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## A comparison of acquisition of a behavior chain using social, edible and no reinforcers

Deanna Marie Giannini  
*Northeastern University*

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A Comparison of Acquisition of a Behavior Chain Using Social, Edible and No  
Reinforcers

**A Thesis Presented**

**by**

Deanna M. Giannini

Department of Counseling and Applied Educational Psychology

In partial fulfillment of the requirements

for the degree of

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Author: Deanna Marie Giannini

Department: Counseling and Applied Educational Psychology

Approved for Thesis Requirements of Master of Science Degree

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William H. Ahearn

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Julie S. Weiss

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Sue Langer

**A Comparison of Acquisition of a Behavior Chain Using Social, Edible and No  
Reinforcers**

By

Deanna Marie Giannini

B.A., Bradley University

Submitted in partial fulfillment of the requirements for the degree  
of Master of Science in Applied Behavior Analysis  
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## Abstract

There has been basic research conducted on chains and task analyses, however, no studies have compared the effects of different consequences on the acquisition of a behavior chain. The purpose of this study was to compare the acquisition of a behavior chain taught with various consequence conditions. These conditions consisted of either edible or social consequences or no reinforcer following responding. Three individuals diagnosed with an autism spectrum disorder participated. Three 15-step play constructs were taught using an alternating treatments design and the dependent measures were the number of trials and sessions to acquisition and the number of errors in each consequence condition. Sessions in each condition consisted of one probe trial followed by 10 training trials with the behavior chain. Most-to-least prompting with a constant delay was utilized for all conditions. Results showed that all reinforcement procedures were effective while the efficiency varied across learners. For one of the three individuals, acquisition of the behavior chain was demonstrated to be quicker in the edible reinforcer condition. Findings generalized across novel teachers and settings. IOA data were collected in at least 34% of sessions and averaged 97%. Procedural integrity data were taken in at least 34% of sessions and averaged 95%. Intrinsic reinforcers and negative reinforcers may have affected the acquisition of the chains since all three individuals acquired the chain in the edible reinforcer, social reinforcer, and the no reinforcer conditions.

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## A Comparison of Acquisition of a Behavior Chain Using Social, Edible and No Reinforcers

Reinforcement plays a pivotal role in the acquisition of a behavior chain. It is important to assess which type of reinforcer is most effective in increasing correct responding. In working with individuals with an autism spectrum disorder, extrinsic motivation is often necessary. Therefore, assessment of effective reinforcers is helpful in designing instructional programming. This is particularly important because preferences are idiosyncratic. For example, for one individual social consequences in the form of verbal praise and physical attention may be less reinforcing than a preferred edible. However, for another individual, verbal praise and physical attention may be effective reinforcers. Also, social consequences are more typical in educational environments. In efforts to increase the acquisition of a behavior chain, it is imperative that the type of reinforcer used is indeed reinforcing the correct response; otherwise the behavior chain may not be acquired.

There are two classes of reinforcers- intrinsic and extrinsic. Intrinsic reinforcers are considered inherently reinforcing independent of other variables (Skinner, 1953). For example, it may be rewarding for one to complete a puzzle with no other apparent reward besides the activity itself. Extrinsic reinforcers are not considered inherent (Skinner, 1953). These reinforcers come from outside one's self. An example is money or preferred edibles as a reward contingent upon a behavior. In working with individuals with autism spectrum disorder and related disorders, it is important to assess whether or not intrinsic reinforcers play a role in the acquisition of a behavior chain. This will allow for the most effective types of reinforcers to be presented and provide information on

which activities are inherently motivating to an individual. For example, an individual may complete a chain of behaviors, such as putting a puzzle together, because the activity itself is motivating. Negative reinforcement may also play a role in which the individual may complete the puzzle to remove the initial task placed on them to complete the sequence of behaviors. Another possibility is that the individual may only complete or more quickly complete the chain of behaviors for an extrinsic reinforcer such as a preferred candy. It is important to assess which of these types of reinforcers is the most effective and whether or not intrinsic reinforcers play a role in the acquisition of a chain of behaviors.

Chaining is the linking together of several responses to achieve a more complex behavior (Cooper, Heron, and Heward, 1987). A task analysis is a method in which complex behaviors are broken down into smaller elements and steps (Libby, Weiss, Bancroft, and Ahearn 2008). Chaining and task analyses are significant because the acquisition of daily living skills and behavior chains play an important role in individuals with disabilities. Task analyses involve prompting and fading procedures that guide the individual to complete the task independently. Task analyses consist of many components. Much research has focused on the uses of task analyses, the type of chaining methods, contexts in which chaining methods are used, and the prompting procedures involved (Cooper et al., 1987; Libby et al., 2008).

Different types of chains are explained by Cooper, Heron and Heward (1987) and include forward, backward, and total task. In forward chaining, reinforcement is delivered when the predetermined criterion for the first behavior in the sequence is achieved. Each succeeding step requires the cumulative practice of all previous steps in

the proper order. A criterion is prescribed for decreasing steps when the individual makes errors. In backward chaining, all behaviors identified in the task analysis are first completed by the trainer except for the final behavior in the chain. The last step is trained in the task analysis. All other steps are either performed by the instructor or manually guided. In total task chaining, the individual is trained on every step of the task analysis during every session and a prompt is given on every step unless it is independent.

Horner and Keilitz (1975) examined the importance of using task analyses. The authors discussed the need for dental hygiene among individuals with disabilities. In order to teach these skills, they developed a 15-step tooth-brushing task analysis for individuals with mental retardation. All eight of their participants showed improvements in tooth-brushing. The study showed that training a chain of behaviors can improve self-care skills. They proposed a within-subject design to evaluate the tooth-brushing program which consisted of a task analysis and systematic training strategies. During baseline, "I want you to brush your teeth by yourself" was stated to the individual. During training, four types of procedures occurred: no help, verbal instruction, demonstration and verbal instruction, and physical guidance and instruction. The first group of four individuals produced high performance levels and the second group, the replication group, also produced high performance levels. Most of the participants achieved a high criterion performance and the other participants made gains from their baseline performance.

A comparison between forward and backward procedures for the acquisition of response chains in humans was examined in a study conducted by Weiss (1978). His participants included ten first-year students from a university all of whom had no

previous knowledge on response chaining. They were split into two groups. The forward chain first group was exposed to learning using a forward chain, backward chain, forward chain, and then a backward chain. The second group began with a backward chain and ended with a forward chain. The response was remembering which buttons go with which symbols and the participants were instructed to make responses without any mistakes until they made up to six responses with no errors. The forward chain procedure was more effective in the acquisition of the six-step response chain.

Other research has compared the effects of the different types of chains. Walls, Zane, and Ellis (1981) examined the effects of total task, forward and backward chaining methods in teaching adults construction-assembly tasks. It was the authors' purpose to evaluate the effects of forward, backward and whole task chaining. They developed a task analysis of a chain of behaviors for assembling a bicycle brake, a meat grinder, and a carburetor using these different types of chaining methods. They determined that more incorrect responses were made by the individuals during the whole task chaining method than the forward and backward chaining methods. Undifferentiated results were demonstrated for both of the other chaining procedures.

