the task associated with autonomous-reward.

Discussion

The purpose of Study One was to test the assumption that when performance-based rewards were delivered in combination with increased opportunities for choice making (i.e., autonomous-reward condition), children with autism would experience the task associated with increased choice as more reinforcing than tasks devoid of choice. It was hypothesized that children would show increased intrinsic motivation (IM); as measured by task engagement in the absence of reward for tasks associated with autonomous-reward relative to tasks associated with traditional-reward. Further, that children would continue to show increased IM throughout the post-intervention sessions, including at follow-up.

During the training phases of the study, the hypotheses were not supported. On the measures of time on task, accuracy and affect, there was no effect of reward, nor an effect of context. On these measures, children's performance increased from baseline levels to near ceiling levels when the reward contingency was in effect. Although there was a non-significant difference between baseline and withdrawal phase, and between baseline and the reward phase, a small but statistically significant difference was observed between the reward phase and the subsequent withdrawal phase. Although this finding suggests the possibility of a reward effect, there was a non-significant difference between the baseline and reward phase (necessary for evidence of a reward effect). It is possible that the inability to detect a difference between the baseline and reward phase was due to low statistical power.

During the post-intervention phases, the hypotheses were partially supported. Children chose to engage with the task associated with the autonomous-reward more often than they chose to engage with the task associated with the traditional-reward. Unfortunately, task preference was the only measure that revealed a significant effect.

Although not statistically significant, children's time on task, accuracy, and affect were unexpectedly high during post-intervention sessions relative to their levels during the training phase of the study. It is plausible that the experience of choice between two of the same academic tasks, along with the combined experience of reward, carried over into the procedurally similar post-intervention session. Initially, during baseline and withdrawal sessions, children were free to engage in either an academic task or look at a picture book. Most often, children elected to engage with the picture book. This was expected as the picture book would have been previously associated with low-demand situations and higher rates of reinforcement. During the autonomous-reward phase, children were given four opportunities for choice making; one of the choice-making opportunities offered to children was within an academic task (e.g., math: addition versus subtraction). Although during post-intervention sessions children were informed that rewards were not available, children were given the opportunity to select between two academic tasks (i.e., math versus LA). If the experience of choice making is reinforcing as posited by Skinner (1971), then the experience of choice alone (in the absence of reward) during post-intervention sessions served to motivate children's engagement with the tasks. Thus, the experience of choice between two tasks (with previously similar rates of reinforcement) was itself enough to increase engagement (cf. matching law, Herrnstein, 1961; 1970). This finding, along with children's statistically significant preference to engage in the task associated with autonomous-reward, suggests that the combination of choice and reward can increase children's IM for academic tasks. It is likely that the lack of overall statistical significance may simply be an artifact of low statistical power.

Study One had several limitations. Particularly notable is the small sample size, treatment order, and limited exposure to conditions. Although there were only three children who participated in the experiment, the findings indicated a similar pattern of results for three of the measures; time on task, accuracy, and affect. As previously noted, in order to show a reward effect, both baseline and withdrawal phases must be significantly different from the reward phase. The present data suggests the potential for a generalized reward effect as evidenced by a statistically significant difference between the reward and withdrawal phase. However, the lack of observed difference between the baseline and reward phase may be the result of the small sample size. It is possible that if a true difference existed between the baseline and reward phases (as suggested by the difference between the reward and withdrawal phases) a larger sample would have helped to detect this difference.

The second notable limitation concerned order effects. All three children experienced the traditional-reward context first, followed by the autonomous-reward. There is no way of determining to what extent the experience of the adult-directed, choice-limited, traditional-reward context impacted children's subsequent performance during the autonomous-reward condition. Also unknown is whether the combination of traditional-reward followed by autonomous-reward uniquely impacted children's post-intervention performance. To determine whether the order in which the treatments were presented confounded the present study, the procedures should be replicated with counterbalancing of the treatment order.

Lastly, the children experienced three sessions of each phase of the experiment. Although between-group research designs typical expose participants to the manipulation only once, within-group and single subject designs have shown that continued exposure to the conditions allows for the analysis of trends and transition states (Feingold & Mahoney, 1975). It is plausible that the subtlety of the manipulation (four opportunities for choice making per session, across three sessions), would have required more exposure to effect change in the children's IM. Subsequent research should increase children's exposure to the manipulation to ensure sufficient opportunity to experience enhanced choice making.

The results of Study One were used to inform the subsequent study. The purpose of Study Two was to resolve some of the limitations inherent in Study One including increasing the sample size, counterbalancing the conditions to rule out potential order effects, as well as increasing the amount of exposure to the manipulation.

Chapter 5 - Study Two

Method

The purpose of Study 2 was to evaluate the hypotheses of Study 1 after addressing specific limitations, including increasing the number of participants, counterbalancing conditions to rule out order effects, and increasing participants exposure to the manipulation. To avoid redundancy, only those aspects of Study Two that are different from Study One are discussed.

Participants

Initially, 12 participants were sought for Study Two. Ten families expressed interest in the research; however, only eight were eligible for participation. Thus, eight participants were recruited for this study. Although eight completed the intervention phase of the experiment, two were lost to attrition prior to the follow-up phases.

Children were recruited from a publically funded school for children with diverse behavior disorders near Sacramento California. The ages of the children were between 7 years, 9 months and 12 years, 10 months. The children had a primary diagnosis of either autism or Asperger's Disorder (n=1). Although the school did not provide diagnostic assessment services, eligibility for the specialized services that the school offered was contingent upon receipt of a diagnosis. Each of the parents confirmed that their child was diagnosed by diagnostic clinicians specializing in autism at the Mind Institute at the University of California, Davis. Letters of informed consent were disseminated to the parents of eligible children by the director of the school (see Appendix E). The families were enrolled in the study in the order in which they volunteered and subsequently randomly assigned to experimental conditions. Table 6.1 provides a summary of children's assessment scores. Pseudonyms are used for the children's names.

Adam.

Adam was 10 years, 5 months of age with a primary diagnosis of autism. Adam was a quiet boy who had a very difficult early life. Adam was exposed to illicit drugs before birth, and experienced many complications during birth. Adam is African American, and due to Larry P. vs. Riles 1979 United States Court ruling, African American students are not required to participate in standardized intelligence testing. However, based on classroom performance, it was believed that Adam's intellectual and academic capabilities were below average. Adam was assessed with a variety of other instruments. As shown in Table 5.1, Adam's score on the Receptive One Word Picture Vocabulary Test (ROWPVT), a measure of his understanding of language, yielded a standard score of 64 (low range). This means that Adam has difficulty understanding language in comparison to his age mates. On the Expressive One Word Picture Vocabulary Test (EOWPVT), a measure of his ability to use language, Adam achieved a standard score of 62 (low range). This means that he has difficulty using language with the same proficiency as his age mates. When assessed with the Vineland Adaptive Behavior Scales – Second Edition (VABS-II), Adam achieved a standard score of 65. This means that his abilities to communicate, socialize, and engage in daily living activities were in the low range. The Clinical Evaluation of

Language Fundamentals (CELF), fourth edition, was used to gather a better understanding of Adam's understanding and use of language. The assessment yielded a standard score of 50, which is indicative of a social language deficit. Finally, on the Beery Test of Visual Motor Integration, his standard score was 77, which places him in the low range. Qualitatively, Adam approached each session positively and showed interest in trying new activities.

Alex.

Alex was 11 years, 6 months of age with a diagnosis of autism. He was a quiet, and somewhat shy, male who possessed good language skills. He had recently participated in an educational assessment. On the Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV) his full scale score was reported to be 81, placing him in the low-average range (see Table 5.1). His performance on the ROWPVT yielded a standard score of 116. This means that his ability to demonstrate his understanding of words was in the high average range. His ability to use speech was in the average range (standard score 103) as measured by the EOWPVT. The CELF-4 indicated that Alex possesses a social language deficit. That is, he struggles with social reciprocity when speaking with another person. Qualitatively, like many children with autism, Alex displayed very flat affect and did not initiate social interaction as would be expected for children his age.

Brandon.

Brandon was a highly verbose male of 10 years, 3 months. He was diagnosed with Asperger's Disorder. Brandon had an extensive vocabulary and his academic capabilities placed him in the average or almost average range according to the School's curriculum assessments. Qualitatively, he had an impressive amount of knowledge about the flora and fauna of California, and each day would attempt to teach me about one of his favorite carnivorous plants. Brandon struggled with social reciprocity. His conversation topics were highly restricted; usually focusing on the military, some aspect of war, or horticulture.

David.

David was 12 years, 10 months of age. He had a diagnosis of autism. David had satisfactory language skills, however, much of his language was repetitive and scripted. As described in Table 5.1, a recent educational assessment was conducted with David and his WISC-IV full-scale score was 66, placing him in the low range. David also suffered from a comorbid Oppositional Defiant Disorder (American Psychiatric Association, 2000), which was thought to have negatively impacted the standardized testing scenario, resulting in an underestimation of his true abilities. On the ROWPVT and the EOWPVT, David achieved standard scores of 75 (below average range) and 87 (average range), respectively. On the Vineland Adaptive Behavior Scales – Second Edition (VABS-II), David's overall standard score was 63, also placing him in the low range. The Woodcock-Johnson Test of Achievement, Third Edition (WJ-III) indicated that his in reading, math, and written language his standard scores were 68, 79, and 70, respectively. These scores place his level of academic achievement in the low to borderline ranges. Finally, his performance on the CELF indicated a social language deficit, and on the Children's Communication Checklist – Second Edition (CCC-2), his performance was rated as significantly below average. Qualitatively, during sessions, David displayed many of the behaviors that are characteristics of children with autism. When excited, he engaged in hand-flapping and vocal stereotypes. He also was the most aggressive of the children using challenging behaviors (e.g., hitting, attempting to turn over the table, choking the experimenter) as a protest against non-reward conditions.

Kyle.

Kyle was diagnosed with autism and was 7 years, 9 months at the time of the research. Kyle was a happy child although he openly expressed his dislike of academics. His performance on the ROWPVT resulted in a standard score of 90 which is within the average range (see Table 5.1). His performance on the EOWPVT resulted in a standard score 82 (low average range). On the VABS-II his overall standard score was 71, placing him in the moderately low range. Kyle possessed a social language deficit (as indicated by the CELF) and his academics were progressing toward ‘within average’ levels. Qualitatively, Kyle was very enthusiastic about the opportunity to earn rewards and to play with new activities. However, like many children with autism, his play lacked creativity and spontaneity. For example, rather than creating interactive play scenarios with the desired toys (action figures), Kyle tended to simply pose them and arrange them in a display-like manner.

Nathan.

Nathan was 8 years and 8 months at the time of the research. He was diagnosed with autism. As described in Table 5.1, on the ROWPVT, Nathan’s standard score was 69. That means his ability to demonstrate his understanding of language was in the low range. On the EOWPVT, his standard score was 62. Similarly, his ability to use speech to express his ideas was in the low range. On the VABS-II, his standards score was 62, placing him in the low range. According to the CELF, Nathan's performance was indicative of a social language deficit. Qualitatively, the majority of Nathan's language was repetitive and scripted. He had the tendency to become very fixated on the rewards used in the research project, to the extent that he was so motivated to earn tokens exchangeable for the rewards, that he continued to talk about earning tokens, and the activities with which he wanted to engage. His perseveration on the topic of the rewards often interfered with his completion of the academic tasks.

Table 5.1. Summary of children and their assessment history.

Child	Age	Dx[1]	Test[2]	SS	%ile	Qualitative
Adam	10-5	Autism, ADHD	ROWPVT	64	1	Low
			EOWPVT	62	1	Low
			VABS	65	1	Low
			CELF-4	50		Social Language Deficit
			BEERY	77	14	Low
Alex	11-6	Autism, ADHD	ROWPVT	116	86	High average
			EOWPVT	103	58	Average
			WISC-IV	81	10	Low average
			CELF			Social Language Deficit
Brandon	10-3	Asperger's, ADHD	N/A			Academics at, or progressing toward, standard
David	12-10	Autism, ODD, ADHD	ROWPVT	75	5	Borderline
			EOWPVT	87	19	Low average
			WISC-IV	66	1	Low
			VABS-II	63	1	Low
			WJ-III			
			Reading	68	2	Very Low
			Math	79	8	Low
			Written Lang.	70	2	Low
			CELF			Social Language Deficit
			CCC-2			Significantly Below Average
Kyle	7-9	Autism	ROWPVT	90	25	Average
			EOWPVT	82	12	Low Average
			VABS-II	71	3	Moderately Low

						Academics progressing toward standard
Nathan	8-8	Autism	ROWPVT	69	2	Low
			EOWPVT	62	1	Low
			VABS-II	62	1	Low
			CELF			Social Language Deficit
Noah	10-3	Autism, ADHD	WRAML	91	27	Average
			BEERY	90	25	Average
			WJ-III			
			Reading	74	4	Low
			Math	88	21	Low Average
			Written Lang.	79	8	Low
			BASC-2			Behavior in the clinically significant range
Robert	10-10	Autism	ROWPVT	73	4	Moderately Low
			EOWPVT	88	21	Adequate
			WJ-III			
			Reading	72	3	Low
			Math	56	0.2	Very Low
			Written Lang.	75	5	Low
			CELF-4			Social Language Deficit
			CCC-2	72	3	Low

[1] Dx = Diagnosis; SS = standard score; [2] ROWPVT = Receptive one word picture vocabulary test; EOWPVT = Expressive one word picture vocabulary test; WICS-IV = Wechsler intelligence scale for children, fourth edition; CELF-4 = Clinical evaluation of language fundamentals, fourth edition; VABS-II = Vineland adaptive behavior scales, second edition; WJ-III = Woodcock-Johnson test of achievement, third edition; WRAML = Wide range assessment of memory and learning; BEERY = Beery test of visual-motor integration; CCC-2 = Children's communication checklist, second edition.

