Title: The Effects of Various Instruction Ratios During the Use of the High Probability Instructional Sequence to Increase Compliance

by

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Abstract

Title: The Effects of Various Instruction Ratios During the Use of the High Probability Instructional Sequence to Increase Compliance

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Noncompliance is a common behavior problem exhibited by individuals who are typically developing as well as individuals with intellectual disabilities. The high probability sequence, an antecedent intervention, has proven to be effective to increase compliance to instructional demands. The high probability sequence involves presenting instructions with which an individual is likely to comply (high-p), followed by an instruction with which the individual is not likely to comply (low-p). Typically, three high-p instructions are presented before presenting the low-p instruction. The current study compared different ratios of high-p to low-p instructions (1:1, 3:1, and 5:1) to determine if there is a most effective ratio. In addition, participant preference for various ratios was also examined. Results showed that the 5:1 ratio was most effective at increasing compliance, and ratio preference was idiosyncratic across participants.

Keywords: compliance, high-p instructions, low-p instructions, noncompliance, ratio sequence.
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Dedication

I would like to dedicate this to my family. Without your love, affection, and encouragement, I would not have been able to achieve this success. Mom and dad, your continuous support throughout my journey of working to achieve my academic goals has meant the world to me. Hunter and Hollie, I treasure you both as siblings, friends, and role models. I am forever grateful for you all.
Introduction

The Effects of Various Instruction Ratios During the Use of the High Probability Instructional Sequence to Increase Compliance

Noncompliance can be defined as a low level of compliance to a request that is within an individual’s response repertoire (Wilder, Nicholson, & Allison, 2010). Typically, it is a request that occasions 30% compliance or less each time it is presented to the individual. Noncompliance is a common problem among children with and without intellectual disabilities (Kalb & Loeber, 2003). It has been consistently noted as one of the top reasons why parents refer their children for outpatient behavioral or mental-health services (McMahon & Forehand, 2003). Kalb and Loeber (2003) found that 25 to 65 percent of children and adolescents display noncompliance. Additionally, McMahon and Forehand (2003) found that 85% of parents who have 4 to 7 year old children who already receive mental health services, report noncompliance at home.

Noncompliance is a term that does not pass the dead man’s test (Malott & Suarez, 2004), which is a test used to determine if something should be considered behavior. The idea behind this test is that if a dead man can do it then it is not
behavior. For example, a dead man can sit still, therefore sitting still is not behavior. Similarly, a dead man can be noncompliant. Despite the fact that the term does meet this test criteria, it has a long history of use in the literature, so it will be used in this manuscript to keep consistent with the existing literature on noncompliance. An individual is said to be noncompliant when he or she displays a low level of compliance to an instruction that is within his or her response repertoire (Wilder, Nicholson, & Allison, 2010). Compliance to instructions is essential for early learners. Teacher instruction is ubiquitous in school settings; thus children need to learn how to comply with demands in order to maintain their academic placement and stay on track in school. Additionally, once in a school setting, noncompliance can have negative effects on a child’s success and learning rate. Of course, noncompliance with academic demands is just one problematic area. There are also a large number of individuals who display noncompliance with medical requests, which is also a widespread problem.

Noncompliance is also important to address because when it occurs at a young age it is correlated with a number of psychiatric diagnoses later in life. These disorders include oppositional defiant disorder and conduct disorder (Keenan, Shaw, Delliquadri, Giovannelli, & Walsh, 1998). Another reason noncompliance is essential to treat is because it covaries with other aberrant behaviors such as aggression, disruption, self-injury, and tantrums (Mace, Hock,
Lalli, West, Belfiore, Pinter, & Brown, 1988). Indeed, some studies suggest that increasing compliance will help decrease these aberrant behaviors (Cataldo, Ward, Russo, Riordan, & Bennett, 1986; Parish, Cataldo, Kolko, Neef, & Egel, 1986).

There are a variety of interventions used to treat noncompliance. These interventions can be separated into antecedent and consequence-based procedures. Antecedent interventions are treatments which involve manipulating stimuli before the presentation of the instruction or instruction to make compliance more likely to occur. Consequence-based procedures are those that involve manipulating stimuli after the instruction has been issued to make compliance to the instruction more likely. Elements of both antecedent and consequent-based interventions are included in the high-probability sequence. For example, the high-p sequence includes antecedent components in that there is an environmental manipulation before the target instruction is presented, and it involves consequences in that there is a reinforcer provided contingent on compliance before the target instruction is presented. However, the aim of the current study is not to delineate between the effects of each, but rather, to examine the effectiveness of the intervention as a whole. Given that the high-probability sequence is commonly referred to as an antecedent-based intervention in the literature (Wilder et al., 2015), that is how it will be discussed in the present review. To review what has been done to treat
noncompliance as a whole, both consequence and antecedent based interventions will be reviewed.

**Consequence Based Interventions**

**Differential Reinforcement**

Differential reinforcement is an operant procedure used to increase the occurrence of desirable behavior while simultaneously decreasing undesirable behavior (Vladescu & Kodak, 2010). Differentially reinforcing acts of compliance has proven to be an effective procedure to decrease noncompliance. Studies have shown that providing positive reinforcement contingent on compliance to instructions, while placing acts of noncompliance on extinction, will increase the likelihood of compliance to demands. Previous studies have examined both praise and physical attention as positive reinforcers for compliance to instructions (Schutte & Hopkins, 1970; Zeilberger, Sampen, & Sloane, 1968). Another study conducted by Sweizy, Matson, and Box (1992) examined the efficacy of using points and tokens as positive reinforcement for compliance. In all of these studies, the results demonstrated an increase in compliance when differential reinforcement for compliance was utilized. Wilder, Harris, Reagan, and Rasey (2007) examined a differential reinforcement procedure which involved contingent access to coupons that could be exchanged for access to the activity that was maintaining
noncompliance. The authors found that the differential reinforcement procedure was effective at increasing compliance for both participants.