Some research has focused on other factors that may affect skill acquisition including the context of the approach and naturalistic settings. Kayser, Billingsley and Neel (1986) compared total task, single-trial method versus backward chaining, and multiple trials in traditional instructional approaches versus in-context approaches. The authors explained that training in-context could potentially facilitate skill generalization as well as acquisition. They compared the effects of an instructional approach using more traditional modes of task and trial sequencing. According to Kayser et al., the

independent performance of individual task steps indicated that total task, single-trial instructional strategy produced the most optimal results for three of eight students.

According to Wall and Gast (1999) the focus of most existing literature in the areas of observational and incidental learning are limited to mostly discrete skills, school-age individuals, and classroom. In order to facilitate the acquisition of incidental information and observational learning by adolescents with moderate intellectual disabilities, Wall and Gast used instructional arrangements presented during community-based or simulated instruction for a chained response skill. Their research focused on the acquisition of a vocational response-chain skill, incidental information, and observational learning of incidental information during constant time-delay instruction. Constant-time delay instruction was effective in teaching each of the six individuals the target grocery-bagging skill.

Along with the type of chain and the context in which it is used, the type of prompting procedure is important to assess. Many studies have examined and compared prompting procedures. However, correct responding must eventually respond to natural stimuli and not only to prompts. According to Demchak (1990), the goal of instruction is to have the individual respond to natural stimuli rather than response prompts. This is accomplished by fading the original prompt to a less restrictive prompt until the person is able to respond to the natural stimuli. Four methods for systematically fading response prompts include: increasing assistance, decreasing assistance, graduated guidance, and time delay.

Demchak (1990) explains that fading prompts is necessary in order for the response to occur independently. Increasing assistance (also known as least-to-most

prompts) is comprised of a series of prompts that move from lesser to greater degrees of assistance. Decreasing assistance (most-to-least prompts) progresses from greater degrees to lesser degrees of assistance. Graduated guidance begins with the amount of assistance necessary for the individual to complete the task correctly, however the amount of assistance provided can vary within the trial instead of across successive trials. Time-delay fades prompts by increasing the amount of time between the naturally occurring stimuli and the prompt. Snell and Gast (1981) explain that in constant time-delay, the delay interval level is selected and then blocks of trials are presented at that level during the course of training.

Demchak (1990) compared the following response prompting and fading methods: 1) comparisons of increasing assistance and decreasing assistance, 2) comparisons of increasing assistance and progressive or constant time delay, 3), comparisons of constant time delay and progressive time delay and, 4) miscellaneous comparisons. Demchak explained that different response prompting and fading methods are used given certain conditions, skills, or students. For example, if the focus of instruction is the acquisition of a response, then decreasing assistance is the most efficient method. However, if instruction is focusing on fluency, then increasing assistance is the most efficient method. Time delay is more efficient than increasing assistance, and constant time delay and increasing assistance are equally effective for teaching chained responses.

Cuvo, Leaf, and Borakove (1978) taught janitorial skills to individuals with mental retardation and examined the acquisition, generalization, and maintenance of these skills. According to the authors a task analysis is advantageous because it identifies

prerequisite responses required for completing the task, objectives of training, and a sequence of instruction. A task analysis also clearly specifies correct responses which facilitates their reliable scoring. There are few studies on research validating instructional methods for janitorial skills. According to Cuvo et al., their experimental procedures using intrusive prompt sequences, occasioned rapid acquisition, generalization, and maintenance of performance. The essential feature of their procedure was the prompt sequence. These results replicate and extend past findings which demonstrate the combined effectiveness of a task analysis, sequence of prompts, and response consequences to train vocational skills to individuals with mental retardation.

A comparison of prompt sequences was also conducted by Glendenning, Adams, and Sternberg (1983). The authors note that there is limited research examining little the superiority of one prompt sequence over other prompt sequences. Therefore, in their study, the authors analyzed which of three prompt sequences was the best for instruction. The study included 12 individuals with mental retardation trained using a 48-step string-tying task analysis. The first sequence of prompts used included: verbal cue, gesture, model, and full physical assistance. The second sequence consisted of: verbal cue and full physical assistance, verbal cue and light physical assistance, verbal cue and gesture, and verbal cue. The third sequence included: full physical assistance, moderate physical assistance, light physical assistance, and gesture. Different effects resulted from the sequences. There was a difference in direction of improvement of self-initiated responses between the first sequence and the other two sequences. The results are significant because teachers typically use prompts with their students in efforts to increase independence in correct responding. These results found by Glendenning et al., support

this concept because the training provided individuals with the ability to demonstrate behavior independently.

Day (1987) compared two prompting procedures; an antecedent procedure and a consequent procedure. Day also examined the effects of the two prompting procedures on the acquisition of tasks. In the antecedent procedure, the trainer used an errorless model in which the trainer prompted the learner prior to the individual's response and gradually faded the prompt on subsequent trials. In the consequent procedure, the learner was prompted after an error response and the prompt was gradually faded on subsequent corrections. The results showed that greater gains were made with the antecedent prompting procedure compared to the consequent prompting procedure.

Sisson, Kilwein, and Van Hasselt (1988) conducted a graduated guidance procedure for teaching dressing skills to children with disabilities. According to the authors, errors were minimized while children acquired greater independence in dressing as a result of the graduated fading of guidance. There was a prompt hierarchy that included less assistance during the dressing actions. The training approach was successful in teaching independent dressing skills to individuals with disabilities.

Walls, Crist, Sienicki, and Grant (1981) examined the effects of three prompting sequences on the acquisition of independent living skills with individuals with mental retardation to determine how the various commonly used procedures affected the acquisition of these skills in terms of time to mastery and number of errors. During the task trainings- shirt folding, table setting, and use of a cassette tape recorder, and a back-up task of using a pocket calculator- three prompting sequences were used. These sequences included: a least-to-most restrictive sequence (VMP), a most-to-least

restrictive sequence (PMV), and a physical guidance fading procedure (full, partial, slight- FPS). The results showed that the individuals with higher levels of aptitude made fewer errors and took less time to master the tasks; however, the authors found no differences attributed to prompting sequences. The authors note that different prompting sequences may emerge and differences among sequences may become more evident with further research.

Libby, Weiss, Bancroft and Ahearn (2008) used edibles as reinforcers in a comparison between most-to-least (MTL) and least-to-most (LTM) prompting on the acquisition of solitary play skills. Forward chaining was used in the comparison between MTL and LTM. Then MTL and LTM with a 2-second delay before prompting was used and the authors found in all three participants that MTL with the delay was similar in efficiency as LTM in producing acquisition yet produced fewer errors. The edibles used in this study functioned as effective reinforcers for the acquisition of the chains for the solitary play skills.

Even though little research has focused on establishing operations in task analyses, another important element in the acquisition of a chain of behaviors is the effects of reinforcement and extinction. Kuhn, Vorndran, Lerman, and Addison (2006) conducted a study analyzing factors that affect responding in a two-response chain in children with developmental disabilities. These authors explain that few studies have directly examined how behavior chains become established or disrupted in applied settings. They reviewed a few studies that examined the effects of extinction and disruptions of simple chains. One important finding included that one or more members of a behavior chain may be inadvertently extinguished if caregivers begin to withhold

reinforcement for the terminal response even though earlier responses in the chain continue to produce conditioned reinforcers. Therefore, the authors used a two-response chain to evaluate the procedures extinction, satiation, and unchaining. Using a behavior chain that consisted of a response (signing “open”) that resulted in a small box opening and a food reinforcer being displayed, the presence of that food reinforcer occasioning another response (signing “eat”) and resulting in eating a preferred food item, led the authors to predict that both members of the chain would decrease under the satiation and extinction procedures but that one response might decrease more rapidly. They also expected that only the first response would decrease under the unchaining procedure.