Noah.

At the time of the research, Noah was 10 years and 3 months of age. He was diagnosed with autism. Noah's academic record indicated that on the Wide Range Assessment of Memory and Learning (WRAML) his standard score was 91 (average range). On the Beery Test of Visual Motor Integration, his standard score was 90 (average range). And on the Behavior Assessment System for Children, Second Edition (BASC-2), he achieved a standard score that was considered 'clinically significant'. That means that he struggles to use behavior that is appropriate for the situation in comparison to other children his age. On the WJ-III his standards scores in reading were 74 (Borderline range), math was 88 (Average range), and written language was 79 (Borderline range) (see Table 5.1). Qualitatively, Noah was a shy and very quiet boy, whose actions seemed tentative. Consistent with the other children in the study, Noah struggled with social reciprocity. Much of his speech and play was repetitive and scripted.

Robert.

Robert was 10 years, 10 months and diagnosed with autism. On the ROWPVT and EOWPVT, Robert achieved standard scores of 73 (moderately low) and 88 (adequate), respectively. That means that although his understanding of language was slightly behind his age mates (receptive language), his use of language to communicate with others was in the average range. Despite this, on the Children's Communication Checklist, second edition, he obtained a standard score of 72, which places him in the low range. As well, on the Clinical Evaluation of Language Fundamentals (CELF-4), his performance indicated a social language deficit. Academically, Robert's skills were assessed using the WJ-III. In the areas of reading, math, and written language, he achieved standard scores of 72 (low range), 56 (very low range), and 75 (low range), respectively. Qualitatively, Robert was very enthusiastic about participating in the research project. The teachers at the school commented that he made reference to the research and to the experimenter daily. Within sessions, Robert displayed many of the characteristics of autism, including a lack of social reciprocity, frequent use of neologisms, and was somewhat inflexible about the degree to which the experimental room was organized and kept tidy.

Setting

The experiment was conducted at a specialized school for children with special educational needs. The children who attended this school did so because previous educational placements had not been successful. All of the children had an individualized education plan (IEP) tailored to meet their unique academic needs. Approximately half of the students at the school had a diagnosis of autism. All of the children attended the school on a full-time basis.

The experiment occurred in a separate room within the school. None of the children had ever been in the room in the past. The room was approximately 80 square feet and formerly served as a resource room for teachers within the school. Within the room was a large filing cabinet, a table, two chairs, the boxes of experimental materials and rewards, and a laptop computer. There was one window that looked into the hall; the blinds were shut to eliminate distractions during experimental sessions. A small video camera was set up in the corner of the room on a tripod. All sessions were video recorded. Sessions lasted approximately 30 minutes for each child each day.

Materials

The experimental activities for Study Two were the same as were used in Study One; including math and language arts (LA) worksheets. As in Study One, the experimenter prepared each child’s experimental curriculum based on review of the children’s Individualized Program Plans (IPPs) and previous standardized assessments. The academic curriculum was arranged into 10-page packages of approximately 10 questions per page. Also provided were a variety of writing implements, tokens, distracters (e.g., Eye Spy books), and reward (e.g., favorite toys, books, action figures, Lego®, edibles, and physical outdoor games).

Design and Phases of Experiment

The training phase of Study Two was identical to Study One in that there were two experimental conditions (autonomous-reward and traditional-reward) that were each preceded by a baseline phase, and followed by a withdrawal phase (reward contingencies described below). “A” phases were presented as free-choice periods, whereas the “B” and “C” phases were the experimental manipulations. The autonomous-rewards were presented in the B phases (i.e., increased opportunities for choice making), and the traditional-rewards presented in the C phases (adult directed with no choice).

In Study Two, eight participants were recruited and randomly assigned to conditions. The eight participants were assigned to two blocks (n = 4 per block) for order of presentation of the interpersonal context (autonomous-reward vs. traditional-reward). That is, half the participants received rewards in the traditional context and then were rewarded in an autonomous context. The order of the two contexts was reversed for the other participants. Within blocks, half the children were randomly assigned mathematics activities in an autonomy-supportive context and language arts in a traditional context. The other children within the block received the opposite assignment of the activities in the two contexts. Thus, the orders for subject matter (math vs. LA) and context (traditional vs. autonomous-reward) were counterbalanced within and across blocks, respectively. Refer to Table 5.2 for a graphic representation of counter-balancing.

The post-intervention phases in Study Two differed from Study One. Unlike Study One, there were only two post-intervention phases designed to test for maintenance and generalization (A5 and A6, respectively). The second last phase, called A5, was initiated after a 5-month period of no experimental contact. The last phase, called A6, began immediately after A5 ended and tested the children's intrinsic motivation in novel contexts. Phases A5 and A6 of Study Two were implemented exactly as in Study One. Children were presented with both the Math and the LA activities and asked with which activity they preferred to engage. Children were then permitted to engage with the activity for the duration of the session.

Table 5.2. Representation of experimental counter-balancing during the intervention condition.

	Academic Subject 1			Academic Subject 2			Follow-up	
	A1	Auto	A2	A3	Trad	A4	A5	A6
Adam	LA	LA	LA	Math	Math	Math	LA & Math*	LA & Math*
Alex	LA	LA	LA	Math	Math	Math	LA & Math	LA & Math
Brandon	Math	Math	Math	LA	LA	LA	LA & Math	LA & Math
David	Math	Math	Math	LA	LA	LA	LA & Math	LA & Math
Kyle	LA	LA	LA	Math	Math	Math	LA & Math	LA & Math
Nathan	LA	LA	LA	Math	Math	Math	LA & Math	LA & Math
Noah	Math	Math	Math	LA	LA	LA	LA & Math	LA & Math
Robert	Math	Math	Math	LA	LA	LA	LA & Math*	LA & Math*

Note. A = free-choice periods; Auto = autonomous context; Trad = traditional context; LA = Language arts; * = was not completed.

Procedure

Proficiency in target areas, token training, subject and reward preferences, and reward contingencies.

The procedures for Study One were generally replicated for Study Two. Children's proficiency in the target areas (math and LA) was assessed in the same manner. As well, children were taught how to answer the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) following each pre-intervention session. Children's preferences for rewards and academic subjects were assessed, both of which using forced-choice paired assessments. During that time, they were also taught how to earn tokens to be exchanged for rewards. Children were told that each token was exchangeable for one minute of time with one of their preferred reward. Specifically, "Today, if you try really hard, you can earn tokens. Each token will get you 1 minute of time with your reward (name)". Tokens were only delivered following each correct response and a response was deemed correct if the answer corresponded to the question.

Description of experimental phases.

Unlike Study One, in the present study, children participated in eight experimental phases (six phases during the intervention component, and two follow-up phases) of 5-minutes in duration. Each phase was comprised of five 5-minute sessions. The participants were removed from their typical classrooms for approximately 30 minutes each day. Multiple 5-minute sessions occurred within each 30-minute time slot every day. Sessions were staggered across time slots to ensure that children did not repeatedly miss the same block of time from their typical school day. Six of the participants experienced 40, 5-minute sessions over the duration of the experiment [i.e., eight separate phases (e.g., A1, Auto, A2, etc.), five sessions per phase, each lasting 5 minutes], for a grand total of 200 minutes of experimental time. However, the two participants who did not complete the follow-up, did complete the intervention phases (30 sessions) with a total time of 150 minutes. Their data is included in the analysis of the intervention period.

Consistent with Study One, during free-choice (baseline) phases, children were always presented with two tasks: an academic task and an alternative activity (i.e., picture book). During the reward phases, children were only given one of the two academic tasks (i.e., math and LA) and were rewarded for correct responding. Children were allowed to engage with their reward for the number of minutes that corresponded to the number of correct responses/tokens they received. During the last two phases of the experiment (i.e., A5 and A6), children were presented with the academic task only (i.e., math or LA).

Phases of the experiment (A1, autonomous-reward, A2, A3, traditional-reward, A4, A5, and A6).

As done in Study One, during free choice (A phases) of the experiment, children were told, “You can work on some math (or LA) worksheets or look at the book. You can do whatever you like for five minutes”. Children were free to engage with the material or do nothing. During the experimental phases (B and C phases), children were informed of the reward contingency, “…each correct answer will earn you a token. Each token is worth 1 minute of time with your activity (labeling the reward).” The reward was placed on the table just out of the child’s reach. “The more tokens you get, the more time you get. So you need to try your best”. Once the reward contingency was stated, the autonomous versus traditional context manipulations began (see below for description).

During the post-intervention phases (A5 and A6), children were presented with only the academic material (math or LA, the distracter was no longer offered). Phase A5 was designed to assess maintenance of children’s intrinsic motivation for each of the two academic tasks. The purpose of the A6 phase was to assess the transfer of motivation from one situation to another (novel settings). It was identical to phase A5, however, before beginning the sessions, the children were escorted to a different setting on the school’s campus (e.g., the gym, library, other administration room).

Experimental manipulations: Autonomous-reward versus traditional-reward.

Just as conducted in Study One, the traditional educational context was characterized by a high degree of adult direction, and no opportunities for child choice. In addition, in the traditional-reward context, explicit instructions were given to children as to when to start and stop each activity. In contrast, the autonomous-reward context was characterized by providing the children with choice making opportunities within each academic activity. Children were offered choice between academic activities, between implements, between locations to complete the activity, and when they could start and stop.

Dependent Measures

In Study Two, children's intrinsic motivation was measured in the same six ways that it was in Study One: time on task, accuracy, affect, task preference at follow-up, disruptive behavior, and a self-report measure. Below is an overview of each of these measures.

Time on task.

In the present study, each session lasted for 300 seconds (i.e., 5 minutes). Children were considered 'on task' if they were looking at the academic material, writing, or gave the appearance that they were actively solving one of the tasks and 'off task' if they engaged in any other behavior for greater than three seconds.

Accuracy.

Children received one mark for each correct answer for academic activities. Accuracy was recorded as a percent correct and calculated by dividing the number of correct responses by the total number of responses that were attempted, multiplied by 100.

Child affect.

The child affect scale (Koegel & Egel, 1979) was used as a measure of children's range of positive to negative affect (see Study One for a complete description). Following every session, children received a rating from 0 indicating negative affect, avoidance of the task, and/or withdrawal from the situation to 5 indicating high levels of interest, engagement with the task, and positive affective response.

Task preference.

Task preference was evaluated by determining whether the proportion times that children selected the autonomous-reward post-intervention differed from chance levels. That is, to evaluate whether children favored the task associated with autonomous-reward.

Disruptive behavior.

Given the larger sample size of Study Two, it was expected that there would be greater numbers of disruptive behavior to permit statistical analyses. Disruptive behavior included any behavior that explicitly interfered with task completion, such as yelling, swearing, hitting, kicking, throwing or destroying materials, as well as oppositional behavior.

Self-report measure.

In Study One, the self-report measure [Children's Academic Intrinsic Motivation Inventory (CAIMI, Gottfried, 1986)] was unreliable. This may have been the result of the children' selected or that insufficient effort was taken to teach the children how to accurately complete the scale. Thus, in Study Two, greater effort was taken to teach the children how to complete the measure, and the size of the measure was reduced to seven items (particularly problematic items were omitted). See Study One for a description of the measure.

Data Analysis

The data analysis framework for Study Two was identical to Study One. During the training phases of the study, analyses included: the effects of phase, an examination of difference scores (A2-A1 versus A4-A3), and comparison of reward contexts (autonomous-reward versus traditional-reward). If a non-significant difference was found between reward contexts, the baselines, reward, and withdrawal phases were collapsed into one baseline, one reward, and one withdrawal phase. One additional analysis was conducted as part of the training phase of Study Two. To account for the potential impact of order effects, a repeated measures ANOVA was conducted with six levels of phase and two levels of context order as a between subject factor. Post-intervention analyses were also consistent with Study One with the exception of the log transformation.