**Time Out**

Rortvedt and Miltenberger (1994) conducted a study to examine the effects of a time-out procedure on noncompliance. Time out involves removing the individual from the environment contingent on noncompliance to instructions (Rortvedt & Miltenberger, 1994). In their experiment, if the child was noncompliant then he or she was removed from the environment by the child’s parent, and placed in a chair in a different room. In order to leave time out, the child had to sit in the chair for 1 minute, while being quiet for the last 10 seconds of the time out duration. Researchers found that this was an effective procedure to increase compliance.

Forehand et al. (1976) used an isolation procedure to decrease noncompliance. The procedure is similar to time out; however, it requires that the parent of the noncompliant individual to leave the room for one minute contingent on any act of noncompliance. The authors found the isolation procedure to be effective at decreasing noncompliance. These two experiments demonstrate that removing the reinforcing consequence from the child’s environment is a critical aspect of reducing noncompliance with demands.
Guided Compliance

Guided compliance is a procedure which involves providing progressively more intrusive prompts contingent on noncompliance with an instruction. There have been some procedural differences in guided compliance interventions (e.g., number of steps, length of inter-prompt interval). However, all have involved the delivery of prompts culminating in physical guidance contingent upon noncompliance with a less intrusive prompt. A study conducted by Wilder and Atwell (2006) examined the effectiveness of a guided compliance procedure with typically developing preschool children. In this experiment, if the child was noncompliant with the delivery of the first instruction, then the experimenter would go through the following steps: gain eye contact, re-present the instruction, and then model the correct performance of the requested action. Researchers found the guided compliance procedure to be effective for four out of their six participants. The guided compliance procedure was ineffective for the other two participants, and a differential reinforcement procedure was necessary to have the participant complete the task. This involved the experimenter physically guiding the child to complete the instruction. In this procedure, compliance may be due to escape extinction component of the intervention.

A study in which guided compliance was shown to be ineffective was conducted by Wilder et al. (2012). Researchers again used the three step guided
The experimenters used two modifications of the guided compliance procedure. First, they omitted the model prompt. Second, they omitted the model prompt and decreased the interprompt interval from 10 seconds to 5 seconds. The researchers found that the first modification was effective for one out of the three participants. For the remaining two participants, the experimenters found that differential reinforcement in the form of contingent access to preferred edibles was necessary to decrease noncompliance.

Guided compliance has also been taught to caregivers to increase compliance to their instructions. Tarbox, Wallace, Penrod, and Tarbox (2007) trained caregivers to implement a guided compliance procedure with their children. The caregivers were taught to first provide a vocal prompt to the child. Then, contingent on noncompliance, they delivered a model prompt to the child, followed by physical guidance. Their results suggest that the guidance compliance procedure was effective to increase compliance with caregiver instructions and that caregivers can effectively implement a guided compliance procedure when given the proper training. Another study, conducted by Miles and Wilder (2009), showed that a behavioral skills training package was effective to increase correct caregiver implementation of guided compliance. The behavioral skills training consisted of modeling, rehearsal, and feedback. Researchers used the package to increase
compliance among 3 participants. Not only did their results show that the training package improved caregivers performance of using the guided compliance procedure, but generalization probes revealed that the skills taught were exhibited across different settings up to 6 weeks after training.

**Extinction**

Extinction procedures have not been widely examined in relation to treating noncompliance. One study in which an escape extinction component was examined was conducted by Cote, Thompson, and McKerchar (2005). Researchers provided model and physical prompts after the initial instruction to transition to a different activity. The experimenter gave advance notice about the upcoming transition and the child could choose a toy to bring with him or her during the transition. When the escape extinction procedure was added, compliance with the instructions increased to nearly 100% for all 3 participants. Adding the extinction component was effective because it removed escape as a possible reinforcer for noncompliance.

**Reprimands**

A study conducted by Forehand et al. (1976) looked at comparing the delivery of a reprimand (e.g., “Stop disobeying me!”) contingent on noncompliance versus repeating the command. Researchers used 38 mother-child pairs as participants in the study. During the experiment, if the child was noncompliant, the
experimenter delivered a verbal reprimand followed by a glare at the child. Their results showed that negative attention, in the form of a reprimand, decreased noncompliance for all of their participants, whereas repeating the command did not.

**Antecedent Based Interventions**

**Form of Instruction**

Two different types of instructions have been identified in the literature: alpha instructions and beta instructions. Alpha instructions are simple and clear one word instructions while beta instructions are more vague. Forehand and Long (2002) described the different types of beta instructions as either chained directions, vague directions, question directions, “let’s” directions, or directions followed by a rationale. Roberts, McMahon, Forehand, and Humphreys (1978) trained parents to use alpha instructions instead of beta instructions. They found that using more alpha instructions resulted in an increase in compliance to demands.

Bouxsein, Tiger, and Fisher (2008) examined compliance when the instruction was given in a general statement versus a specific statement. An example of a general statement would be “You need to do this” while an example of a specific statement would be “Answer your math questions”. They found that there was a greater increase in compliance to the instruction when the demand was presented as a specific instruction. This particular experiment suggests that it might
be necessary to deliver unambiguous and precise instructions, instead of vague instructions, in order to increase compliance.