The results demonstrated that satiation, extinction, and unchaining were associated with decreases in one or both members of a two-response behavior chain in 9 out of the 10 cases. The unchaining procedure did take longer to disrupt the chain and therefore caused for unclear implications. A behavior chain may be exposed to extinction when the terminal response cannot be reinforced. Responses would be expected to decrease if the individual no longer received access to the reinforcer, extinction, and/or began to obtain free access to the reinforcer and become satiated.

Another study assessed the effects of a specific type of reinforcer used to train a chain of behaviors. Natof and Romanczyk (2008) conducted a study to determine if children with autism spectrum disorder generally demonstrate better task performance with high teacher attention or if some children with autism spectrum disorder demonstrate better task performance with low teacher attention. High teacher attention consisted of the teacher sitting face-to-face with the participant, instructing the student to make eye contact, gave the participant high fives and praise with emotive facial

expressions and an uplifting voice for correct responses, and initiated conversations between tasks. The low teacher attention condition consisted of the teacher sitting slightly behind the participant, instructing the participant to orient toward the materials, gave performance feedback in a neutral tone without physical contact, and refrained from initiating conversation. The participants were instructed to match in each condition. Out of the 12 participants, two performed better in the high teacher attention condition and two participants performed better in the low teacher attention condition. Differential performance was confirmed for only one participant under high teacher attention and one participant under low teacher attention. When teachers were asked to judge participant performance, they stated that all students performed better with high teacher attention.

Reinforcement is an important element in training a chain of behaviors. Teaching chains of behavior requires the presentation of reinforcers. The completion of a step is the discriminative stimulus for the next step, and reinforcers are delivered contingent upon completion at the final step. Therefore, each step of the chain functions as a conditioned reinforcer for a preferred edible, praise, and/or perhaps the removal of the chain. While there is basic research on chains and task analyses, there is little applied research and there are areas for concern that must be examined. Negative reinforcers could be involved in chains because the most common prompting hierarchy used is most-to-least prompts. This is the most intrusive prompting procedure requiring physically manipulating the student which may be aversive. Negative reinforcement may be demonstrated also because the quicker the acquisition of the chain, the quicker the removal of the chain. Therefore, the participant may emit avoidance/escape behavior.

Some chains of behavior may have intrinsic reinforcers embedded within them. For example, after pouring a glass of juice or making a sandwich, the participant is able to consume the final product at the final step of the chain. Other chains of behavior may involve an activity that the individual prefers to engage in. Another example is if the individual has a history of being presented with an instruction, following the instruction, and reinforcers presented contingent on this compliant behavior, they may generalize this contingency when presented with other instructions.

Reinforcement plays an important role in the acquisition of a behavior chain. It is important to assess which type of reinforcer to use: preferred edible or tangible item, social reinforcers or no reinforcers. Much research has focused on the uses of task analyses, the type of chaining methods, contexts in which chaining methods are used, and the prompting procedures involved; however, little research has been conducted on comparisons of the effects that the type of reinforcers used have on skill acquisition. The present study assesses and compares the effects of edible reinforcers, social reinforcers, and no reinforcers on the acquisition of a behavior chain. The results can demonstrate the importance of individualizing reinforcers and determine whether different types of reinforcers affect the acquisition of a chain of behaviors. They may also demonstrate acquisition of a chain of behaviors with no contingent reinforcers.

## Method

### *Participants*

Three individuals who attended a residential program for individuals with autism and related disabilities participated in this study. Ian was a 13-year-old male with a diagnosis of an autism spectrum disorder. He communicated using vocalizations in the

form of full sentences. He could follow directions and had a history of task analyses for a multitude of skills including vocational, leisure, and daily hygiene routines.

Evan was a 17-year-old male with a diagnosis of an autism spectrum disorder. He communicated using a picture exchange communication system and with simple manual signs and vocal approximations. He could follow one- and two-step directives and he had a history of using task analyses for vocational, leisure and daily hygiene routines.

Ben was a 12-year-old male with a diagnosis of an autism spectrum disorder. He communicated using vocalizations in the form of full sentences with prompting. He could follow one- and two-step directives and he had a history of using task analyses for skills including vocational, leisure and daily hygiene routines.

All three participants had the prerequisite skill of attaching Legos<sup>®</sup> together.

#### *Settings and Materials*

Sessions were conducted either at the individuals' school in a quiet work room and/or at the individuals' residences in a quiet work room consisting of a table and chairs.

The stimuli used included: Lego<sup>®</sup> blocks, data sheets, a pen, and edibles. The Lego<sup>®</sup> constructs included: one green baseboard, one red baseboard, one yellow baseboard, and 14 Lego<sup>®</sup> blocks per baseboard. The Lego<sup>®</sup> task analysis consisted of 15 steps with the discriminative cue "Let's build Legos<sup>®</sup>."

Sessions were conducted two to three times per day, four days a week, and no more than two sessions an hour were conducted. Ten trials were conducted per session with breaks between sessions.

#### *Dependent Variables*

The number of independent steps per session, the number of sessions and trials to mastery, and the number of errors per condition were measured. Correct responding consisted of placing the pieces in the correct sequence and direction at the designated prompt for the training step. Generalization of responding across novel experimenters and settings for each condition was also measured.

#### *Independent variables*

*Contingent edible reinforcer condition.* Contingent upon completion of the training step with the designated prompt and a 2-s delay, an edible was immediately delivered.

*Contingent social reinforcer condition.* Contingent upon completion of the training step with the designated prompt and a 2-s delay, a social reinforcer was immediately delivered.

*No reinforcer condition.* After completion of the training step with the designated prompt and a 2-s delay, no reinforcer was immediately delivered.

#### *Response Measurement and Interobserver Agreement*

The frequency of the number of independent steps of the task analysis per session, the number of sessions and trials to mastery of the task analysis, and the number of errors per condition were measured. Sessions for all conditions and generality assessments were videotaped and data were collected at the time of the session for each condition using a task analysis data sheet. Sessions for the reinforcer assessments were videotaped and data were recorded at a later time. Data were recorded for the task analysis by the total number of independent steps per session and the trials to mastery for each condition for each individual.

Interobserver agreement (IOA) data were collected during at least 33% of sessions during reinforcer assessments and 34% during experimental conditions. A second trained observer independently collected data using the same methods as the primary observer. IOA was determined by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%.

Table 1 depicts IOA during the social reinforcer assessments for Evan, Ian, and Ben. IOA was conducted for 33% of sessions. Interobserver agreement was 100%, 100%, and 95%, respectively. Table 2 depicts IOA during the edible reinforcer assessments for Evan, Ian, and Ben. IOA was collected for 33% of sessions. Interobserver agreement was 100%, 100%, and 98%, respectively. Table 3 depicts IOA during all conditions for all participants. For Evan, IOA data were collected during 40% of sessions across conditions. Across the different conditions, IOA was 96%. For Ian, IOA data were collected for 39% of sessions, and there was 100% agreement. For Ben, IOA data were collected during 34% of sessions during conditions and there was 96% agreement. Procedural integrity data were taken in at least 34% of sessions and averaged 95%.