Consistent with Study One, in Study Two there were very few instances of disruptive behavior; too few to permit statistical analysis. Children were also given greater practice with the self-report measure, and they appeared to complete the scale accurately. However, similar to Study One, as Study Two progressed, it became apparent that children's responses no longer matched their behavior; their response pattern was undifferentiated (e.g., responding tended to be unaffected by questionnaire items that were reverse coded). In the present research context, the CAIMI was deemed invalid and unreliable.

Inter-Observer Agreement

All of the measures were collected and scored by the experimenter. The second observer was a doctoral-level graduate student in psychology who was naïve to the conditions to which the children were assigned. Initial training occurred with the video recordings of the pilot project. Twenty percent of all of the sessions were co-scored. Each child participated in 40 five-minute sessions. Therefore, eight sessions for each of the eight children were co-scored. Percentage of agreement was calculated by dividing the number of agreements by the total number of judgments. Disagreements were resolved through discussion. For time on task, accuracy, affect, and problem behavior, agreement was 87.36%, 93.21%, 85.25%, and 90.05%, respectively.

Treatment Fidelity

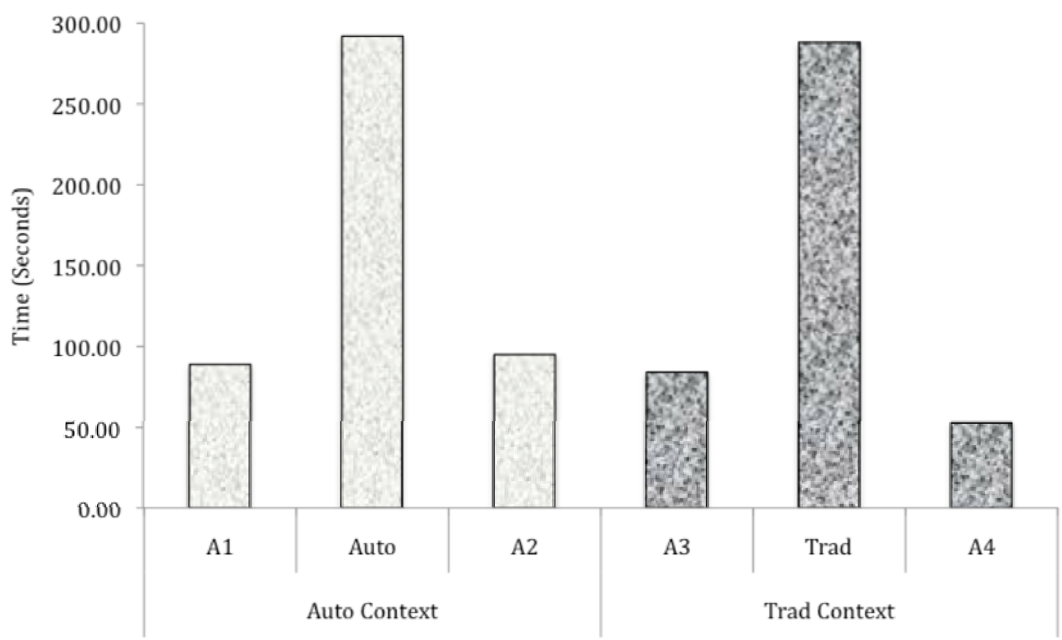
To ensure the phases of the study (i.e., free choice periods, and autonomous- and traditional-reward conditions) were implemented consistently throughout the experiment, 30 percent of sessions were randomly selected for review by a second reviewer. The video recordings of the experimental manipulations were reviewed and scored by a trained graduate student research assistant naïve to experimental conditions (see Appendix F for Treatment Fidelity Form). The reviewer completed the brief checklist after reviewing each session. The reviewer gave each item either a plus sign (+) or a negative sign (-) indicating that the experimenter implemented the component of the intervention correctly or incorrectly. Percentage of correct implementations was calculated as the number of correct implementations divided by the number of correct implementations plus incorrect implementations and multiplying by 100. The correspondence between the experimenter's implementation and the reviewer's ratings was 96.25 percent.

Results

Time on Task: Training Phases of the Study

A repeated measures one way ANOVA on time on task revealed a significant effect of phase, $F(3, 35) = 22.492$, $p < 0.001$, $r^2 = 0.763$. To examine the effects of the different phases on time on task, several comparisons were made. First, paired-samples *t*-tests were conducted comparing baseline to withdrawal phases. The results indicated no significant differences between A1 (*M* = 89.28, *SD* = 96.58) and A2 (*M* = 95.28, *SD* = 83.01), $t(7) = 0.497$, $p = 0.634$, *n.s.*, $d = 0.176$, or between A3 (*M* = 84.18, *SD* = 116.87) and A4 (*M* = 53.45, *SD* = 70.44), $t(7) = 0.555$, $p = 0.596$, *n.s.*, $d = 0.196$. These findings indicate that time on task did not differ significantly from baseline to withdrawal phases. Figure 5.1 presents children's mean time on task across the six phases.

Figure 5.1. Children's time on task during the training phases of the experiment.



Note. A1 = autonomous baseline; Auto = autonomous-reward; A2 = autonomous withdrawal; A3 = traditional baseline; Trad = traditional-reward; A4 = traditional withdrawal.

To assess whether the order in which the reward contexts were implemented impacted time on task, a repeated measures ANOVA was conducted with six levels of phase (A1 – A4), and two levels of context order (autonomous-reward experienced first versus traditional-reward experienced first) as a between subject variable. Analyses revealed a significant effect for phase, $F(5, 30) = 24.869$, $p < 0.001$, $r^2 = 0.806$., a non-significant effect for context order, $F(1, 6) = 2.182$, $p = 0.190$, *n.s.*, $r^2 = 0.267$, and a non-significant interaction, $F(5, 30) = 1.739$, $p = 0.156$, *n.s.*, $r^2 = 0.225$. This indicates that the order in which the reward contexts were experienced did not impact children's time on task.

Using difference scores, comparisons were made for the time on task between baseline and withdrawal sessions for both autonomous-reward and traditional-reward phases (A2-A1 versus A4-A3). A paired-samples *t*-test revealed a non-significant difference, $t(7) = -0.230$, $p = 0.825$, *n. s.*, $d = -0.081$. These findings indicate that there were no mean differences between children's baseline versus withdrawal sessions for autonomous-reward (*Mdiff* = -16.750, *SD* = 95.259) and traditional-reward (*Mdiff* = -7.875, *SD* = 40.123) phases.

The next analysis examined differences between the two reward contexts (autonomous-reward and traditional-reward). A paired samples *t*-test revealed a non-significant finding, $t(7) = -0.281$, $p = 0.787$, *n.s.*, $d = 0.01$. This result indicates that there were no differences in children's time on task during the reward conditions beyond the effect of the reward itself.

Because there was no significant difference between the two reward contexts on children's time on task, the data for the two reward phases (autonomous-reward and traditional-reward), along with the respective baseline and withdrawal phases, were aggregated into one baseline phase, one reward condition, and one withdrawal phase. A repeated measures ANOVA, with three levels of phase (baseline, reward, withdrawal), was significant, $F(2, 14) = 46.401$, $p < 0.001$, $r^2 = 0.869$. Subsequent paired-samples *t*-tests revealed that the baseline phase was significantly different from the reward phase, $t(7) = -6.085$, $p < 0.001$, $d = -2.151$. Similarly, the reward phase was significantly different from the withdrawal phase, $t(7) = 9.173$, $p < 0.001$, $d = 3.243$. These findings indicate that children spent significantly more time on task during reward conditions, irrespective of context (autonomous vs. traditional), than during baseline and withdrawal phases. The comparison for baseline versus withdrawal phases was not significant, $t(7) = 1.103$, $p = 0.306$, *n.s.*, $d = 0.390$.

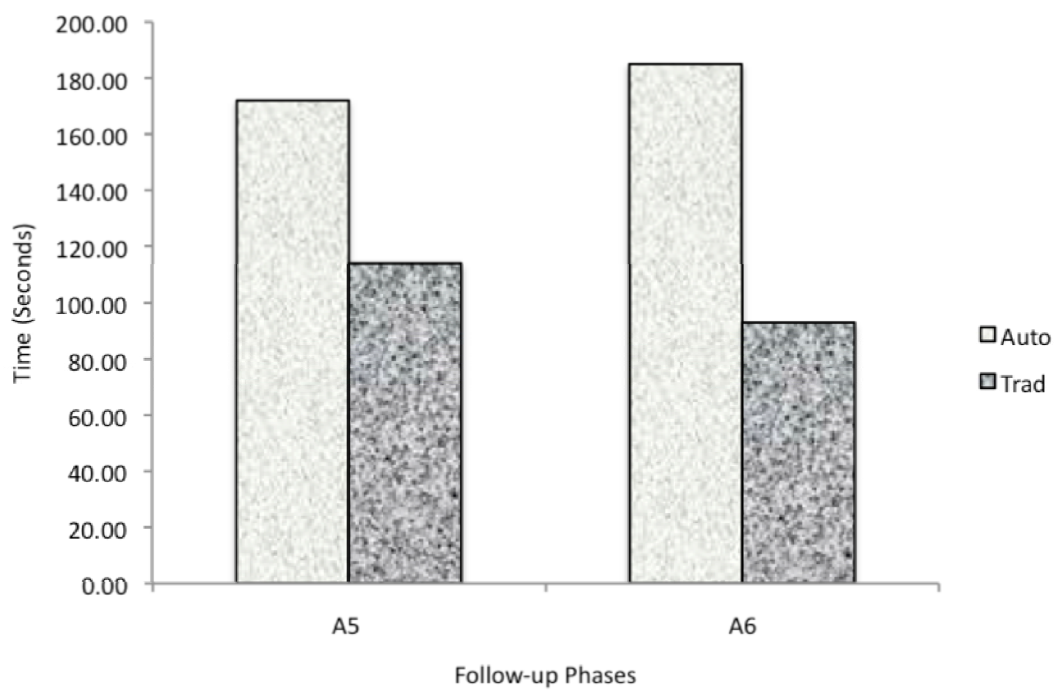
Time on Task: Post-Intervention

A repeated measures ANOVA was conducted with two levels of context (autonomous-reward and traditional-reward) and two levels of phase (A5 and A6). The results yielded a non-significant effect for phase, $F(1, 5) = 2.635$, $p = 0.165$, *n.s.*, $r^2 = 0.345$, a non-significant effect for context, $F(1, 5) = 0.900$, $p = 0.386$ *n.s.*, $r^2 = 0.153$, and a non-significant interaction, $F(1, 5) = 0.484$, $p = 0.518$, *n.s.*, $r^2 = 0.088$. These results suggest that there were no differences in children's time on task at follow-up by reward context.

Children spent an average of 171.80 seconds of available time engaged with academic material previously completed in an autonomous-reward setting ($SD = 96.03$) (see Figure 5.2). During the same maintenance phase (A5), children spent an average of 113.60 seconds of available time engaged with academic material previously completed in the traditional-reward setting ($SD = 102.01$). As shown in Figure 5.2, children's time on task during the final follow-up phase

(A6), the test of transfer, was slightly higher than previously observed (i.e., in A5) for those tasks associated with autonomous-reward (*M* = 185.47, *SD* = 105.44) in comparison to the tasks associated with the traditional-reward procedures (*M* = 92.73, *SD* = 105.63). These results indicate more intrinsic motivation for tasks done in autonomous-reward settings—the lack of statistical significances relates to low power of the test.

Figure 5.2. Children's time on task at follow-up.

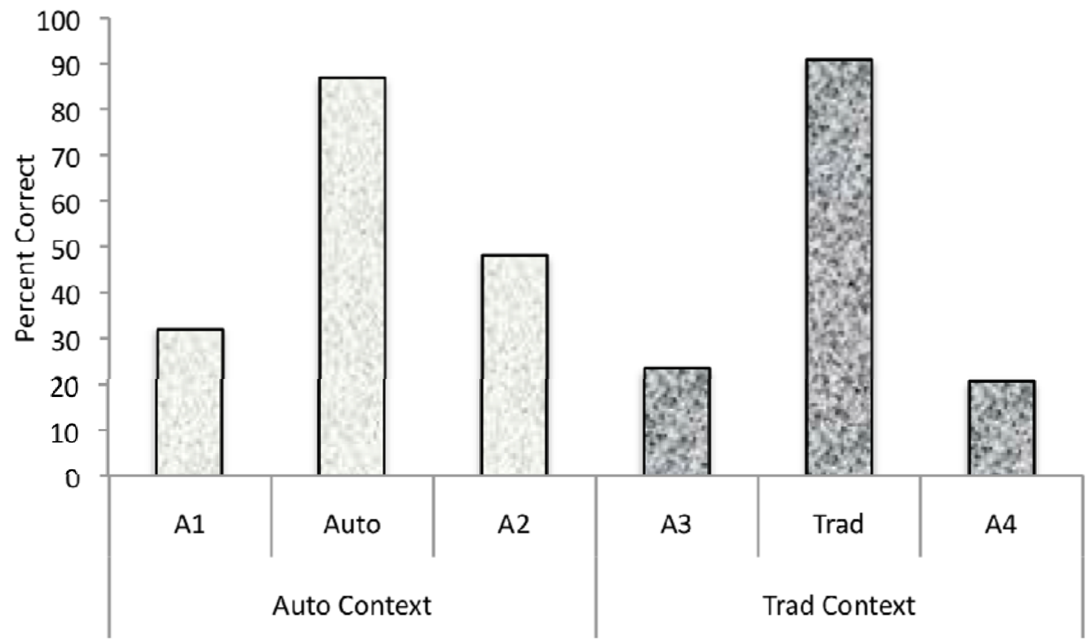


Note. A5 = maintenance phase; A6 = transfer phase.