Hamlet, Axelrod and Kuerschner (1984) have also conducted studies examining the necessary steps in making alpha instructions most effective. Their research suggests that first making eye contact helps to increase compliance levels. In their experiment, they required eye contact before they delivered an instruction during the treatment phase. They found that compliance increased relative to baseline levels.

Additionally, researchers have examined whether demands should be given in “do” or “don’t” format. Neef, Shafer, Egel, Cataldo, and Parrish (1983) examined using “do” versus “don’t” instructions. For example, “put your toy away” versus “don’t keep playing with your toy”. Their results suggest that one form was not better than the other, but rather each format increased compliance within that specific instruction. That is, “don’t” instructions did not generalize to “do” instructions, and vice versa. Later, Ducharme and Worling (1994) examined the efficacy of the different forms of “do” and “don’t” instructions. Unlike Neef et al. (1983), they found that “do” instructions increased compliance more for one participant, and they had to change the “don’t” form to the “do” form to increase compliance for the second participant. This research suggests that phrasing the
An instruction in the “do” form (e.g., “sit down”) may be more effective than phrasing an instruction in the “don’t” form (e.g., “don’t stand up”).

A study conducted by Everett, Olmi, Edwards, and Tingstrom (2005) obtained different results with respect to one form of the instruction being more effective than the other. The authors of this experiment conducted a study in which they examined the effects of eye contact and praise on compliance to both direct and indirect instructions. The direct instructions were similar to alpha instructions and the indirect instructions were similar to beta instructions. In their experiment, they sequentially introduced instructions without eye contact, instructions with eye contact, and lastly contingent praise to increase compliance. They used this procedure for both direct and indirect instructions. Their results suggested that eye contact and contingent praise are more important than the type of instruction (indirect versus direct) that is being delivered. These results are noteworthy because they differ from other studies (Neef et al., 1983; Olmi et al., 2005; Roberts et al., 1978), which suggest that the form of the instruction is the most important aspect to increase compliance.

Another form of instruction that has been previously examined is delivering a rationale for the instruction. Wilder Allison, Nicholson, Abellon, & Saulnier (2010) examined the effects of using a rationale both before and after an instruction was delivered. The experimenters randomly delivered one of three rationales
related to the instruction (e.g., “Give me the ___ because it is good to share with others”). Their results suggest that providing the participants with a rationale did not increase compliance to the instruction for all 6 of their participants. They found that contingent access to preferred items was necessary to increase compliance for 5 participants, and follow up phase of guided compliance was necessary to increase compliance for one participant. In a follow-up experiment conducted by Wilder, Myers, Nicholson, Allison, and Fischetti (2012), the authors further examined using a rationale to increase compliance. They used a rationale with differential reinforcement to increase compliance. By providing a rationale to the participants, researchers were still examining form of the instruction to determine its efficacy. Their results suggested that the rationale and differential reinforcement were not effective; a guided compliance procedure was necessary to increase compliance.

**Advanced Notice**

Advance notice, which involves giving the child information about when the demand will be presented, has been evaluated to increase compliance. Wilder, Zonneveld, Harris, Marcus, and Reagan (2010) used advance notice with participants who were 4 to 5 years old. In this study, the researchers provided notice when the child was going to be asked to return a toy (e.g. “In 2 minutes you’ll need to give me the toy”). Additionally, they provided another notice 1 minute before the instruction was delivered. They found that providing advance
notice was ineffective at increasing compliance to demands. Compliance only increased when they implemented both an advanced notice statement and used physical guidance.

**Response Effort**

Fischetti, Wilder, Myers, Leon-Enriquez, Sinn, and Rodriguez (2012) conducted a study in which they examined the effects of decreasing the response effort associated with compliance to instructions. The instruction used in this experiment was to put a toy away in a bin. The experimenters manipulated the response effort associated with this task by placing the bin .3 meters and 3 meters away. Throughout the experiment, they systematically increased the distance of the bin following a response effort manipulation phase. They found that the response effort manipulation, moving the bin closer the child, was not effective at increasing compliance for two out of their three participants. Due to this, researchers implemented a guided compliance procedure in combination with differential reinforcement. They found that differential reinforcement was necessary for compliance to maintain at high levels as the distance to the bin was increased. These results suggest that manipulating the response effort associated with compliance may sometimes be an effective procedure. However, other times it may need to be used in combination with other interventions.
High Probability Instructional Sequence

A number of experiments have examined the high-probability sequence to increase compliance. The high-probability (high-p) sequence involves delivering several instructions with which the individual is likely to comply (high-p instructions), immediately prior to delivering an instruction with which the individual is not likely to comply (Bullock & Normand, 2006). The instruction with which the individual is not likely to comply is termed the low probability (low-p) instruction and is presented at the end of the high-p sequence. The high-p sequence is a useful tool because it does not require the experimenter to physically guide the child during any point of its implementation. This is especially useful in classroom settings in which a teacher may not have time for physical guidance, or in the event that the individual’s size may make physical guidance dangerous (Bullock & Normand, 2006).

The high-p sequence is purportedly based on behavioral momentum theory. The process involves an increase in responding as a result of the procedure that is being used. Behavioral momentum theory refers to the propensity for a behavior to persist following a change in environmental conditions (Mace, Hock, Lalli, West, Belfiore, Pinter, & Brown, 1988). In the basic behavior analytic literature, the disruptive factor is usually an extinction or satiation component. However, when applied to the high-p sequence, the disruptive factor is the presentation of the low
probability instruction. Behavioral momentum theory posits that it is the buildup of reinforcement in the form of “behavior mass” during the high-p instructions which leads to the persistence of the response in the face of the disruptive factor (the low-p instruction).