### Procedure

*Edible reinforcer assessment.* Edible reinforcers were presented contingent upon correct responses on the training step of the task analysis. These reinforcers were determined in reinforcer assessments. Three edible items were selected either based on teacher observations, selected by the individual and/or by results from previous preference assessments based on Fisher, Piazza, Bowman, Hagopian, Owens, and Slevin (1992). The highest preferred edibles were then used in reinforcer assessments based on

Smaby, MacDonald, Ahearn, and Dube (2008). The target response was placing a token in the experimenter's hand. The sessions were five minutes long or until one minute of no responding occurred. The experimenter rotated sessions starting with an extinction component then an edible component. For extinction, the experimenter stated "red" and manually guided the participant to place tokens into the experimenter's hand five times. No reinforcer was presented contingent upon placing a token in the experimenter's hand. Then the experimenter stated "red" again, and held out a hand. No reinforcer was presented contingent upon placing a token in the experimenter's hand. Three different types of preferred edibles were used for the other conditions. For each edible component, the experimenter stated the name of the edible and manually guided the participant to place the token in the experimenter's hand five times, presented the edible contingent upon the response, then stated the edible again and placed their open hand out. Contingent upon token placement in the experimenter's hand, the edible was presented.

*Social reinforcer assessment.* Social consequences that functioned as reinforcers were presented contingent upon correct responses on the training step of the task analysis. These reinforcers were determined based on the results of the Smaby et al. (2008) analysis. The procedure was the same as previously described, except instead of edible items, social consequences were used. These consequences were chosen based on teacher observations and/or asking the individual which they would prefer. During extinction components, "red" was stated and the procedure previously described was conducted. For the social consequence components, three different types of attention were used for each individual (for example, clapping, high fives, and verbal praise). The experimenter stated, for example, "Clapping" and manually guided the participant to

place the token in the experimenter's hand five times, then clapped, then stated "Clapping" again and placed their open hand out. Contingent upon token placement in the experimenter's hand, clapping was presented. This was also conducted for the other two social consequences.

An alternating treatment design was used to compare the effects of three reinforcer conditions for training behavior chains. The task analysis used for training the chains of behavior included a most-to-least with a 2-s delay prompt procedure and forward chain. The criteria to fade the prompt were based on Libby, Weiss, Bancroft, and Ahearn (2008). An increase to the next prompt level followed two successful trials at the prescribed prompt on the training step. An increase to the next training step occurred if the participant successfully anticipated and completed the step independent of the prompt for two consecutive trials, or following two successful trials at independent. If an error occurred on the training step, the participant was manually guided to complete the step and no reinforcement was delivered. If two consecutive incorrect responses were made on the training step, an increase in prompt level was made. For errors on previously mastered steps, hand over hand manual guidance was used to prompt a correct response. If two consecutive errors were made on a previously mastered step, that step was retrained starting with hand over hand prompting.

*Baseline.* The experimenter stated, "Let's build Legos<sup>®</sup>". The individual was given the opportunity to build the constructs. No reinforcers were presented and no prompting or training was provided. The materials remained in front of the individual until they made an error building the construct or until 15 seconds of no responding elapsed.

*Contingent edible reinforcer condition.* The experimenter stated, “Let’s build Legos<sup>®</sup>”. The task analysis used for training included a most-to-least with a 2 s delay prompt procedure and forward chain. The criteria to fade the prompt were based on Libby et al. (2008); two consecutive incorrect responses indicated to increase the prompt to a more restrictive prompt. Contingent upon the individual completing the chain at the training step with the designated prompt, a preferred edible was delivered, and untrained steps were not completed to avoid observational learning. The experimenter removed the materials and then began the next trial.

*Contingent social reinforcer condition.* The experimenter stated, “Let’s build Legos<sup>®</sup>”. Contingent upon the individual completing the chain at the training step with the designated prompt, the social reinforcer was delivered, and the untrained steps were not completed. The experimenter removed the materials and then began the next trial.

*No contingent reinforcer condition.* The experimenter stated, “Let’s build Legos<sup>®</sup>”. The individual was not presented with either social reinforcers nor edible reinforcers for completing the chain at the training step with the designated prompt and the untrained steps were not completed by the experimenter. The experimenter removed the materials and then began the next trial.

*Generalization.* Mastery of a construct was met if the individual had independent responding on step 15 for two consecutive trials. The individual was tested for generalization of that construct in a different setting and with a novel experimenter. The individual met generalization by completing the construct independently two consecutive times.

## Results

Figure 1 depicts edible reinforcer assessments for Ian. Each condition consisted of two components: extinction components immediately followed by reinforcer components. During extinction components, Ian emitted 7 instances of responding for the first condition. In all other extinction components, responding decreased and eventually Ian did not respond during extinction components. Ian's highest preferred edibles were fruit slice candies, Reese's Pieces<sup>®</sup>, and Skittles<sup>®</sup>. Ian responded the most during the fruit slices components with 32, 31, and 38 instances of responding. During the Reese's Pieces<sup>®</sup> components, Ian emitted 6, 35, and 30 instances of responding. During the Skittles<sup>®</sup> components, Ian emitted 16, 27, and 30 instances of responding. Ian had high rates of responding in all conditions and he vocally requested Reese's Pieces<sup>®</sup> in all other conditions. Therefore, Ian was asked before beginning the experimental conditions, which candy he wanted to earn. He requested Reese's Pieces<sup>®</sup>.

Figure 2 depicts social reinforcer assessments for Ian. During extinction components, Ian only emitted 5 instances of responding for two out of the nine extinction components. During all other extinction components, Ian did not emit the target response. Ian's preferred social consequences included verbal praise, high five, and a pat on the back. Ian responded the most during the verbal praise components. In this component, the experimenter stated, "good job" after the target response was emitted. Ian emitted 37, 49, and 38 instances of responding in the experimenter's hand during the verbal praise component. During the high five components, Ian emitted 36, 20, and 29 instances of responding. During the pat on the back components, Ian emitted 12, 5 and 29 instances of responding.

Figure 3 depicts edible reinforcer assessments for Evan. Evan's highest preferred edibles included Skittles<sup>®</sup>, ¼ inch Reese's Peanut Butter Cups<sup>®</sup>, and jelly beans. During extinction components, Evan emitted 4, 1, and 0 instances of responding before Skittles<sup>®</sup> components. He emitted 0, 18, and 0 instances of responding for components preceding the Reese's Peanut Butter Cups<sup>®</sup> components. He emitted 2, 0, and 0 instances of responding during extinction components that preceded the jelly bean components. Evan responded the most during the Reese's Peanut Butter Cups<sup>®</sup> components with 31, 30, and 21 instances of responding. During the Skittles<sup>®</sup> components, Evan responded with 25, 21, and 22 instances of responding. During the jelly bean components, Evan responded with 27, 6 and 9 instances of responding.

Figure 4 depicts social reinforcer assessments for Evan. Evan's highest preferred social consequences included high fives, verbal praise in the form of "good job, Evan", and the experimenter clapping. During extinction components, Evan responded with very low rates of the target response. He emitted 4 instances of the response and for all other extinction components emitted 1 or 0 instances of the target response. Evan emitted the most responses during the verbal praise components with 25, 30, and 21 instances of responding. During the high five components, Evan emitted 23, 34, and 5 instances of responding. During the clapping components, Evan only emitted 10, 1, and 2 instances responding.