Accuracy: Training Phases of the Study

A repeated measures one way ANOVA on children's accuracy during the training phase indicated a significant effect, $F(5, 35) = 12.629$, $p < 0.001$, $r^2 = 0.643$. To examine the effects of the different phases on children's accuracy, the first analysis included a paired-samples *t*-test to compare baseline to withdrawal phases. The results indicated no significant differences between A1 (M =31.93, SD = 33.70) and A2 (M = 48.04, SD = 39.16), $t(7) = -1.103$, $p = 0.307$, *n.s.*, d = -0.39, or between A3 (M = 23.40, SD = 32.37) and A4 (M = 20.68, SD = 29.19), $t(7) = 0.850$, $p = 0.424$, *n.s.*, $d = 0.30$. These findings indicate that accuracy did not differ significantly from baseline to withdrawal phases. Presented in Figure 5.3 are the mean percentages that children achieved in each of the six phases.

Figure 5.3. Children's accuracy during the training phases of the experiment.



Note. A1 = autonomous baseline; Auto = autonomous-reward; A2 = autonomous withdrawal; A3 = traditional baseline; Trad = traditional-reward; A4 = traditional withdrawal.

To assess whether the order in which the reward contexts were implemented impacted accuracy, a repeated measures ANOVA with six levels of phase (A1 – A4), and two levels of context order (autonomous-reward experienced first versus traditional-reward experienced first) as a between subject variable was conducted. Analyses revealed a significant effect for phase, $F(5, 30) = 15.167$, $p < 0.001$, $r^2 = 0.717$, a non-significant effect for context order, $F(1, 6) = 5.116$, $p = 0.064$, *n.s.*, $r^2 = 0.460$, and a significant interaction, $F(5, 30) = 2.570$, $p = 0.048$, $r^2 = 0.300$. An independent-sample *t*-test, with context order as the grouping variable, revealed a significant difference between children's final withdrawal phases, $t(6) = 3.814$, $p = 0.009$, $d = 3.81$. Children who experienced the traditional-reward context followed by the autonomous-reward context showed no difference in their IM when their traditional-reward was withdrawn. However, they showed evidence of an enhancement effect of IM when the subsequent autonomous-reward was withdrawn. In contrast, for children who experienced the autonomous-reward followed by the traditional reward, IM was left unaffected during both withdrawal sessions. Thus, IM was unaffected in all conditions except for during the autonomous-reward withdrawal phase when it was experienced after the traditional-reward. This finding means that the order in which the context manipulations are experienced differentially impacted (i.e., increased) children's IM as measured by accuracy.

Difference scores were used to compare differences between children's accuracy between baseline and withdrawal sessions for both autonomous-reward and traditional-reward phases (A2-A1 versus A4-A3). A paired-samples *t*-test revealed a non-significant difference, $t(7) = 1.277$, $p = 0.242$, *n.s.*, $d = 0.452$ indicating that there was no mean differences between children's baseline versus withdrawal sessions for the autonomous-reward (*Mdiff* = 16.113, *SD* = 41.329) and traditional-reward (*Mdiff* = -2.725, *SD* = 9.07) phases.

Examining the difference between the two reward conditions (autonomous-reward versus traditional-reward) revealed a statistically significant finding, $t(7) = -2.460$, $p = 0.43$, $d = -.087$. Children were slightly, but significantly, more accurate in the traditional-reward condition ($M = 90.90$, $SD = 8.51$) than they were in the autonomous-reward condition ($M = 86.90$, $SD = 8.76$). Because a significant difference was found between the two reward conditions, the data for the baseline, reward, and withdrawal phases were not collapsed for additional analyses.

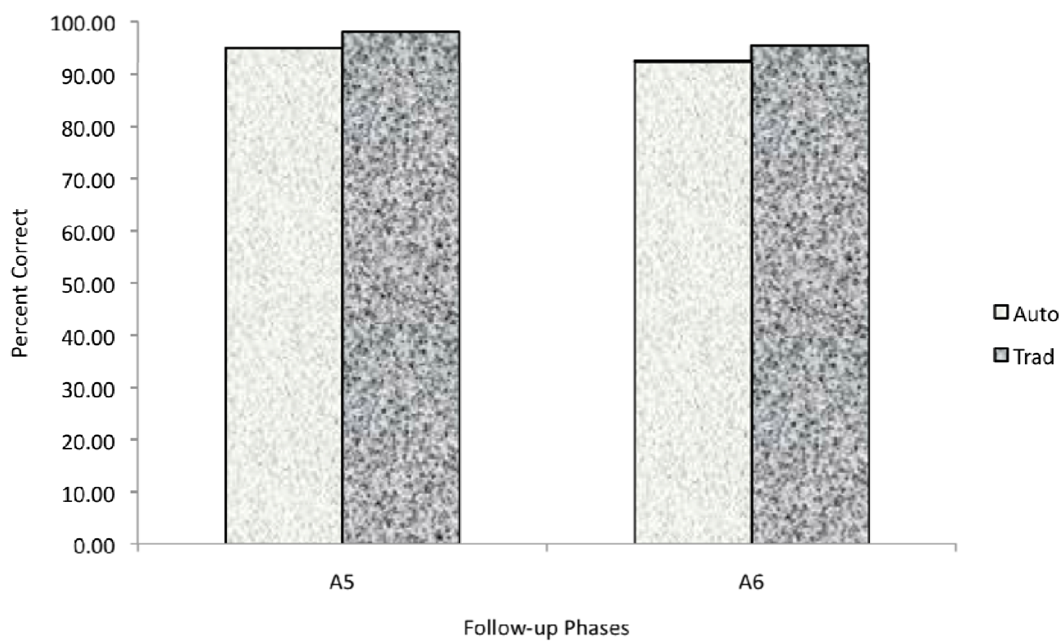
Paired-samples t-tests were used to compare the reward phases (autonomous-reward and traditional-reward) to their respective baseline and withdrawal phases. Comparison of the autonomous baseline (A1) to autonomous-reward condition revealed a significant effect, $t(7) = -3.988$, $p = 0.005$, $d = -1.41$, and the autonomous-reward to its withdrawal (A2) was significant at $t(7) = 2.775$, $p = 0.027$, $d = 0.98$. Similarly for the traditional phases, baseline (A3) was significantly different than traditional-reward, $t(7) = -5.498$, $p = 0.001$, $d = -1.94$, and the traditional-reward was significantly different from its withdrawal (A4) phase, $t(7) = 6.556$, $p < 0.001$, $d = 2.32$. These findings indicate an effect of reward for both the autonomous-reward and traditional-reward contexts.

Accuracy: Post-Intervention

A repeated measures ANOVA was conducted with two levels of context (autonomous-reward and traditional-reward) and two levels of phase (maintenance and transfer). The results yielded a non-significant effect for phase, $F(1, 2) = 2.065$, $p = 0.287$, *n.s.*, $r^2 = 0.508$, a non-significant effect for context, $F(1, 2) = 0.305$, $p = 0.636$, *n.s.*, $r^2 = 0.132$, and a non-significant interaction, $F(1, 2) = 4.00$, $p = 0.184$, *n.s.*, $r^2 = 0.667$. These findings indicate that there were no differences in children's accuracy at follow-up.

As displayed in Figure 5.4, during the maintenance phase (A5) children's mean accuracy for completion of tasks associated with autonomous-reward was 94.89 percent (*SD* = 6.89). In contrast, children's mean accuracy for traditional-reward tasks was 97.96 percent (*SD* = 2.85). During the transfer phase (A6), children's mean accuracy for the task associated with autonomous-reward was 92.42 percent (*SD* = 4.75). Children's mean accuracy for the material associated with the traditional-reward was 95.38 percent (*SD* = 6.02).

Figure 5.4. Children's accuracy during follow-up.

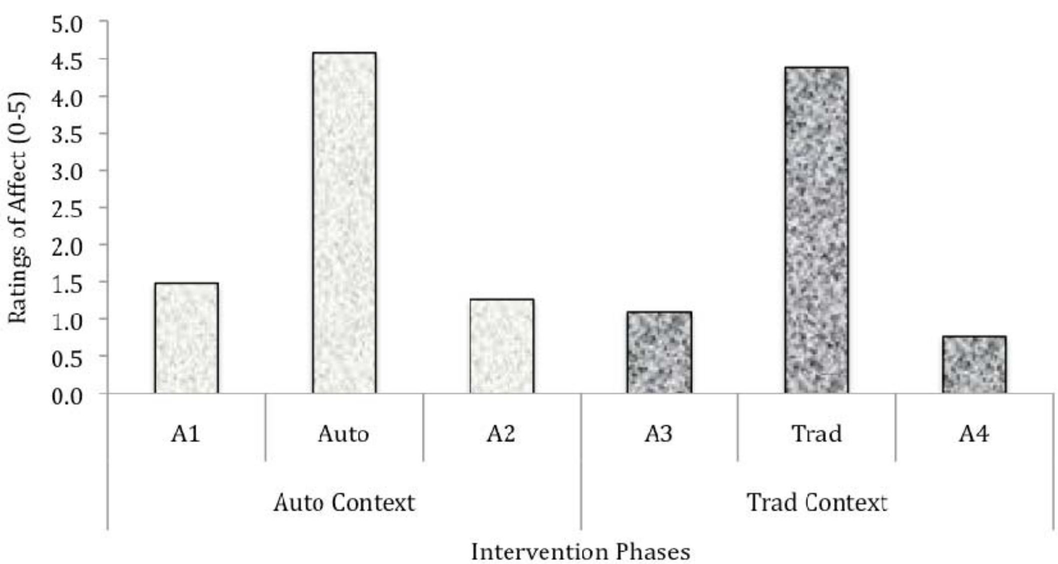


Note. A5 = maintenance phase; A6 = transfer phase.

Affect: Training Phases of the Study

A repeated measure one way ANOVA was conducted on ratings of children's affect during the training phases of the experiment. Analyses revealed a significant effect, $F(5, 35) = 24.837$, $p < 0.001$, $r^2 = 0.776$. The effects of the different phases on children's affect were compared using paired-samples *t*-tests. Comparisons of baseline to withdrawal phases revealed non-significant differences between A1 ($M = 1.48$, $SD = 1.46$) and A2 ($M = 1.26$, $SD = 1.09$), $t(7) = 0.994$, $p = 0.353$, *n.s.*, $d = 0.352$, and between A3 ($M = 1.10$, $SD = 1.72$) and A4 ($M = 0.76$, $SD = 1.07$), $t(7) = 0.597$, $p = 0.569$, *n.s.*, $d = 0.212$. Presented in Figure 5.5 are the mean ratings of children's affect. These findings indicate that, and as shown in Figure 5.5, children's affect did not differ significantly from baseline to withdrawal phases.

Figure 5.5. Ratings of children's affect during training phases of the experiment.



Note. A1 = autonomous baseline; Auto = autonomous-reward; A2 = autonomous withdrawal; A3 = traditional baseline; Trad = traditional-reward; A4 = traditional withdrawal.

To assess whether the order in which the reward contexts were implemented differentially impacted ratings of affect, a repeated measures ANOVA was conducted with six levels of phase (A1 – A4), and two levels of context order (autonomous-reward experienced first versus traditional-reward experienced first) as a between subject variable. Analyses revealed a significant effect for phase, $F(5, 30) = 24.806$, $p < 0.001$, $r^2 = 0.805$, a non-significant effect for context order, $F(1, 6) = 2.101$, $p = 0.197$, *n.s.,* $r^2 = 0.259$, and a non-significant interaction, $F(5, 30) = 1.160$, $p = 0.352$, *n.s.,* $r^2 = 0.162$. This indicates that the order in which the reward contexts were experienced did not impact children's affect.