Mace et al. (1988) conducted a series of five studies on the high-p sequence to note its effects on compliance to the low-p instruction. In the first experiment, Mace examined compliance to both “do” (e.g., put your lunchbox away) and “don’t” (e.g., please don’t leave your lunchbox on the table) commands. Effects of the high-p instructional sequence were observed for one participant. The “do” and “don’t” low-p commands were preceded by 3 to 4 high-p commands. Researchers found that establishing a pattern of compliant responding was effective at increasing compliance to “do” and “don’t” commands. In the second experiment, researchers examined the generality of the high-p sequence and the effects of positive attention on noncompliance. The procedure was identical to experiment 1, except researchers added an attention control condition in which the experimenter provided positive attention (e.g., “That’s a nice shirt you’re wearing”) before issuing the low-p instruction. Attention was provided on a fixed-time 1 minute schedule. This condition was alternated with the high-p instructional sequence condition and baseline condition. Researchers found that the high-p sequence was more effective than attention at increasing compliance to the low-p instruction. In
experiment 3, the dependent variable again was compliance to both “do” and “don’t” low-p commands. The manipulated independent variable was the interprompt time (IPT). The IPT was defined as the amount of time between the last high-p instruction in the sequence and onset of the low-p instruction. A 20 second versus 5 second IPT was compared. The Researchers found that, regardless of the “do” or “don’t” low-p command, compliance was always higher when the IPT was 5 seconds.

In experiment 4, the dependent variable was compliance latency, which was defined as the time between the completion of the experimenter’s instruction and the participant’s initiation of the requested task. The independent variable in this study was the high-p instructional sequence, with an attention control condition. Mean latency to complete the task was 156 seconds during baseline, 117 seconds during the attention condition, and dropped significantly to a mean of 17 seconds during the high-p condition. Similar results were obtained for the two other participants that were involved in this study. In experiment 5, researchers examined the duration of time a participant spent completing three task segments while in the shower. The independent variables in this study included a contingency management condition, a prompting condition, and a high-p instructional sequence condition. In the contingency management condition, contingent on the occurrence of off-task behavior, the participant was shown three preferred items, and told that
if he completed his shower tasks by the time a buzzer went off then he would have access to one of the presented items. In the prompt condition, both gestural and vocal prompts were provided contingent on off-task behavior. The prompt was repeated every 15 seconds until the participant resumed on-task behavior. In the high-p condition, the command sequence was given contingent on each instance of off-task behavior. Researchers found that all three interventions were effective at decreasing the duration of the three task segments while in the shower. However, the high-p sequence was most effective at decreasing the average time across all segments. In summary, results showed that not only did the high-p sequence increase compliance to the low-p instruction more effectively than other interventions, but it also decreased compliance latency and task duration. Additionally, they found that the “momentum like” effects were shown to be contingent on the contiguity between the high-p instructions and the low-p instruction.

Since the Mace et al. (1988) experiments, there has been a growing body of research on the high-p sequence which describes the conditions under which it is most successful. Davis, Brady, Hamilton, McEvoy, & Williams (1994) examined the effects of the high-p sequence on social interactions of young children with disabilities. Researchers examined social initiations, social responses, continued interactions, and the performance of both high and low probability instructions. A
peer training procedure was conducted prior to baseline to teach the children without disabilities how to effectively interact with the children who displayed social skills deficits. The high-p instruction sequence consisted of 3 to 5 high-p commands followed by the presentation of a low-p command. Results of this study demonstrated that the high-p instructional sequence was effective at increasing student’s responding to low-p instructions to initiate social behavior. Unprompted initiations were also found to the training peers both within and outside the training procedure. They also found unprompted responses and initiations to peers in a second setting in which training did not occur, which demonstrates that compliance can generalize following the implementation of the high-p procedure.

In reference to the necessity of reinforcement contingent on compliance to the high-p instructions, Pitts and Dymond (2012) compared the effects of delivering edibles and tangibles versus no programmed reinforcement, and found that compliance to the low-p instruction was more likely when reinforcement was provided. Following this finding, research was then conducted on the quality of reinforcement following compliance to the high-p instructions. Wilder et al. (2015) compared the effects of praise (a less preferred reinforcer) to edibles (a more preferred reinforcer). Their results showed that using edibles was more effective than using praise at increasing compliance.
There has also been research on the most effective inter-instruction interval between demands in the high-p sequence. Both Pitts and Dymond (2012) and Wilder et al. (2015) examined the inter-instruction interval duration. Pitts and Dymond (2012) found that compliance to the low-p instruction is more likely when the inter-instruction interval is shorter rather than longer (e.g., 5 seconds rather than 10 seconds). Wilder et al. (2015) then further expanded upon this by noting that even shorter intervals (e.g., 1 to 2 seconds) are also effective to produce compliance to the low-p instruction.

In addition to the quality of reinforcement and inter-instruction interval, the topography of the behavior, as a result of compliance with the instruction, has also been examined. Esch and Fryling (2013) conducted a study in which they compared instructions that were in maintenance with leisure based instructions. An example of maintenance based instruction were instructions like “touch you head” or “touch your nose”, while leisure based instructions were “drive your truck” or “fly your airplane”. Researchers found that both maintenance and leisure based high-p instructions resulted in an increase in compliance. However, the leisure based instructions resulted in the largest compliance increases.