Figure 5 depicts edible reinforcer assessments for Ben. Ben's highest preferred edibles include M&M's<sup>®</sup>, Skittles<sup>®</sup>, and Sour Patch Kids<sup>®</sup>. Ben had the highest rates of responding during the M&M's<sup>®</sup> components. During the extinction components that preceded the M&M's<sup>®</sup> components Ben did not emit any responses. Ben emitted 14, 11,

and 15 instances of responding during the M&M's<sup>®</sup> components. During the extinction components that preceded the Skittles<sup>®</sup> components, Ben emitted 12, 11, and 0 instances of responding. Ben emitted 10, 10, and 11 instances of responding in the Skittles<sup>®</sup> components. During the extinction components that preceded the Sour Patch Kids<sup>®</sup> components, Ben emitted 10, 9, and 0 instances of responding. During the Sour Patch Kids<sup>®</sup> components, Ben emitted 11, 11, and 12 instances of responding.

Figure 6 depicts social reinforcer assessments for Ben. Ben's highest preferred social consequences include verbal praise in the form of the experimenter saying "good job, Ben", a rub on the head, and high five. Ben had the highest rates of responding during the verbal praise components. During the extinction components that preceded the verbal praise components, Ben emitted 10, 12, 0, and 0 instances of the target response. Ben emitted 12, 12, 0, and 3 instances of the target response during the verbal praise condition. During the extinction components before the head rub components, Ben emitted 8, 9 and then 0 instances of responding for the last two sessions of the extinction component. Ben emitted no responses until the last condition with 7 instances of the target response during the head rub component. During the extinction components before the high five component, Ben emitted 3 responses for the first session and no responses for the last three sessions in extinction. During the high five component, Ben emitted 3, 5, 2 and 4 instances of responding.

Figure 7 depicts the results for the edible, social and no consequence conditions for Ian. Ian acquired the Lego<sup>®</sup> construct for all three conditions: edible, verbal praise, and no consequence. He acquired the chain in 9 sessions for verbal praise, in 8 sessions

for edible, and 10 sessions for no consequence. For Ian, responding generalized across experimenters and settings for all three conditions.

Figure 8 depicts the results for the edible, social and no consequence conditions for Evan. Evan acquired the chain in all conditions. He acquired the chain within 27 sessions for the no reinforcer condition, 26 sessions for the social reinforcer condition, and 25 sessions for the edible reinforcer condition. Evan became prompt dependent and shadowed his hand over the constructs instead of building it himself. Therefore, the experimenter had to prompt Evan to build according to the 2 sec delay and correction procedures. This may have reinforced his waiting if the physical guidance was preferred. The experimenter extended the 2-second delay to 10-second delay in session 48 and this was successful in decreasing Evan's waiting. For Evan, responding generalized across experimenters and settings for all three conditions.

Figure 9 depicts the results for the edible, social, and no consequence conditions for Ben. Ben acquired the chain in all conditions. He learned the chain the quickest in the edible reinforcer condition. He acquired the chain within 20 sessions for the edible condition, 29 sessions for the verbal praise condition, and 30 sessions for the no consequence condition. For Ben, responding generalized across experimenters and settings for all conditions, however, he made an error on one step in the social reinforcer condition.

The number of errors per condition were also recorded. This was calculated by taking the total number of errors per condition and dividing it by the number of sessions per condition. Ian had an average of 2.22 errors during the no reinforcer condition, 1.86 errors during the verbal praise, and 3.14 errors for the edible reinforcer condition. Evan

had an average of 4.88 in the no reinforcer condition, 4.08 errors in the verbal praise condition, and 3.92 in the edible condition. Ben had an average of 4 errors in the no reinforcer condition, 4.07 in the verbal praise condition, and 3.3 errors in the edible condition. Figure 10 depicts the number of trials to mastery for all participants. Figure 11 depicts the number of sessions to mastery for all participants. For all participants, the most trials and sessions to mastery occurred during the no reinforcer condition.

### Discussion

In the current study, results of a comparison of the effects of different consequences on the acquisition of behavior chains showed that the type of consequence used affected responding for only one of the three individuals. For all three individuals, the Lego<sup>®</sup> construct chain was acquired in all three conditions. However, one individual acquired the chain more quickly and in fewer trials and sessions in the edible reinforcer condition than in the social and no reinforcer conditions. Also, that same individual made an error in the social reinforcer condition during generalization. The number of errors were similar for each condition for all participants.

These findings extend research that has assessed different elements that may affect acquisition of skills. Prompting procedures and types of chains are important contributing factors when teaching new skills to individuals, as Libby, Weiss, Bancroft, and Ahearn (2008) demonstrated. The current study replicated findings from the Libby et al. (2008) study and found that the most-to-least with the 2-second delay before prompting procedure was effective in training a chain of behaviors. Also, few errors per session were demonstrated using this prompting procedure. The current study also extends the research that Natof and Romanczyk (2008) conducted, which assessed types

of reinforcers and their effects on skill acquisition. Natof and Romanczyk (2008) found differentiated performances among different types of social consequence conditions and the current study also found some differentiated performances among the different types of reinforcers for one participant and also during social consequence reinforcer assessments for all participants.

In this study, the findings of the edible reinforcer and social reinforcer assessments demonstrate that it is important to assess which preferred items function most effectively as a reinforcer because not all the types of social consequences functioned as a reinforcer for each individual and there are differences in preferences among edibles. This study demonstrates that the type of consequence used contingent upon correct responding in a task analysis may affect acquisition of that skill.

The effects of negative reinforcement may have been demonstrated in the current study. All three individuals acquired the chain of behaviors in the no consequence conditions, possibly to remove the initial demand of building the constructs if they found it to be aversive and/or less preferred than not building the constructs. This would demonstrate negative reinforcement since they did indeed learn the constructs- completing the training step was reinforced by the experimenter removing the materials and demand which then increased this behavior until the entire chain was acquired.

Another explanation is that there may be intrinsic reinforcers embedded into the activity of completing the chain of behaviors. Some individuals may complete it simply because they were instructed to complete the activity by the instructor. All three individuals were residential students and had a history of exposure to directives from their teachers who typically reinforced compliant behaviors. Many of these reinforcers

consisted of approval from their teachers in the form of verbal praise, cheering, high fives, clapping, and light physical contact. The individuals had a history of being presented with an instruction, and having reinforcers contingent upon correctly responding and complying with that instruction. Also, building Legos<sup>®</sup> may have been a preferred activity for the participants in this study. Therefore, perhaps the type of extrinsic reinforcer does not matter if the individual finds the completion of the activity intrinsically rewarding. However, preferences are idiosyncratic and therefore it is imperative that the instructor assesses the type of reinforcer used to teach a chain of behaviors in order to achieve the most efficient methods of skill acquisition.