Using difference scores, comparisons were made of the difference in affect between baseline and withdrawal conditions for both autonomous-reward and traditional-reward phases (i.e., A2-A1 versus A4-A3). A paired-samples *t*-test revealed an non-significant difference, $t(7) = -0.710$, $p = 0.501$, *n.s.*, $d = -0.251$. This finding indicates that there were no mean differences between children's baseline versus withdrawal sessions for autonomous-reward (*Mdiff* = -0.438, *SD* = 1.24) and traditional-reward (*Mdiff* = -0.112, *SD* = 0.533) phases.

Analysis of the differences in children's affect between the autonomous-reward phase ($M = 4.58$, $SD = 0.53$) versus the traditional-reward phase ($M = 4.38$, $SD = 0.48$) was subsequently conducted. A paired-samples *t*-test revealed a non-significant difference, $t(7) = 1.058$, $p = 0.325$, *n.s.*, $d = 0.374$. This result indicates that children's affect did not differ in response to the autonomous-reward.

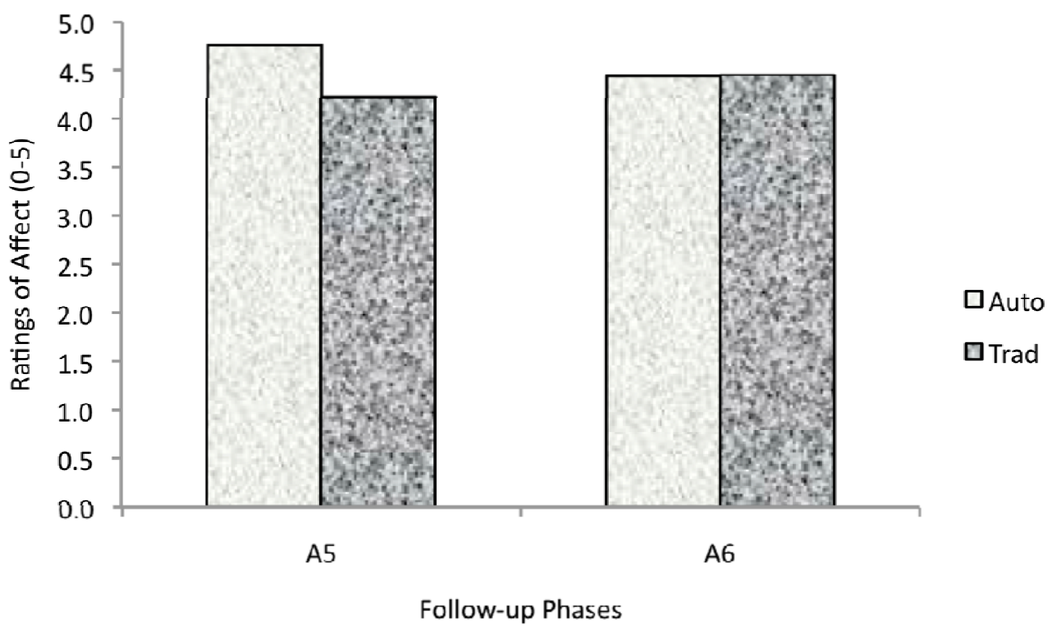
Since there was no significant difference between the two reward phases (autonomous-reward and traditional-reward), the data, along with the respective baseline and withdrawal sessions, were collapsed into one baseline phase, one reward condition, and one withdrawal phase. A repeated measures ANOVA, with three levels of phase (baseline, reward, withdrawal) was conducted and was significant, $F(2, 14) = 46.401$, $p < .001$, $r^2 = 0.869$. Additional paired-samples *t*-tests revealed that children's positive affect was greater in the reward condition ($M = 4.48$, $SD = 0.43$) than during baseline ($M = 1.29$, $SD = 1.34$), $t(7) = -6.085$, $p < .001$, $d = -2.153$. Children also displayed more positive affect during the reward condition than during the withdrawal ($M = 1.01$, $SD = 0.93$), $t(7) = 9.173$, $p < .001$, $d = 3.243$. These findings indicate that children's positive affect was significantly higher when the reward contingencies were in effect. However, when a comparison was made between children's baseline versus withdrawal levels of affect, a non-significant difference was found, $t(7) = 1.103$, $p = 0.306$, *n.s.*, $d = 0.39$.

Affect: Post-Intervention

A repeated measures ANOVA was conducted, with two levels of context (autonomous-reward and traditional-reward) and two levels of phase (maintenance and transfer). The results yielded a non-significant effect for phase, $F(1, 2) = 0.097$, $p = 0.785$, *n.s.*, $r^2 = 0.046$, a non-significant effect for context, $F(1, 2) = 1.00$, $p = 0.423$, *n.s.*, $r^2 = 0.333$, and a non-significant interaction, $F(1, 2) = 1.609$, $p = 0.332$, *n.s.*, $r^2 = 0.446$. These findings indicate that there were no significant differences in ratings of children's affect at follow-up.

Presented in Figure 5.6 are ratings of children's affect during their engagement with tasks associated with autonomous-rewards versus traditional-rewards for the transfer and maintenance (A5 and A6) phases of the study. As shown in Figure 5.6, children's mean rating of affect, as it corresponded to their engagement with tasks previously associated with autonomous-reward, was 4.76 (*SD* = 0.23). In contrast, children's mean affect rating for tasks associated with the traditional-reward was 4.22 (*SD* = 1.26). During the final phase of the follow-up (A6), the test of transfer, children's affect ratings for autonomous-reward tasks marginally reduced from 4.76 to 4.44 (*SD* = 0.50). However, children's affect for tasks complete in traditional-reward contexts marginally increased from 4.22 to 4.45 (*SD* = 0.66).

Figure 5.6. Ratings of children's affect at follow-up.



Note. A5 = maintenance phase; A6 = transfer phase.

Task Preference

Across follow-up phases (A5 - maintenance and A6 - transfer), children each had ten opportunities to choose to engage in either the task that had been completed in an autonomous-reward setting or the task completed in traditional-reward setting. Presented in Table 5.3 are the proportions of time that children selected the task previously paired with autonomous-reward. As shown in Table 5.3, children selected the task associated with autonomous-reward from zero to 10 times (M = 6.33, SD = 3.39). To evaluate whether the frequency of choices was statistically significant, each child's proportion of autonomous-reward choices were compared in a one-sample t-test to determine whether the mean exceeded chance or 0.5. The analysis indicated that individual children chose autonomous-reward tasks more than expected by chance, $t(5) = 4.58$, $p = .006$, $d = 0.8076$. This finding indicates that children showed an increase in IM for the academic subject completed in an autonomous-reward setting.

Table 5.3. Children's proportion of choices at follow-up for tasks completed in an autonomous-reward context.

Participant	Proportion of Opportunities
Alex	0.7
Brandon	0.0
David	1.0
Kyle	0.8
Noah	0.6
Nathan	0.7

As shown in Table 5.4, preference changed in favor of the task associated with autonomous-reward for half of the children (three out of six). Two of the remaining children received autonomous-rewards for engaging in their preferred task, and their preference was unchanged at follow-up. However, for one child, his preference changed in favor of the task associated with the traditional-reward. Thus, with the exception of one child, all other children showed a post-intervention preference for the task paired with autonomous-reward.

Table 5.4 Children's pre- versus post-intervention task preferences.

Child	Pre-Intervention Preference	Task Paired with Autonomous-Reward	Post-Intervention Preference
Alex	LA	LA	LA
Brandon	Math	Math	LA
David	Math	Math	Math
Kyle	Math	LA	LA
Noah	Math	LA	LA
Nathan	Math	LA	LA
Adam	LA	Math	DNF
Robert	Math	Math	DNF

Note. LA = language arts; DNF = did not finish.

Discussion

Study Two accounted for the limitations of Study One by doubling the sample size, counterbalancing the order in which the treatments were experienced, and increased the amount of exposure to each experimental condition.

There were several findings that were consistent with Study One. First, in Study One there was consistency in the children's performance across time on task, accuracy, and affect. That trend was replicated in Study Two; children's levels of performance were consistent across measures of time on task, accuracy and affect. Second, and consistent with the Study's hypotheses, children spent more time on task, were more accurate, and displayed more positive affect when the reward contingencies were in effect. Third, the reward did not appear to impact children's intrinsic motivation (IM). Fourth, children showed a significant preference for the autonomous-reward task during post-intervention sessions, also consistent with the hypotheses.

There were several findings that were unique to Study Two. First, there was clear evidence of an effect of reward. That is, children had the highest rates of engagement, were most accurate, and were rated as displaying the most positive affect when the reward contingencies were in place. This finding was not unexpected. Self-determination theory and behavioral theories agree that extrinsic rewards serve to motivate individuals (Cameron & Pierce, 2002; Deci & Ryan, 1985).

The second finding unique to Study Two was that children were more accurate in the traditional-reward condition in comparison to the autonomous-reward condition. This finding was unexpected. Although self-determination theory (SDT) and cognitive evaluation theory (CET) do agree that rewards motivate behavior, they are primarily interested in the effects of extrinsic rewards after they have been removed. As such, SDT/CET do not offer an explanation to why this finding was observed. Behavioral theories do offer an explanation. If, as Skinner (1971) posited, Western societies have been socialized to experience signals of freedom (i.e., choice) as reinforcing, the traditional-reward condition would have been experienced as noticeably different from their daily environment and every other phase in the study. Even in the baseline and withdrawal phases, children did have the opportunity to engage in either an academic task or to look at a picture book. During the autonomous-reward phase, children had four opportunities to engage in choice making. The traditional-reward condition was the only condition where there were absolutely no opportunities for choice. In an environment devoid of choice, individuals may have been more motivated to perform well in an effort to earn future choice making opportunities. It is possible that prior learning has taught the children that when they perform well (i.e., are highly accurate with academic tasks) they earn choice making opportunities as part of their reinforcement. This prior learning would have functioned as an establishing operation (Michael, 1982). Thus, when the traditional-reward condition was experienced, children's accuracy increased in order to earn subsequent opportunities to earn choice (as previously experienced in their daily lives, and within previous phases of the experiment).

Lastly, the larger sample size also enabled the counterbalancing of the two reward contingencies (autonomous-reward versus traditional-reward) for the assessment of order effects. Analyses revealed that the order in which the reward contexts were experienced impacted children's intrinsic motivation (IM) as measured by accuracy. Specifically, when the autonomous-reward was experienced before the traditional-reward, it had no detectable effect on children's IM in either withdrawal condition. However, when the traditional-reward was experienced first, children's IM was enhanced when the subsequent autonomous-reward condition was withdrawn. Although this finding cannot be explained by self-determination theory, behavioral theories do offer an explanation. As previously described, social contexts that contain signs of freedom become conditioned reinforcers (Skinner, 1971). When individuals undergo periods of deprivation from reinforcing contexts, subsequent contexts that contain those reinforcers are experienced as much more reinforcing (Michael, 1982). As such, behavioral theories predicted that children who experienced the traditional-reward first, followed by the autonomous-reward, would experience the enhanced choice making available in the autonomous-reward context as highly reinforcing and an increase in IM would result. Alternatively, experiencing the autonomous-reward condition first would place the individual in a state of satiation and the following traditional-reward condition would likely leave children's IM unaffected.

Originally, 12 children were sought for recruitment in Study Two. Unfortunately, only eight were eligible, and two were lost to attrition. Although Study Two doubled the number of participants of Study One, it still suffered from a relatively small sample size. It is highly likely that many of the non-significant comparisons were due to low statistical power. For example, there were two notable trends in children's time on task data during the training phase of the study. Children's IM tended to increase following the autonomous-reward, and tended to decrease following the traditional-reward (see Figure 5.1). These two trends were consistent with the original hypotheses of the study, and a larger sample size would likely have shown evidence of a true difference. Further, children were found to be more accurate in the traditional-reward condition than they were in the autonomous-reward condition on the accuracy measure only. Perhaps with a greater sample size that difference would have been replicated with the additional measures. Lastly, it was expected that with a larger sample size, a post-intervention difference favoring the autonomous-reward task would have been found on the time, accuracy, and affect measures. Despite the fact that children showed a statistically significant preference for the autonomous-reward task, there were no other statistically significant findings for the other post-intervention measures.

Overall, the findings of Study Two indicate that children's IM can be increased as evidenced by preference for the task associated with autonomous-rewards, and that an autonomous-reward condition can promote IM (based on accuracy) when experienced after a period devoid of autonomy-support.

Chapter 6

General Discussion

Overview of Findings

The purpose of this program of research was to investigate how IM could be promoted for academics in children with ASD. In Study One, all three children experienced the traditional (no-choice) context first, followed by the autonomous (choice) context second. During the training phases of the study, there was partial evidence of an effect of reward on children's intrinsic motivation (IM). However, neither the reinforcement contingency, nor the context manipulation was shown to impact children's IM. During the post-intervention phases, children showed a clear preference for the task associated with enhanced choice, despite no observed differences on children's time on task, accuracy, or affect.