More recently, experimenters examined whether presenting high-p instructions is even necessary for compliance to a low-p demand. Normand and Beaulieu (2011) examined the efficacy of delivering preferred items on a fixed-
time (FT) schedule before delivering the low-p instruction. Researchers conducted this study with two participants across three different instructions. They found that FT delivery of preferred items was effective to increase compliance to two of the three instructions.

The high-p sequence has also been shown to be effective when combined with other interventions. Penrod, Gardella, and Fernand (2012) used the high-p sequence in combination with demand fading to increase bite acceptance with individuals who exhibited food selectivity. Demand fading involves a gradual increase in demand requirements before reinforcement is provided. It was also successfully used in combination with escape extinction to treat food refusal (Patel et al., 2007).

The high probability sequence has also been examined in regard to high-p and low-p instruction topography. Recently, a study by Lipschultz, Wilder, Ertel, and Enderli (in press) observed the differences between motor and vocal instructional requests. Researchers compared instructional sequences that had similar topographies (e.g., motor high-p’s to motor low-p’s) to instructional sequences that hid dissimilar topographies (e.g., motor high-p’s to vocal low-p’s). Researchers found that having a similar topography of instruction during the high-p sequence did not differentially effect compliance, compared to the high-p sequence that had dissimilar topographical instructions.
Recently, Axelrod and Zank (2012) trained teachers to use the high-p sequence with two individuals in their classroom who were noncompliant. They found that the initial 3:1 (3 high-p instructions followed by 1 low-p instruction) sequence was effective at increasing compliance to the low-p instruction for both students. Researchers then faded the number of high-p instructions in the sequence to 1:1 and found that compliance to the low-p instruction was only maintained for one participant. Belfiore, Basile, and Lee (2008) also conducted a study in which they faded the number of demands in the high-p sequence. In the first intervention, researchers presented 3-5 high-p instructions before presenting the low-p instruction, and found compliance increased (mean compliance ranging from 78-85%) over baseline levels. During the fading procedure, researchers presented one high-p instruction before presenting one low-p instruction. Here, they found compliance was again increased over baseline levels, but was not as effective as the previous intervention in which 3-5 high-p’s were used. Mean compliance during fading was 77%. These two studies provide support for the idea that presenting more high-p instructions, before the presentation of the low-p, may be more effective at increasing compliance.

Although a broad body of literature exists on the high-p sequence, it is still lacking in some areas. Specifically, research on the optimal number of high-p instructions is needed. Currently, a 3:1 ratio is most commonly used. However, if a
1:1 ratio is equally effective to increase compliance, then this could save teachers and clinicians time and effort. On the other hand, behavior momentum theory posits that it is the buildup of response momentum that results in the compliance to the low-p instruction. So, perhaps increasing the number of high-p instructions, and therefore increasing the momentum, will result in the greatest increase in compliance. The purpose of the current study was to systematically compare the presentation of one, three, and five high-p instructions before the presentation of the low-p instruction, and to examine which ratio results in the most compliance to the low-p instruction. Additionally, preference for sequence variation was also examined.
Method

Participants and Setting

Three individuals with a history of noncompliance to instructional instructions were recruited from a clinic serving children with autism at a children’s hospital in central Florida. Individuals were selected based on parent or therapist report of frequent noncompliance, defined as engagement in any behavior, other than what had been specified by an adult delivered instruction (McMahon and Forehand, 2003). All individuals in the study had a diagnosis of Autism Spectrum Disorder, were 5 years old, and were males. For each participant, the context of the experimental sessions was a therapy treatment room and was kept the same throughout the study. Additionally, the experimenter was identical throughout the duration of the study.

Dependent Variable and Data Collection

Compliance with the low probability (low-p) instruction was the primary dependent variable. Compliance was defined as completing a low-p instruction within 10 seconds of its delivery. The specific low-p instruction was determined for each participant via therapist or parent report. The instructions were then tested prior to the experiment in a pre-intervention assessment. In the assessment, each potential low-p was presented to the participant 10 times. If it occasioned 30% or
less compliance it was eligible to be used as the low-p instruction. This procedure for determining low-probability instructions was based on previous research on low-p assessments (Wilder et al., 2015). Each participant had one low-p instruction that was used throughout the study. Each low-p instruction was different for the three participants. Paul’s low-p instruction was to “stand up” while seated on the floor. Paul had complied with this and similar instructions in the past, but did so irregularly. Jake’s low-p instruction was to put a specific toy in a box, for example “put the zebra in the Z box”. Jake had successfully tacted all toys that were used in the study. Daniel’s low-p instruction was “give me a letter” from an array of letter toys. Daniel had complied with this instruction in the past, but did so irregularly. Given that all participants had complied with the low-p instruction in the past, their lack of compliance was not due to a skill deficit. All instructions were presented vocally to the participants.