There are some limitations in the current study. One individual, Evan became prompt dependent and shadowed his hand over the constructs instead of building them himself. Therefore, the experimenter followed the 2 second delay procedure and correction procedures and manually guided Evan to build. This may have reinforced waiting if physical guidance was preferred. The experimenter extended the 2-second delay to a 10-second delay and this was successful in decreasing Evan's waiting. For one individual, Ben, according to the social reinforcer assessment, verbal praise may have not functioned as an effective reinforcer because responding during extinction components was variable and he emitted high rates of responding during the first two components of extinction before the praise components. However, out of the three social consequences used in the assessment, he emitted the highest mean rate of responding during the verbal praise components. Also, Ben did acquire the Lego<sup>®</sup> chains in all three conditions, including the social reinforcer condition.

Another limitation is that the experimenters built the constructs with similar difficulty to the best of their ability; however, the constructs were not counterbalanced across conditions. Future studies should counterbalance the constructs across conditions in efforts to avoid confounds in regard to level of difficulty of each construct.

These current findings also have implications for future research. Future research should assess the differences in skill acquisition using different types of reinforcers including negative reinforcement, or no consequence. One of the individuals in the current study demonstrated that the type of consequence does affect how quickly that particular individual acquired the chain; however, the other two individuals did not show major differences across conditions. Future research should try to extend these methods to determine more results with different individuals. Also, future research should examine more elements involved in task analyses and the acquisition of a behavior chain including reinforcement, type of chains, and prompting procedures.

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Table 1.

Inter-observer agreement measures for social reinforcer assessments for all participants.

	% of sessions with IOA	Total errors	Total opportunities	% Agreement
Evan	33%	0	34	100%
Ian	33%	0	65	100%
Ben	33%	2	37	95%

Table 2.

Inter-observer agreement measures for edible reinforcer assessments for all participants.

	% of sessions with IOA	Total errors	Total opportunities	% Agreement
Evan	33%	0	61	100%
Ian	33%	0	56	100%
Ben	33%	1	45	98%

Table 3.

Inter-observer agreement measures for all conditions for all participants.

	% of sessions with IOA	Total errors	Total opportunities	% Agreement
Evan	40%	13	300	96%
Ian	39%	0	90	100%
Ben	34%	11	270	96%

Table 4.

The number of errors per session in all conditions for all participants.

Participants	No Consequence			Verbal Praise			Edible		
	Total sessions	Total errors	Avg. errors per session	Total sessions	Total errors	Avg. errors per session	Total sessions	Total errors	Avg. errors per session
Evan	27	127	4.88	26	102	4.08	25	94	3.92
Ian	10	20	2.22	9	13	1.86	8	22	3.14
Ben	30	120	4	29	118	4.07	20	66	3.3

Figure Caption

*Figure 1.* The number of token placement in edible reinforcer assessments for Ian.

*Figure 2.* The number of token placement in social reinforcer assessments for Ian.

*Figure 3.* The number of token placement in edible reinforcer assessments for Evan.

*Figure 4.* The number of token placement in social reinforcer assessments for Evan.

*Figure 5.* The number of token placement in edible reinforcer assessments for Ben.

*Figure 6.* The number of token placement in social reinforcer assessments for Ben.

*Figure 7.* Number of independent steps of the task analysis for the edible, social and no reinforcer conditions for Ian.

*Figure 8.* Number of independent steps of the task analysis for the edible, social and no reinforcer conditions for Evan.

*Figure 9.* Number of independent steps of the task analysis for the edible, social and no reinforcer conditions for Ben.

*Figure 10.* Trials to mastery per condition for all participants.

*Figure 11.* Sessions to mastery per condition for all participants.