The analyses of Study Two revealed that although children's time on task, accuracy, and affect all increased in response to the administration of the reward, however, rewards did not impact children's IM (i.e., did not enhance, nor undermine). The effects of context (i.e., choice) were detectable on only one of the measures: accuracy. Children were more accurate when they received rewards in the traditional (no-choice) condition than they were in the autonomous condition. An interaction effect was also observed for accuracy. Children's IM returned to baseline levels following the removal of the reward contingency for all conditions with the exception of when the autonomous-reward followed the traditional-reward. For the children who experienced this order of conditions, their IM was increased following receipt of the autonomous-reward. Thus, when children experienced a period of non-choice making followed by choice making opportunities, the rewards received during the choice making period are experienced as more reinforcing. Lastly, children in Study Two also showed a clear preference for the task associated with autonomous-reward during post-intervention sessions.

Integrating the Two Studies

Study Two replicated the findings of Study One, and provided further clarification of the ways in which rewards and context can impact IM. Regarding the effect of rewards, the two studies have shown that extrinsic rewards do not undermine IM as some theories predicted (e.g., Deci & Ryan, 1985). Overall, it was observed across both studies that when performance-contingent rewards were withdrawn, children's IM returned to baseline levels. This observed effect is consistent with other repeated measures analyses (Cameron et al., 2001).

Although the effects of the context manipulation were undetected in Study One (likely due to low statistical power), Study Two demonstrated that choice-making opportunities resulted in increased IM (as measured by accuracy) when the choice-making opportunities were introduced after a period devoid of choice. It was also demonstrated that when children receive performance-contingent rewards in combination with enhanced choice making for engaging in academic tasks, children will show a preference for the task associated with choice that will maintain for up to 5 months, and this effect was shown to generalize to novel environments.

Theoretical Analysis

The present research speaks to two aspects of the extrinsic rewards/intrinsic motivation literature. The first concerns the effects that rewards have on IM. The second concerns the social context in which the rewards are administered. These effects are of particular interest to two largely competing theories: cognitive evaluation theory, and Skinner's behavioral theory.

Cognitive evaluation theory.

According to Deci and Ryan, "intrinsic motivation is based in the innate, organismic needs for competence and self-determination" (1985, p, 32). To feel that one is competent at an activity is a necessary element for intrinsic motivation, however it is insufficient if one feels that their behavior is the result of some external pressure. To be self-determined refers to the experience of choice; or more specifically, the experience of feely engaging in an activity. Together, the experience of engaging in an activity in the absence of external pressure, and to feel that one is competent at that activity is the essence of what it means to be intrinsically motivated (IM). When an individual feels some external pressure (such as an extrinsic reward) to engage in an activity, their IM for that activity will begin to erode because they no longer feel self-determined. If, however, the reward provides positive information to the individual about their competence, the undermining effects of the reward may be mitigated.

Cognitive evaluation theory (CET) speaks to both aspects of the experimental manipulation: the performance-based reward contingency, and the choice manipulation. According to CET, performance-based reward contingencies increase the salience of the reward because it is so closely tied to behavior. As such, this contingency could be interpreted as either highly informational, or highly coercive (Deci & Ryan, 1985). CET predicted that children in the present set of studies would have experienced the "performance-based" aspect of the reward as informational. This information would have conveyed that children were competent as the receipt of the reward was contingent upon correct responding. Although the information conveyed by the reward was indicative of competence, the highly salient nature of the contingency would have resulted in a net loss of IM, because of its inherent external pressure.

SDT and CET assert that IM is also affected by the experience of choice (Deci & Ryan, 1985). The increased opportunities for choice making found in the autonomous-reward condition should have reduced feelings of pressure, and increased children's sense of autonomy. This experience would have had a protective effect on IM making it less likely that the reward would undermine. In contrast, the traditional-reward condition should have been experienced as highly coercive due to the absence of choice, which would definitively have left IM undermined. These hypotheses were not supported. There was no statistically detectable undermining effect in either of the two studies.

According to CET, all extrinsic rewards, despite relaying any competence information, are highly controlling. Thus, CET does not predict any enhancement effects of IM as a result of rewards. However, in Study Two an enhancement of IM was found for children's accuracy. The effect was observed for those children who experienced the autonomous-reward condition after the traditional-reward condition. Although CET would predict that children would experience the autonomous-reward condition more positively because it satisfied individuals' innate needs for autonomy, the extrinsic reward should have undermined children's IM. Thus, CET offers no explanation for the observed effect.

CET offers an explanation for why children showed a preference for the task associated with autonomous-reward during post-intervention phases. CET predicted that the autonomy-support (i.e., choice) that was offered during the autonomous-reward condition would have had a protective effect on IM, and because the effects of rewards on IM are not transitory (Cameron et al., 2001; Deci et al., 1999), the protective effect should have maintained throughout the post-intervention sessions. That is why when the autonomous-reward task and the traditional-reward task were paired together, children showed a preference for the task associated with autonomy support, relative to the task purely associated with a coercive reward. CET is only able to explain why children showed a preference for the autonomous task. CET cannot explain why there were no differences on the remaining measures of children's IM (i.e., time on task, accuracy, affect).

The observed findings in this set of experiments are further problematic from the perspective of CET. Deci and colleagues have posited that undermining effects are not a transitory phenomenon (Deci et al., 1999). Thus, it is contrary to CET that not only did rewards not undermine children's IM, but that the pattern of responding maintained over time, generalized to novel environments, and the trends that were observed in Study One were replicated in Study Two.

Behavioral theories.

Although there were methodological differences between the two studies, there were clear trends in children's performance. These trends can be better explained with behavioral theories.

Behavioral theories disagree with CET regarding the mechanism by which rewards influence IM. When rewards are administered contingent upon behavior they provide valuable information regarding performance, resulting in increased feelings of competence and autonomy. Whereas, when rewards are administered non-contingently, they do not provide competence information and are less likely to impact IM (Eisenberger & Cameron, 1996).

The performance-contingent reward procedures in the present studies were analogous to Cameron, Banko, & Pierce's (2001) "tangible, expected, for each unit solved" category wherein they found a negative effect of reward. However, in the present studies, no effect was detected. The finding that the same reward contingency did not lead to an effect on children's IM could be explained by examining the way in which the contingency was experienced. Deci et al., (1999) found that when individuals were offered expected, tangible rewards, and then subsequently earned "less than the maximal amount", this experience indicated failure and resulted in an undermining effect of IM. For this to be experienced, individuals must be informed in advance of the maximum amount of reward available. In the present investigations, children were unaware of the maximum amount of reward that was achievable. Thus, it was highly unlikely that children would have experienced the reward contingency as indicative of failure. Rather, children would have experienced the contingency as receiving “a maximum amount of a performance-based, expected tangible reward”. The effect of this experience (i.e., no undermining effect) is consistent with the findings of Cameron et al. (2001). And, lastly, the studies that demonstrated an undermining effect in Cameron et al.’s analysis were single-exposure, group-designs. The present experiments used repeated measures designs that, as a methodology, have failed to demonstrate an undermining effect.

In the present research, behavior (i.e., time on task, accuracy, and affect) increased to near ceiling levels before the reward contingency was experienced. This immediate increase is consistent with rule-governed behavior (Cooper, Heron, & Heward, 2007). Skinner (1969) wrote that the “Descriptions of contingencies are, of course, often effective” (p.115). He went on to write, “Verbal communication is not, however, a substitute for the arrangement and manipulation of variables” (p. 115). Although the observed increase in behavior that accompanied the first session of the experimental condition was most likely the result of rule-governed behavior, it nonetheless enabled children to experience the reward contingency. When children experienced the subsequent session, it is more likely that the high rates of behavior that followed were the result of reinforcement rather than simply instructional control (Dickinson, 1989). Therefore, the observation that the present rewards left children’s IM unaffected is consistent with previous findings demonstrating that procedures using highly reinforcing, performance-based rewards, delivered over multiple-sessions does not undermine IM (Cameron et al., 2001).

Skinner has argued that the experience of choice is a culturally significant experience that has become a conditioned reinforcer (1971). Behavioral theory predicted that for the children in the present experiments, the rewards received in an environment rich with choice-making opportunities would have been experienced as more reinforcing than the same rewards in an environment devoid of choice. Further, behavioral theory also predicted that choice, as a potential reinforcer, would be experienced as more reinforcing if those individuals first experienced a period of time wherein they were deprived of choice (Michael, 1982). Although the present sample sizes were not large enough to detect a significant effect of context during the training phases, an interaction effect was observed (in Study Two). The observed results supported the behavioral hypothesis; children's IM as measured by accuracy, increased following a period of deprivation. Unexpectedly, children's accuracy was higher during the traditional-reward context. Following from Skinner (1971) and Michael (1982), it is plausible that children's enhanced accuracy during the condition devoid of choice making was an attempt to earn opportunities for choice making as a reinforcer. Lastly, children's post-intervention preferences also provided support for behavioral theory. In both studies, children showed a preference for the task associated with enhanced choice as Skinner (1971) predicted.

In addition to increasing the sample size, Study Two increased the amount of exposure to each condition from three to five sessions. The purpose of this was to ensure that children had sufficient exposure to the manipulation to guarantee that the observed effects were not transitory. However, the repeated exposure to the two academic tasks may have increased children's IM independent of the choice/no-choice manipulation. During post-intervention sessions, children's time on task, accuracy, and affect were observed at levels well above baseline and withdrawal (although non-significant). This may have been the result of practice effects. Bandura (1986) has forwarded that competence at a task naturally follows from increased practice. Further, when individuals feel competent, they feel more efficacious, and over time, even the most uninteresting task becomes more intrinsically rewarding. In the present experiments, the academic activities selected for the experiment were tasks that the children had already demonstrated a high level of competency (presumably they had practiced those tasks in the classroom many times in order to achieve that level of success). Over the course of the experiment, the children had many more opportunities to practice the tasks and further develop their competence. It is plausible that the increased performance observed during post-intervention sessions is the result of increased IM attributable to increased practice rather than the effects of reward or context. That would explain why there were no significant differences between children's performances on the two academic tasks, and why their rates of behavior were higher than baseline and withdrawal levels.

Summary of Theoretical Analysis

During the analysis of the literature on rewards and intrinsic motivation in Chapter Two, it was found that of the 47 individuals that participated in within-subject, repeated measures research designs, following the removal of the reward contingency the intrinsic motivation for 28 individuals was left unaffected. The remaining individuals (n = 19) experienced an increase in intrinsic motivation (refer back to Table 2.5). The results of the present studies are consistent with that analysis. Taken together, Study One and Study Two have shown that extrinsic rewards do not undermine IM as some theories predicted (e.g., Deci & Ryan, 1985). Consistent with the conclusions offered by Cameron, Banko, & Pierce (2001), the present studies have shown that rewards are capable of increasing, decreasing, or leaving IM unaffected. Under the present conditions, performance-contingent rewards, presented repeatedly over multiple sessions, left children's IM unchanged from baseline levels.

Limitations

The present set of studies was limited in several regards. First was the small sample size. Eleven children participated in the two studies, with only 9 completing the entire experimental protocol. In Study One (N = 3), there were limited detectable effects. Despite the lack of significant effects, the trends in the children's performances in Study One were replicated in Study Two (N = 6) where more statistically significant effects were found. Beyond the statistically significant effects, there were additional trends in the data that may have reached significance had there been even greater statistical power (e.g., increasing IM following autonomous-reward, and decreasing IM following traditional-reward).

The present studies set out to determine the effects that reinforcement contingencies had on children's IM. However, it is not entirely clear whether the rewards were in fact reinforcing. For a stimulus to function as a reinforcer, it must have been shown to increase the frequency of the behavior it follows (Pierce &

Cheney, 2004). Children maintained a high level of responding throughout the experimental sessions, following receipt of rewards. This observation is common in repeated measures research designs, and provides support for the assertion that the rewards functioned as reinforcers (Dickinson, 1989). Despite this assertion, the behavior observed prior to the first exposure to the reward contingency speaks to the power of rule-governed behavior rather than the effects of reinforcement (Skinner, 1969). However, given that children's behavior on the second and subsequent administrations of reward were comparable to their behavior prior to experiencing the first reward, it is difficult to discern whether children's overall behavior was rule-governed or the product of reinforcement. As such, definitive claims cannot be made from the present research about the impact that reinforcement had on children's IM. The present research can only be used to speak about the effects of rewards.

The findings of this research are applicable to structured, academic intervention programs for children with ASD. Attempting to generalize the findings to other children with ASD, or targeting other intervention goals, is highly problematic for a number of reasons. First, children with ASD are a very heterogeneous group (American Psychiatric Association, 2000). For example, within Study Two, children's ages ranged from 7 to 12 years of age, and standard assessment scores ranged from 50 to 116. To accommodate the heterogeneity, the academic tasks in which each child was asked to engage were individually selected based on unique strengths and needs. This individualization process is considered best practice in intervention for children with ASD; however, despite this individualization, there is no guarantee, nor expectation, that the effects of the experimental manipulation would be observed to the same degree with any other child with ASD (National Research Council, 2001).