A second independent observer collected data for 57% of Paul’s sessions, 65% of Jake’s sessions, and 68% of Daniel’s sessions. Agreement was evaluated by comparing observer records on a trial-by-trial basis. Agreement was defined as both observers recording either noncompliance or compliance on a trial. The overall agreement was then calculated by dividing the number of sessions with agreement by the total number of sessions. This number was then converted into a percentage. Overall agreement was 100% for Paul, Jake, and Daniel.
To assess treatment integrity, integrity checks were conducted to ensure that the procedure was implemented correctly. Treatment integrity was collected on the interprompt time (amount of time between the last high-p and presentation of the low-p), whether the experimenter gave the participant 10 seconds to comply, delivery of the appropriate reinforcer by the therapist (e.g., either edible or praise), and also whether the experimenter had the participant engage in an observing response at the beginning of the session. Treatment integrity was collected on 57% of Paul’s sessions, 65% of Jake’s sessions and 68% of Daniel’s sessions. Treatment integrity was calculated by dividing the total number of components that were implemented correctly by the total number of components. This ratio was then converted into a percentage. Treatment integrity was 98% for Jake, 99% for Paul, and 100% for Daniel.

**Independent Variables**

The varied high-p instruction sequences were the primary independent variables. To identify instructions used in the high-p instruction sequence, the experimenter asked each participant’s therapist and parent for a list of instructions with which the individual is most likely to comply. The instructions were then tested in a pre-intervention assessment. During this pre-assessment, each potential high-p was presented 10 times. If the participant complied with the instruction within 10 seconds on at least 80% of trials, then that instruction was
eligible for inclusion in the high-p instruction sequence during the study. During the pre-assessment, contingent on compliance to each instruction, the participants received brief praise or an edible item. Both Daniel and Jake received edibles for compliance and Paul received praise, since edibles did not function as a reinforcer for him. Each instruction was presented ten times in random order. The experimenter waited 30 seconds between instruction presentation. For Paul, the following intraverbals were selected as his high-p instructions; “There was an old lady who swallowed a ___”, “I don’t know why she didn’t___”, “She swallowed the clover to brighten the ___”, “She swallowed the butterfly to rest on the___”, and “She swallowed a bird to glide with the__”. For Jake, the following instructions were selected as high-p instructions; “Give me a high-5”, “Who puts out fires?”, “Touch your nose”, “What’s your name?”, and “Where do you sleep?” For Daniel, the following instructions were selected as high-p instructions; echoic “go”, echoic “up”, imitate blowing a kiss, imitate clapping hands, and “Give me a high-5”.

**Experimental Design**

The effects of the high-p instruction sequences for Paul and Jake were evaluated using an ABACADABACADE reversal design. The experimental design for Daniel was an ABACADABACADAFAFE reversal design. “A” represents baseline, “B” represents a 1:1 ratio, “C” represents a 3:1 ratio, “D” represents a 5:1
ratio, “E” represents a choice phase, and “F” represents a contingent access, phase to which only Daniel was exposed. In all phases, each session consisted of 5 trials. Prior to beginning the first phase, a multiple stimulus without replacement (MSWO; DeLeon & Iwata, 1996) preference assessment was conducted to determine preferred edible items for use in that session. The edibles that were included in the MSWO were chosen based on therapist or parent report as being preferred.

**Procedure**

**Baseline.** Baseline sessions were identical for all participants. In each baseline session, the low-p instruction was presented once every 15 seconds. If the participant complied, the experimenter provided brief praise (i.e., “good job”). If the participant did not comply, the experimenter looked away without comment and the low-p instruction was then presented again 15 seconds later.

**High-P Ratio Evaluation.** The high-p instruction sequences were counterbalanced across participants to control for sequencing effects. In all conditions, the time between compliance with the high-p instruction and presentation of the next instruction or low-p instruction was 1-2 seconds. In the 1:1 high-p instruction sequence, only one high-p instruction was presented before the low-p instruction (e.g., “clap your hands” followed by “stand up”). If compliance to the high-p instruction occurred within 10 seconds the experimenter provided access
to the edible item that the MSWO revealed to be the most preferred. If the participant did not comply with a high-p instruction, then the experimenter would make sure the participant was attending, by gaining eye contact before the high-p instruction was presented again. If there was still no compliance to the instruction, then the experimenter would wait 15 seconds then represent the high-p sequence from the beginning. Compliance with the low-p instruction resulted in brief praise. If the participant did not comply with the low-p instruction, then no programmed consequence was delivered. The experimenter looked away and presented the next trial 15 seconds later. This was the same for noncompliance to the low-p for all ratio sequences.

In the 3:1 high-p instruction sequence, 3 high-p demands were presented prior to the low-p demand (e.g., “clap your hands”, “touch your head”, “touch your knees”, followed by the low-p instruction “give me a letter”). If compliance to the high-p instruction occurred within 10 seconds, the experimenter delivered a highly preferred edible item. This occurred for all instances of compliance to each of the 3 high-p instructions in the sequence. If the participant complied with the low-p instruction, the experimenter delivered brief praise.

In the 5:1 high-p instruction sequence, 5 high-p instructions were presented before the low-p instruction (e.g., “clap your hands”, “touch your head”, “touch your knees”, “touch your toes”, “give me a high five”, followed by the low-p
instruction “put your toy away”). If compliance to the high-p instruction occurred within 10 seconds, the experimenter delivered a highly preferred edible item. This occurred for all instances of compliance to each of the 5 high-p instructions in this sequence. If the participant complied with the low-p instruction the experimenter delivered brief praise.

Additionally, each ratio was associated with a specific color to enhance participant discrimination among conditions. In the 1:1 ratio sequence a red posterboard was present in the room. The posterboard had the number 1 and written word “one” on the front. In the 3:1 ratio sequence, a green posterboard was present in the room. This poster had the number 3 and word “three” written on it. In the 5:1 ratio sequence, a blue posterboard was in the room. This poster had the number 5 and written word “five” on it. Prior to beginning each phase, the participant engaged in an observing response. That is, the participant had to touch the posterboard and tact the corresponding color and number.