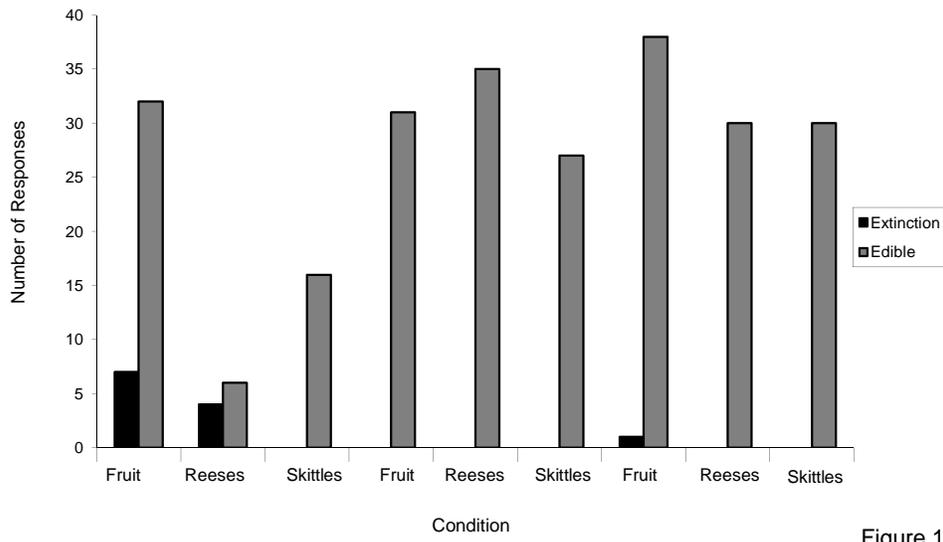


Figure 1

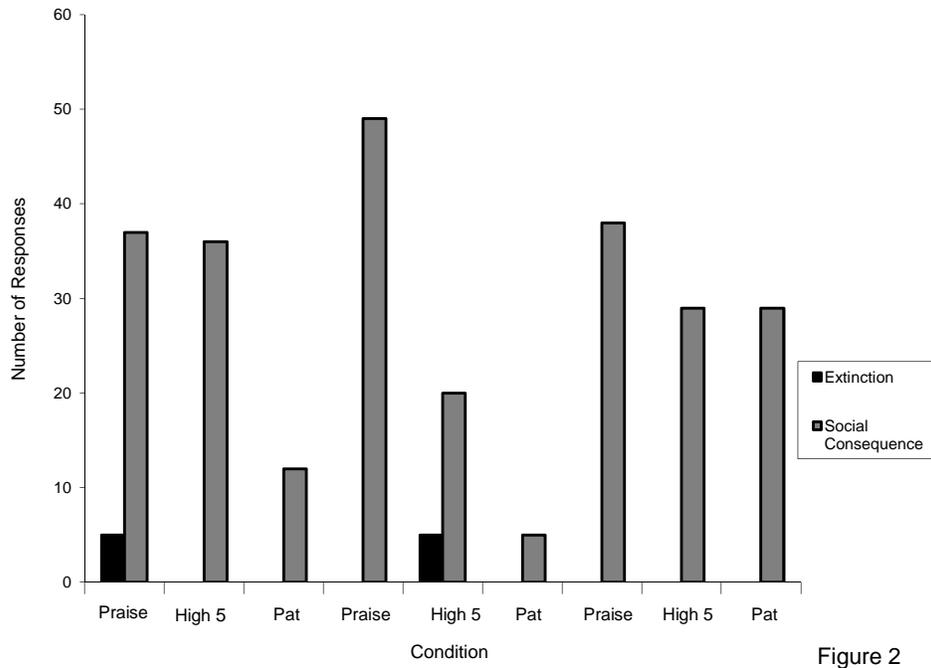


Figure 2

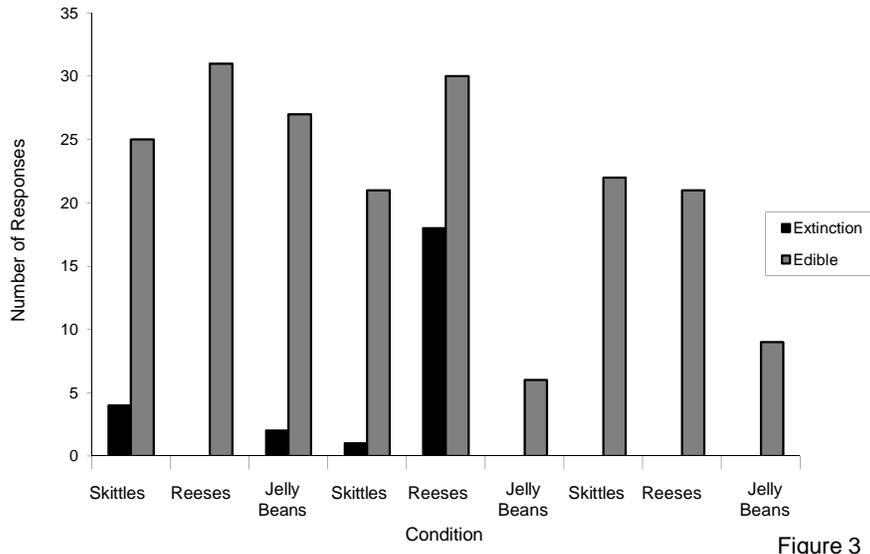


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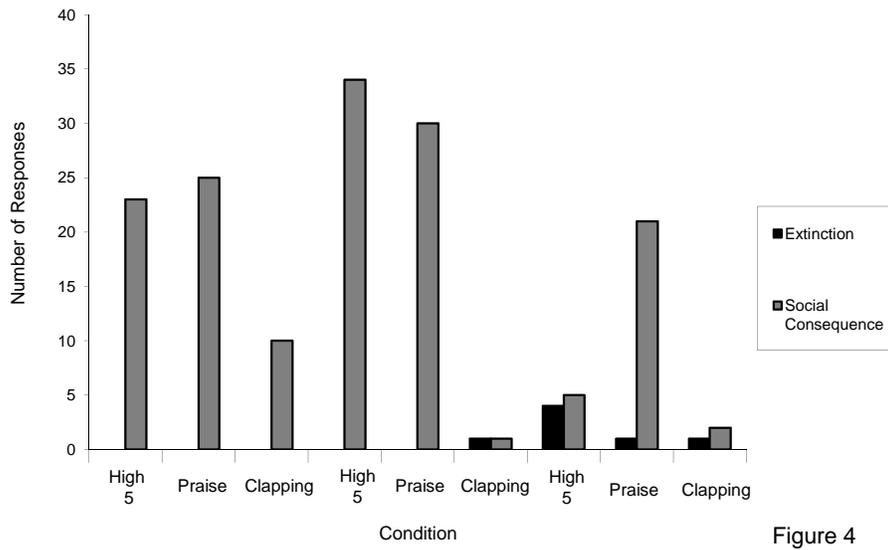


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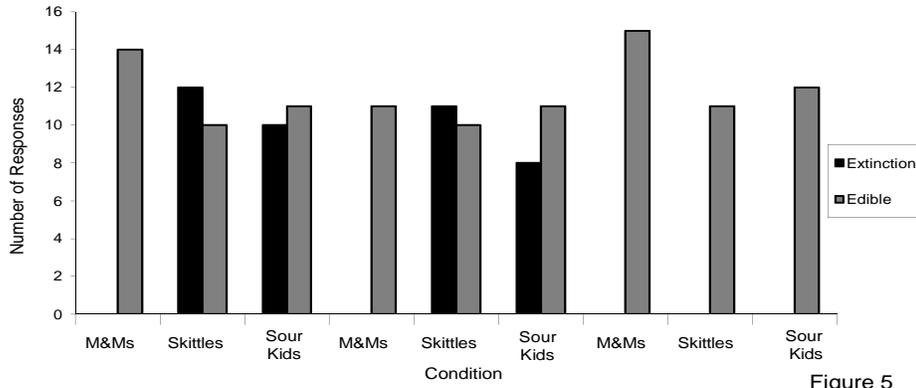


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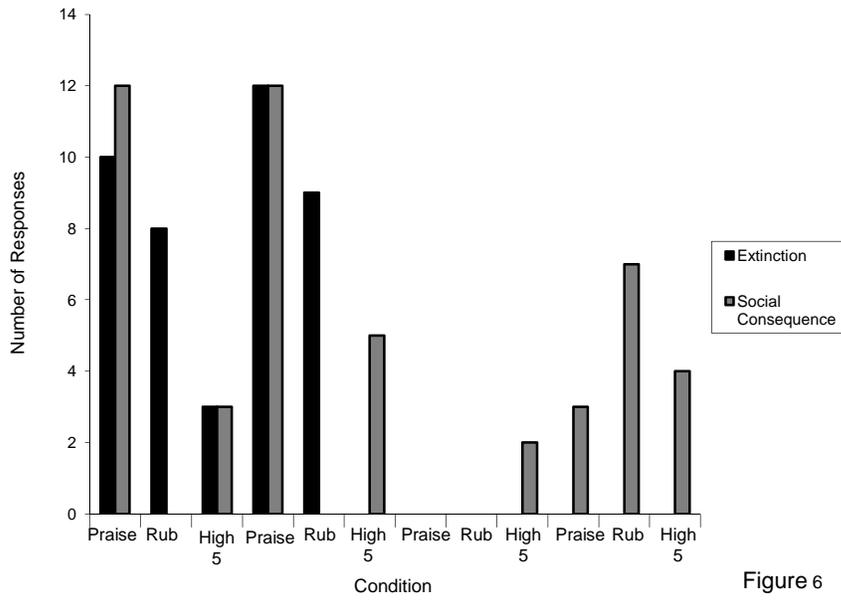