Second, ASD is four to five times more likely in males and females (American Psychiatric Association, 2000). In the present set of studies, all nine of the participants were male. Although there is no reason to expect that the behavioral methodologies employed in the present set of studies would be experienced differently based on the gender of the participants, caution is nonetheless warranted in extending the findings to all children with ASD, as females were not represented.

Third, although participation in this set of experiments was dependent upon meeting eligibility criteria, and participants were randomly assigned to conditions (Study Two only) all of the participants were self-selected by their parents and caregivers. It is also likely that the participants who volunteered for the research represented a unique sub-sample of children and families of children with ASD. Moreover, all of the participants in Study Two attended a segregated school for children with diverse learning needs in California. Despite the fact that ASD presents in all cultures and geographic regions without prejudice (American Psychiatric Association, 2000), the unique learning histories of this group of children makes generalizing the results additionally troublesome.

Practical Implications

This research may be of interest to those who work with children with ASD in academic (i.e., schools) contexts. Those who have argued against the use of extrinsic rewards have claimed that the use of rewards in the classroom will rob students of their intrinsic interest to learn (Deci et al., 1999; Kohn, 1993). However, analyses have identified the procedures required to elicit an undermining effect (Cameron et al., 2001) and subsequent discussions have elaborated upon the ways that the negative effects of rewards can be easily avoided (Cameron & Pierce, 2002). Based on those discussions, and the procedures and their effects that have been observed in the present research, several strategies to help to promote IM in students with ASD within classroom settings can be suggested.

First, educators can take steps to ensure that their rewards function as reinforcers. This may be accomplished by asking students, or their parents, about what interests them. Once a list of potential reinforcers is collected, conducting a forced-choice paired assessment to identify which of the items is most preferred. Once the most preferred item has been identified, making access to the desired item contingent upon engagement in the target behavior and observing the effects it has on the behavior (e.g., leading to an increase in the target behavior). Using these simple steps, classroom teachers can precisely identify effective reinforcers to offer children.

Second, it is unrealistic to implement a student-based or classroom wide reinforcement system that is not highly contingent upon desired behavior; teachers would never reinforce a student for a lack of performance. Teachers should administer reinforcers contingent upon high levels of performance. Although there are individual differences, high levels of performance tend to be synonymous with high degrees of effort. Reinforcing individuals for investing large amounts of physical or cognitive effort (i.e., for trying really hard), in combination with achievement, is capable of teaching individuals to continue to perform well across tasks and situations (Eisenberger, 1992; Eisenberger & Cameron, 1996). This strategy will help to promote intrinsic motivation for academics as well as persistence in the face of adversity.

Third, choice-making opportunities have been shown to be easily incorporated into educational and intervention contexts with children with ASD (Koegel et al., 2003; Koegel et al., 1999). This can be accomplished in numerous ways. The present research demonstrated methods to introduce choice both between- and within-tasks. Children can also be given opportunities to choose the subject matter of which they will learn, how they will demonstrate their knowledge (paper, computer, blackboard), and/or by allowing them the opportunity to incorporate their unique interests into the subject of study. By increasing students' opportunities for autonomy, students may approach learning opportunities more readily, experience more opportunities to earn reinforcers, and ultimately maximize their potential for success.

Future Directions

The present set of studies has offered preliminary support for the assertion that when performance-based reward contingencies are administered in combination with enhanced opportunities for choice-making, children's intrinsic motivation can be increased. Because several of the analyses in the current research did not reach statistical significance, this line of research should be continued with larger samples and with participants recruited from multiple schools and intervention sites.

These studies tested merely two of the assumptions that have been forwarded as important variables that impact effects that rewards have on intrinsic motivation with children with ASD (i.e., performance-based rewards, choice). There are many other variables that impact how rewards are delivered (e.g., other contingencies, expected versus unexpected rewards) and other aspects of the interpersonal context (e.g., the imposition of deadlines, surveillance) that have yet to be evaluated. These additional characteristics of reward administration are all relevant in the education of children with ASD. Most school-aged children with ASD have, despite their young age, already experienced a long history of receiving rewards and reinforcers for behavior. This experience alone makes them a very different group than the typically developing individuals upon which this literature is based. Future research should evaluate how the diverse procedures that have already been identified as impacting intrinsic motivation would impact a group of children whose successful outcomes are dependent upon the receipt of thousands of reward administrations.

Another important consideration in the interpretation of future research on rewards and intrinsic motivation in children with ASD is the potential impact that characteristics of the disorder may exert over children's experience of the manipulations. Children with ASD struggle with social communication (American Psychiatric Association, 2000). For example, they tend to have great difficulty understanding non-literal speech and implied meaning. This is particularly germane as the context manipulations often used in the rewards and intrinsic motivation research tends to be very subtle (e.g., the use of 'should-related' statements to imply coercion). Children with ASD also have difficulty with relating socially to others. This may further impede their ability to detect subtle manipulations of autonomy-support. Deci and Ryan (1985) maintain that intrinsic motivation is based on an innate need for competence and self-determination. If it is the case that the intrinsic motivation of children with ASD is not impacted as these authors predicted, it casts doubt not only on the procedures used to elicit an undermining effect, but also on the innate nature of their theory. Behavioral theories assert that the reinforcing aspects of culturally significant behaviors such as choice making are socially conditioned. Thus, it would not be unreasonable to find that children with ASD are less susceptible to the effects of context manipulations because of the inherent difficulties with social communication.

Future research into the diverse ways that extrinsic rewards impact intrinsic motivation has the potential to add clarity to the process by which rewards impact intrinsic motivation in children with ASD. As well, future research along the proposed lines may also contribute to greater understanding of the uses and limits of the current theoretical models.

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Appendix A

Participants' Letter of Informed Consent - Edmonton

An invitation is being extended to you to have your child participate in a research project. The University of Alberta supports the practice of protection for human subjects participating in research. The following information is provided so that you can decide whether you wish to participate in the present study.

The research is being conducted by Shane Lynch, a graduate student in the department of Educational Psychology. Drs. Judy Cameron and David Pierce are supervisors of this research study. This study is being used to guide the development of a larger research project conducted as part of my doctoral dissertation research. The findings from this research may be published in a research journal. Data for all uses will be handled in compliance with the University of Alberta Standards for the Protection of Human Research Participants.

In this study, your child will be asked to complete a variety of academic activities (i.e., math and language arts), for which each correct answer will earn him or her a token that is exchangeable for a reward. The purpose of the research is to determine whether children will be more intrinsically motivated and demonstrate better performance in educational contexts that give them choice and self-direction versus traditional educational contexts that are adult directed with no opportunities for choice. All sessions will be video recorded, and all information collected will be kept confidential.

Each child will participate in 8-10 sessions, each lasting approximately 20 minutes. The experimenter will come to your home, or a location that best suits your needs and will bring all necessary materials. The sessions are videotaped, and videos are individually examined to ensure that the experiment was performed properly. Videotapes are destroyed once they have been stored for the minimum 5-year requirement.

Research Assistants will comply with the University of Alberta Standards for the Protection of Human Research Participants. This package can be found by going to http://www.ualberta.ca/~unisecr/policy/sec66.html. Other research personnel will sign confidentiality agreements.

There are certain rights that you have as a research participant. You have the right:

- To not participate
- To withdraw at any time without prejudice
- To continuing and meaningful opportunities for deciding whether or not to continue to participate
- To opt out without penalty
- To have any collected data regarding your child withdrawn from the data base and not included in the study
- To privacy, anonymity, and confidentiality
- To safeguards for security of data (data are to be kept for a minimum of 5 years following completion of research)
- To disclosure of the presence of any apparent or actual conflict of interest on the part of the researcher

Your child's participation is strictly voluntary. Do not hesitate to ask any questions about the study. Be assured that your child's name will not be associated with the research findings. If you have any concerns, questions, or complaints you may contact Dr. Judy Cameron through email at judy.cameron@ualberta.ca. Dr. David Pierce may be reached through email at dpierce@ualberta.ca.

If you volunteer to participate in the study, please sign below. I greatly appreciate your cooperation with this project.

Name of Participant:
____

Name of Parent/Guardian:
____

Signature of Parent/Guardian:
____

Date:
____

The plan for this study has been reviewed for its adherence to ethical guidelines and approved by the Faculties of Education, Extension, and Augustana Research Ethics Board (EEA REB) at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Chair of the EEA REB c/o Betty jo Werthmann at (780) 492-3751.

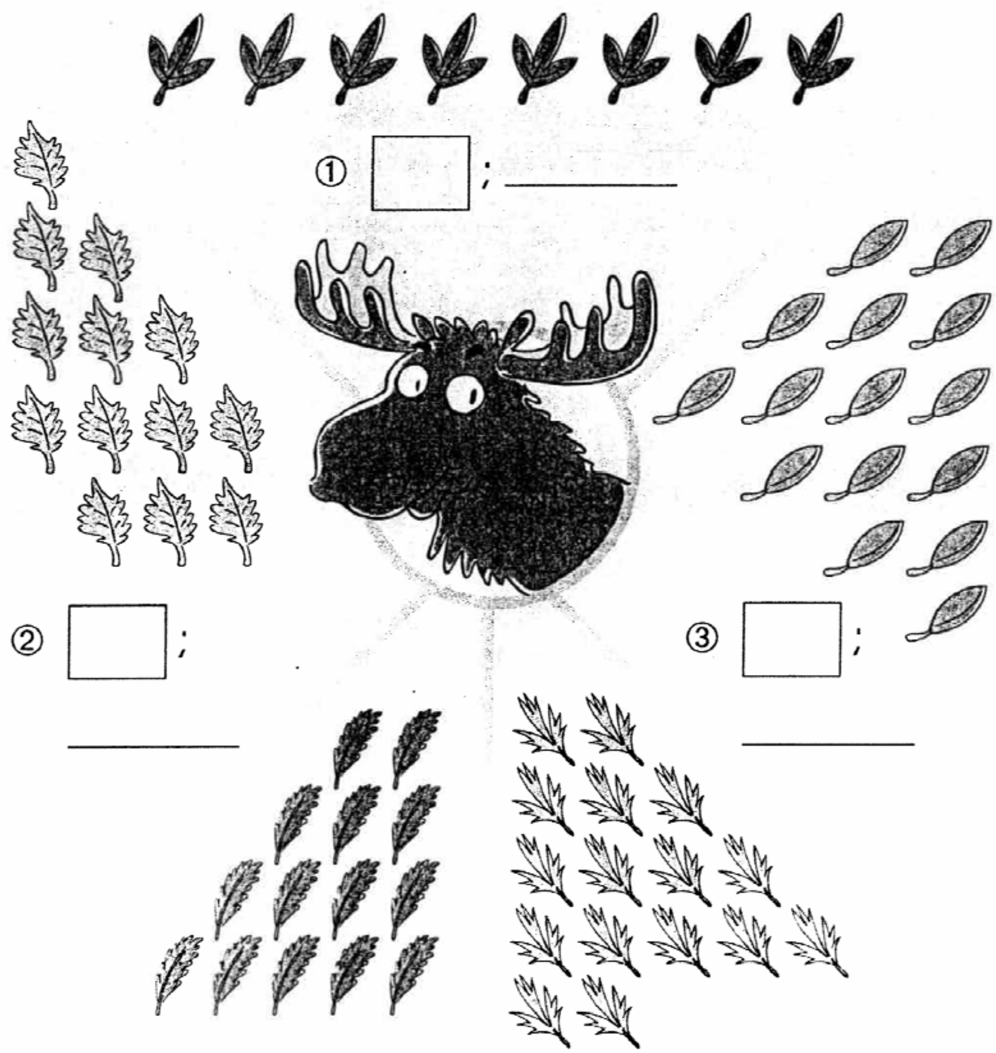
Appendix B

4 Math

Marvin the Moose –

Numbers 1 to 20

Help Marvin count and write the numbers. Then write the numbers in words.



① ☐ ; ________

② ☐ ; ________

③ ☐ ; ________

④ ☐ ; ________

⑤ ☐ ; ________

Which Letters Are Missing?

Fill in the blanks with the missing letters of the alphabet. Write both the uppercase and lowercase letter.