**Choice Probe.** A choice probe was conducted to determine if participants had a preference for an instruction sequence. During the choice probe, 5 ratio training trials were run before each probe. During ratio training, all colored cards were placed in front of the participant. Then the participant was asked to tact both the color and number of each of the 3 cards. Following this, a corresponding number of reinforcers were placed on the card (e.g., five skittles on the 5:1 card, 3
skittles on the 3:1 card, and 1 skittle on the 1:1 card). The participant was then asked to “pick a card” and was told that whichever card he selected, he could then consume that number of edibles. This was conducted five times immediately prior to the choice probe. Since edibles did not function as a reinforcer for Paul, toys were used instead. During the choice probe, all reinforcers were removed from the cards and the participant was again asked to “pick a card”. After choosing a card, the corresponding ratio sequence was conducted exactly the same as it was conducted during intervention. For example, if they picked the 3 card they were asked 3 high-p’s, with reinforcement for compliance, before being asked the low-p.

This choice procedure was identical for 2 out of the 3 participants. However, for one of the participants, Jake, sequencing his choices was more preferred than any edible or tangible reinforcer. He would sequence his choices by continuously choosing the 1 card, followed by the 3 card, then the 5 card in sequential order. To break his sequencing pattern, he was required to engage in 5 forced choice responses for each card before running the choice probe. Contingent on picking up a card and handing it to the experimenter, the participant was given the corresponding number of reinforcers. For example, when only the 5 card was on the table, and the participant picked it up and handed the 5 card over, he would be given 5 edibles. This was done for 5 trials for each card. Then, each card was laid out simultaneously in front of the participant, and he was told to “pick a card”.
After choosing a card, the corresponding ratio sequence was then conducted once. These probes were conducted 3 times across 3 different days for each participant.

**Generalization.** A generalization probe was also conducted for each participant following all ratio sequences. For the generalization probe, a parent conducted one trial following baseline procedures, to test for compliance to the low-p instruction alone, and one trial for the ratio sequence that resulted in the highest compliance. These probes were conducted in order to determine generalization without the use of the high-p intervention and with the use of the high-p intervention.

**Social Validity.** The social validity survey was administered to a parent of the participant. The procedures of the varied high-p ratio sequences were vocally described to the parent in detail. Following a description of the sequences, the parent was asked to answer a series of questions on a Likert Scale survey to determine a ratio preference. An example of the social validity survey can be found in Appendix A.
Results

The results of Figure 1 depict the percentage compliance to each instruction in the low-p assessment for Paul. The instruction “Take a sip” resulted in the lowest compliance (0%) however, experimenters did not want liquid satiation to be a contributing factor to the noncompliance. Given this, “Stand up” was selected as the low-p instruction for Paul, because it resulted in the second lowest level of compliance (20%). The instruction was always issued while he had access to a toy. Figure 2 depicts the percentage compliance to each instruction in the low-p assessment for Jake. Placing a specific toy in a specific box was selected as the low-p instruction for Jake because it resulted in the lowest percentage compliance (30%). Figure 3 depicts the percentage compliance to each instruction in the low-p assessment for Daniel. The instruction “Give me a letter” was selected because it resulted in the lowest percentage compliance (0%).

Figure 4 depicts the percentage compliance to each instruction in the high-p assessment for Paul. The five intraverbals we assessed all resulted in 80% compliance or greater, so they were built into the high-p sequence. Figure 5 depicts the percentage compliance to each instruction in the high-p assessment for Jake. The first 5 high-p’s we tested all resulted in 80% compliance or greater, so they were built in to the high-p sequence. Figure 6 depicts the percentage compliance to
each instruction in the high-p assessment for Daniel. Seven instructions were tested and six resulted in 80% compliance or greater. Out of these six, three resulted in 100% compliance and three resulted in 90% compliance. The three instructions with 100% compliance and 2 instructions that resulted in 90% compliance were included in the high-p sequence.

Figures 7-9 depict the results of the treatment evaluation for Paul, Jake, and Daniel, respectively. For Paul (figure 7), compliance ranged from 0%-60% in the first baseline phase and mean compliance was 11%. During the first 3:1 ratio, compliance ranged from 80%-100% and mean compliance was 93%. During the second baseline phase, compliance ranged from 0%-60% and mean compliance was 24%. During the first 5:1 phase, compliance was 100% for all trials, and mean compliance was 100%. During the third baseline phase, compliance was 0% for all trials, and mean compliance was 0%. During the first 1:1 ratio, compliance ranged from 60%-100% and mean compliance was 87%. During the fourth baseline phase, compliance ranged from 0%-60% and mean compliance was 18%. During the second 1:1 phase, compliance ranged from 60%-100% and mean compliance was 87%. During the fifth baseline phase, compliance ranged from 0% to 20% and mean compliance was 10%. During the second 5:1 phase, compliance was again 100% for all trials, and mean compliance was 100%. During the sixth baseline phase, compliance was 0% for all trials and mean compliance was 0%. During the
second 3:1 phase, compliance ranged from 80%-100% and mean compliance was 93%. During the choice phase, compliance was 100% for all choice probes. Compliance was also 100% to both generalization probes. Paul demonstrated a preference for the 3:1 ratio sequence. He selected the green card first (associated with the 3:1 ratio), the blue card second, and the green card again third.