Figure 6

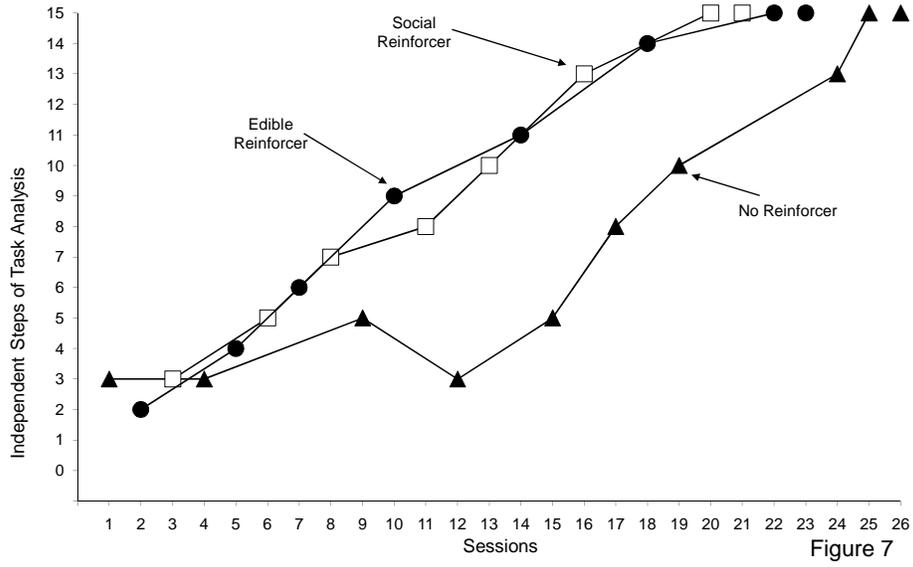


Figure 7

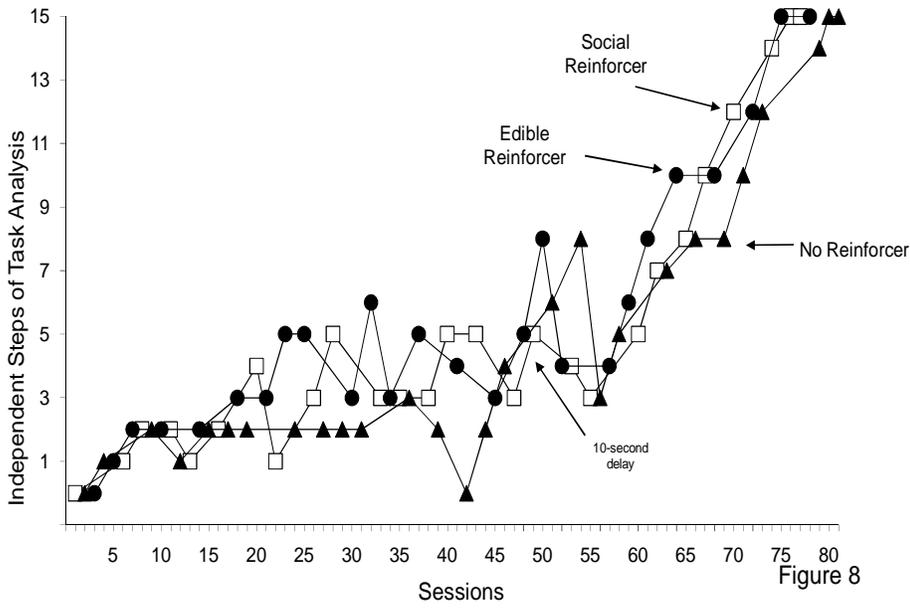


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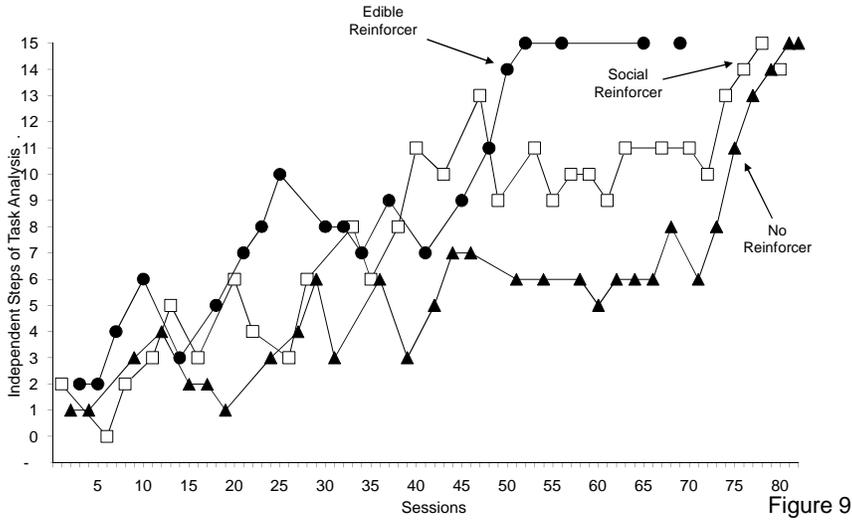


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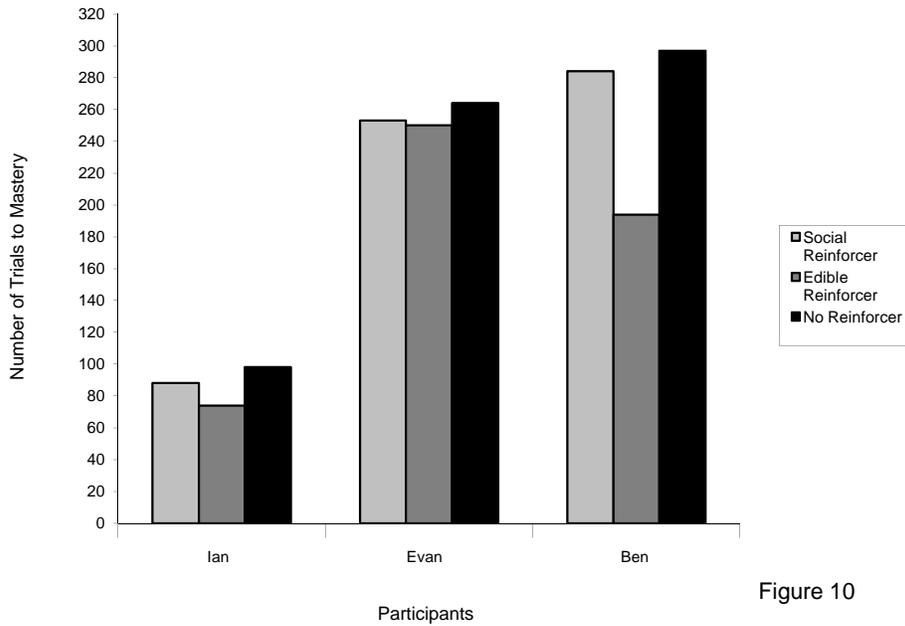


Figure 10

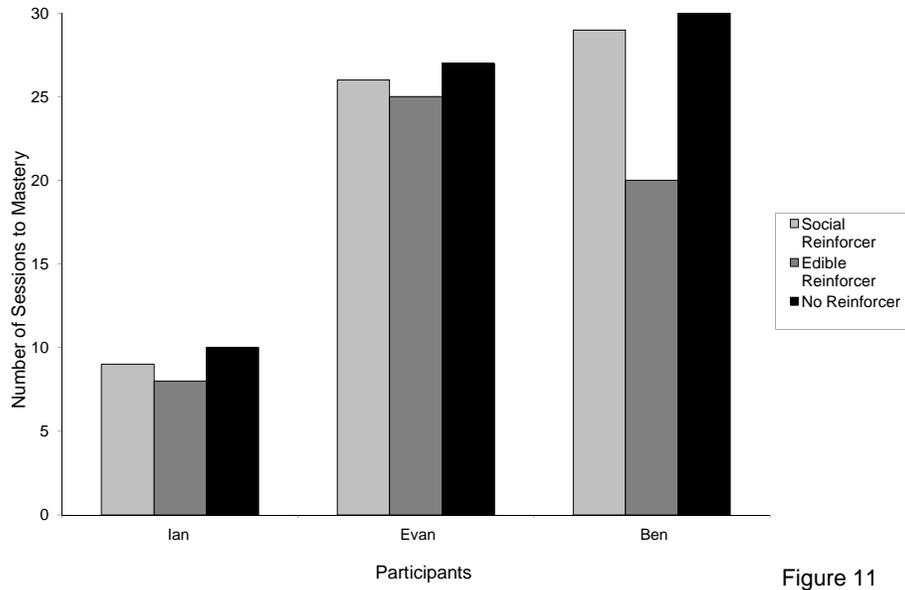


Figure 11