___ ___ **Bb** ___ ___ ___ ___ **Ee**

___ ___ **Gg** **Hh** ___ ___ **Jj** **Kk**

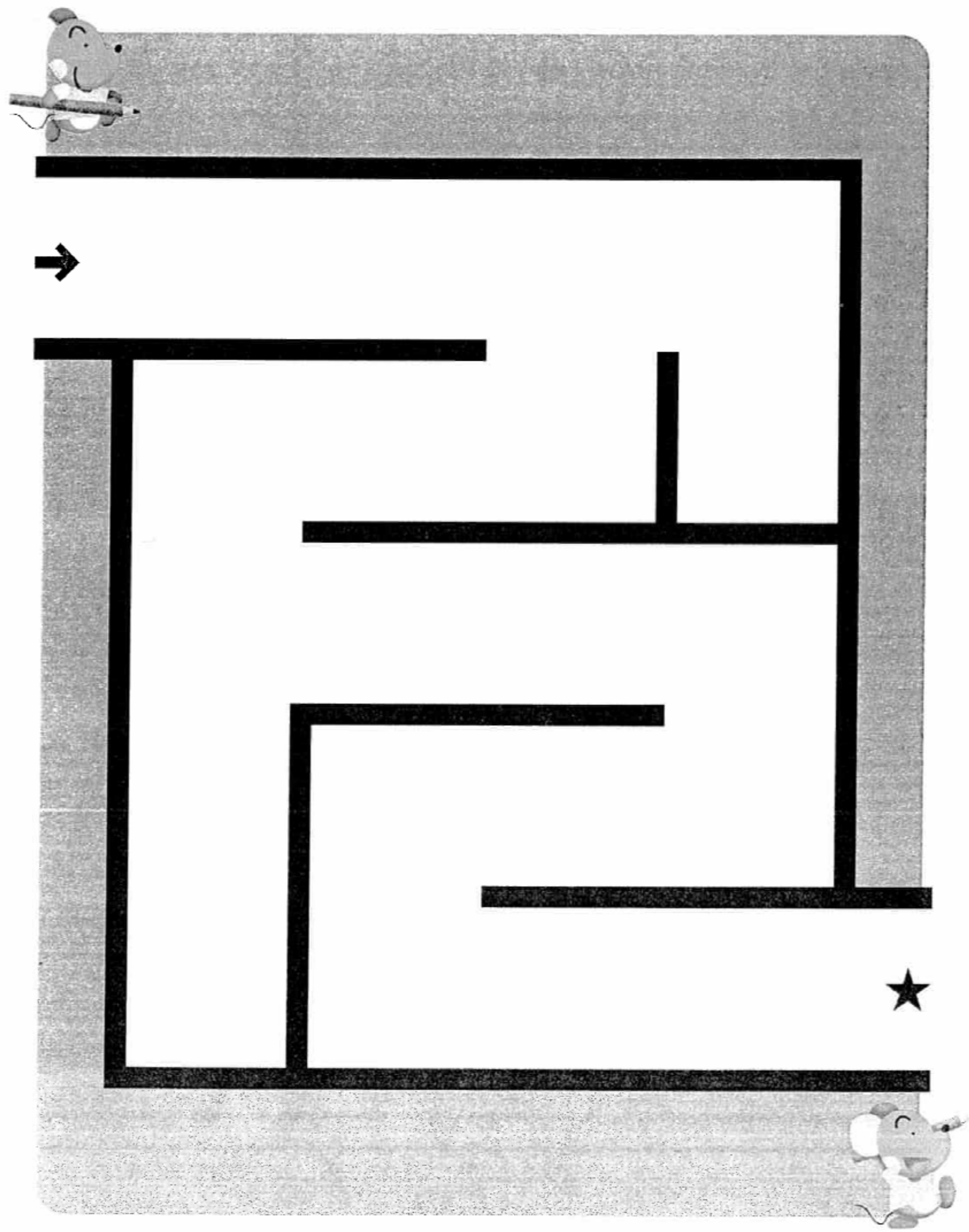
Ll ___ ___ ___ ___ ___ ___ **Pp**

Qq **Rr** ___ ___ **Tt** **Uu**

___ ___ **Ww** ___ ___ ___ ___ **Zz**

Appendix C

Draw a line from the arrow (➔) to the star (★) by following the path.

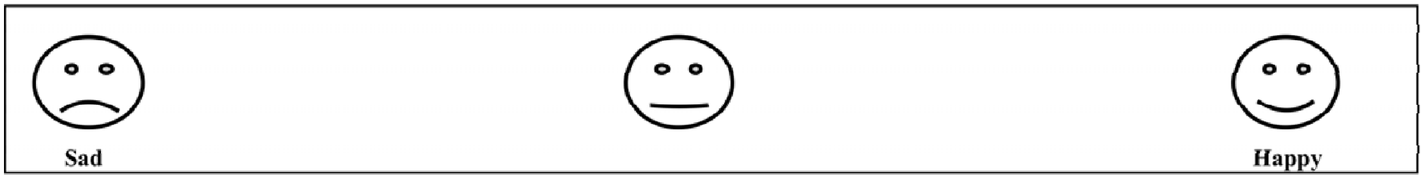


Appendix D

Modifie Children's Academic Intrinsic Motivation Inventory

Name: Condition/Session: Date: Time:

Please circle the number under the face that best describes how you feel about the activity.



1. **Did you like this activity?**

1	2	3	4	5	6	7
No! Not at all			A little bit			**Yes!** Very much

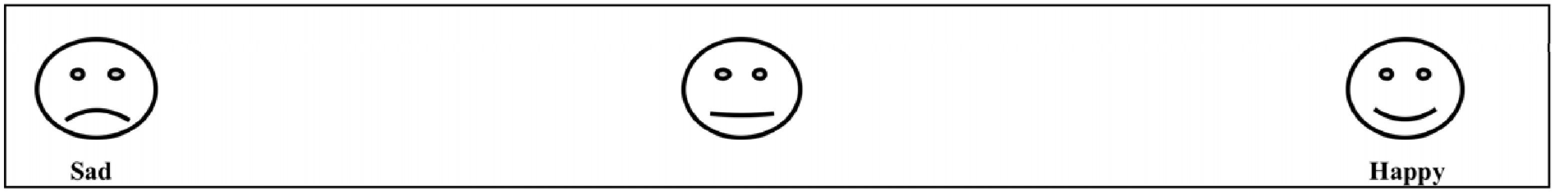
2. **Are you good at this activity?**

1	2	3	4	5	6	7
No! Not at all			A little bit			**Yes!** Very much

3. **Did you try really hard?**

1	2	3	4	5	6	7
No! Not at all			A little bit			**Yes!** Very much

Please circle the number under the face that best describes how you feel about the activity.



4. **Was the activity fun?**

1	2	3	4	5	6	7
No! Not at all			A little bit			**Yes!** Very much

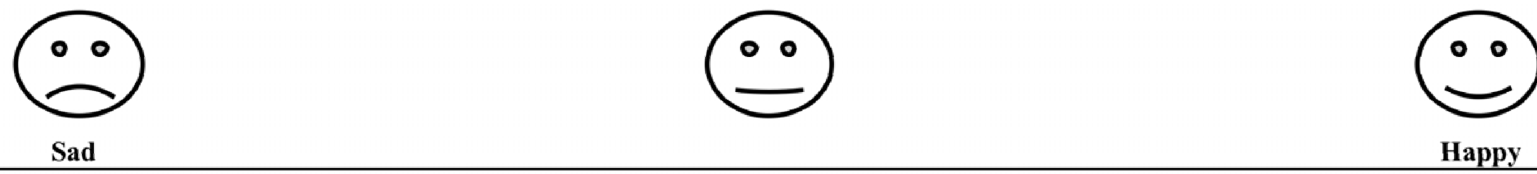
5. **Did you feel nervous or scared doing the activity?**

1	2	3	4	5	6	7
No! Not at all			A little bit			**Yes!** Very much

6. **Did you want to do this activity?**

1	2	3	4	5	6	7
No! Not at all			A little bit			**Yes!** Very much

Please circle the number under the face that best describes how you feel about the activity.



7. **Do you think the activity is important?**

1	2	3	4	5	6	7
No! Not at all			A little bit			**Yes!** Very much

8. **Do you want to do this activity again?**

1	2	3	4	5	6	7
No! Not at all			A little bit			**Yes!** Very much

9. **Did you like earning the tokens?**

1	2	3	4	5	6	7
No! Not at all			A little bit			**Yes!** Very much

Appendix E

Participants' Letter of Informed Consent – Guiding Hands School

An invitation is being extended to you to have your child participate in a research project. The University of Alberta supports the practice of protection for human subjects participating in research. The following information is provided so that you can decide whether you wish to participate in the present study.

The research is being conducted by Shane Lynch, a graduate student in the department of Educational Psychology. Drs. Judy Cameron and David Pierce are supervisors of this research study. This study is being used to guide the development of a larger research project conducted as part of my doctoral dissertation research. The findings from this research may be published in a research journal. Data for all uses will be handled in compliance with the University of Alberta Standards for the Protection of Human Research Participants.

In this study, your child will be asked to complete a variety of academic activities (i.e., math and language arts), for which each correct answer will earn him or her a token that is exchangeable for a reward. The purpose of the research is to determine whether children will be more intrinsically motivated and demonstrate better performance in educational contexts that give them choice and self-direction versus traditional educational contexts that are adult directed with no opportunities for choice. All information collected will be kept confidential.

Each child will participate in a series of sessions, each lasting no more than 30 minutes each day. The project will be conducted at **Guiding Hands School** and the experimenter will provide all necessary materials. The sessions are videotaped, and videos are individually examined to ensure that the experiment was performed properly. Videotapes are destroyed once they have been stored for the minimum 5-year requirement.

Research Assistants will comply with the University of Alberta Standards for the Protection of Human Research Participants. This package can be found by going to http://www.ualberta.ca/~unisecr/policy/sec66.html. Other research personnel will sign confidentiality agreements.

There are certain rights that you have as a research participant. You have the right:

- To not participate
- To withdraw at any time without prejudice
- To continuing and meaningful opportunities for deciding whether or not to continue to participate
- To opt out without penalty
- To have any collected data regarding your child withdrawn from the data base and not included in the study
- To privacy, anonymity, and confidentiality
- To safeguards for security of data (data are to be kept for a minimum of 5 years following completion of research)
- To disclosure of the presence of any apparent or actual conflict of interest on the part of the researcher

Your child's participation is strictly voluntary. Do not hesitate to ask any questions about the study. Be assured that your child's name will not be associated with the research findings. If you have any concerns, questions, or complaints you may contact me, Shane, through email at shane.lynch@ualberta.ca or by phone 780-983-7627. You may also contact either of my Supervisors. Dr. Judy Cameron through email at judy.cameron@ualberta.ca. Dr. David Pierce may be reached through email at dpierce@ualberta.ca.

If you volunteer to participate in the study, please sign below. I greatly appreciate your cooperation with this project.

Name of Participant:
____

Name of Parent/Guardian:
____

Signature of Parent/Guardian:
____

Date:
____

The plan for this study has been reviewed for its adherence to ethical guidelines and approved by the Faculties of Education, Extension, and Augustana Research Ethics Board (EEA REB) at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Chair of the EEA REB c/o Betty jo Werthmann at (780) 492-3751.

A second copy of this consent for will be provided to you. One is for you to keep for your records, the second, signed, copy will be kept by the researcher.

Appendix F

Treatment Fidelity Form

Child:
Session:
Notes:

	Item	Correct (+) Incorrect (-)
Initial set-up		
1.	Has materials prepared prior to bringing child into the room.	
2.	Asks child to sit immediately after entering the room.	
3.	Avoids small talk, and begins session within 5-7 seconds.	
Reward contingency statement		
4.	• "Today, if you try really hard, you can earn tokens. Each token will get you 1 minute of time with your reward (names reward). "	
No-reward statement		
5.	• "Today, there are no tokens available and no activity (labels the reward). You can do the math (or LA) worksheets or you can look at the book. You can do whatever you like for five minutes."	
Autonomy-supportive context manipulation		
6.	• "Which do you want to work on?" (Choice of task)	
7.	• "What do you want to use?" (Choice of implement)	
8.	• "Where do you want to work?" (Choice of location)	
9.	• "You can begin whenever you like" (Choice of when to start)	
Traditional context manipulation		
10.	• "Today, these are the math (or LA) worksheets you must do."	
11.	• "Begin." (Starts timer)	
End of session		
12.	Reward contingency • "Let's see what you've worked on." (Scores worksheet)	
13.	• Delivers tokens quickly	
14.	• Provides immediate access to rewards	
15.	• Uses timer to ensure time with reward	
Prompting		
16.	During experimental manipulations • Restates the reward contingency ["Today, if you try really hard, you can earn tokens. Each token will get you 1 minute of time with your reward (names reward)."].	
17.	During baseline, withdrawal, and follow-up sessions • Restates the S^D ["Today there are no tokens and no activity (labels the reward). You can do the math (or LA, or Math or LA, depending on the phase). You can do whatever you like for five minutes."].	
Escorts child back to class		
18.	• Brings child back to class in a timely manner	
	Total plus signs =	
	Total plus signs + negative signs =	
	Final score =	