For Jake (figure 8), compliance ranged from 0%-40% in the first baseline phase and mean compliance was 20%. During the first 5:1 ratio, compliance ranged from 60%-100% and mean compliance was 83%. During the second baseline phase, compliance ranged from 0%-100% and mean compliance was 49%. During the first 3:1 phase, compliance ranged from 60%-100% and mean compliance was 73%. During the third baseline phase, compliance ranged from 0%-80% and mean compliance was 40%. During the first 1:1 ratio, compliance ranged from 60%-80% and mean compliance was 64%. During the fourth baseline phase, compliance ranged from 0%-80% and mean compliance was 30%. During the second 3:1 phase, compliance ranged from 60%-100% and mean compliance was 77%. During the fifth baseline, phase compliance ranged from 0% to 100% and mean compliance was 31%. During the second 5:1 phase, compliance ranged from 80%-100% and mean compliance was 90%. During the sixth baseline phase, compliance ranged from 0%-40% and mean compliance was 12%. During the second 1:1 phase, compliance ranged from 60%-100% and mean compliance was 63%. During
the choice phase, compliance was 100% for all choice probes. Compliance was also 100% to both generalization probes. Jake demonstrated a preference for the 1:1 ratio sequence. During choice probes, he selected the blue card first (associated with the 5:1 ratio), the red card second (associated with the 1:1 ratio), and the red card again third. His compliance was 100% during all choice probes.

For Daniel (figure 9), compliance ranged from 0%-40% in the first baseline phase and mean compliance was 10%. During the first 1:1 ratio, compliance ranged from 0%-40% and mean compliance was 14%. During the second baseline phase, compliance was 0% for all trials and mean compliance was 0%. During the first 3:1 phase, compliance was 0% for all trials and mean compliance was 0%. During the third baseline phase, compliance was 0% for all trials and mean compliance was 0%. During the first 5:1 ratio, compliance ranged from 40%-80% and mean compliance was 67%. During the fourth baseline phase, compliance was 0% for all trials and mean compliance was 0%. During the second 5:1 phase, compliance ranged from 0%-100% and mean compliance was 32%. During the fifth baseline phase, compliance was 0% for all trials and mean compliance was 0%. During the second 1:1 phase, compliance ranged from 0%-100% and mean compliance was 3%. During the sixth baseline phase, compliance was 0% for all trials and mean compliance was 0%. During the second 3:1 phase, compliance ranged from 0%-20% and mean compliance was 8%. During the contingent access phase,
compliance was 100% for all trials and mean compliance was 100%. During the seventh baseline phase, compliance was 0% for all trials and mean compliance 0%. During the second contingent access phase, compliance was 100% for all trials and mean compliance was 100%. Compliance to the choice probes ranged from 0%-100% and mean compliance was 67%. Compliance was 0% to both generalization probes. The results of Daniel’s choice probes suggest that he did not demonstrate a preference for a ratio sequence. Each time the choice probes were run he chose a different card. On the first probe he selected the red card, on the third probe he selected the green card, and on the third probe he selected the blue card.

Figure 10 depicts the results of the mean compliance for each treatment evaluation phase. Paul’s 5:1 ratios were 100% across both phases, his 3:1 ratio resulted in 93% mean compliance across both phases as well, and the 1:1 ratio resulted in 100% mean compliance followed by 86% mean compliance. Jake’s 5:1 ratios resulted in 83% mean compliance followed by 90% mean compliance. His 3:1 ratio resulted in 73% mean compliance followed by 77% mean compliance. Last, the 1:1 ratio resulted in 64% mean compliance followed by 63% mean compliance. Daniel’s 5:1 ratios resulted in 67% mean compliance followed by 32% mean compliance. The 3:1 ratios resulted in 14% mean compliance followed by 8% mean compliance. The 1:1 ratios resulted in 0% mean compliance followed by 3% mean compliance.
Data were also collected on the frequency of high-p instructions that needed to be repeated for each participant. For Jake, there was a total of 115 high-p instructions delivered across all ratio interventions and he needed a total of 18 of those instructions repeated. That is, Jake displayed compliance to 84% of all the high-p instructions that were delivered during the study. For Daniel, there was a total of 117 high-p instructions delivered across all ratio sequences, and he needed 13 of those instructions repeated. Therefore, Daniel displayed compliance to 89% of the high-p’s that were delivered during the study. Finally, Paul had a total of 75 high-p instructions presented to him over all ratio sequences and he required 8 instructions be repeated. Thus, Paul exhibited compliance to 89% of the total high-p instructions that were delivered.

The social validity survey, which was administered to a parent following the generalization probes, was a Likert Scale survey with a scale ranging from 1 (not at all) to 5 (very much so). Results indicated that all parents found the high-p sequence preferable to compliance interventions they had previously tried (all parents ranked this a 5). Additionally, all parents reported that the likelihood of them using the high-p sequence to increase compliance was very high. Results for how effective they think the high-p sequence is as an intervention ranged between 4-5. In terms of the effectiveness of each individual ratio, all parents ranked the 1:1 ratio at a 4, and the 3:1 ratio at a 4. The 5:1 ratio ranged from 3-5. Jake’s mom
reported that she thought the 5:1 sequence was most effective and the most preferred ratio. Paul’s mom reported that she thought the 1:1 ratio was most effective and the most preferred. Daniel’s mom reported that she thought the 5:1 sequence was most effective, but the 1:1 ratio was most preferred.
Discussion

For all participants, the 5:1 ratio intervention was most effective to increase compliance to the low-p instruction, compared to their baseline levels of compliance. Following the 5:1 ratio, for all participants, compliance increased second most during the 3:1 ratio intervention, and increased the least during the 1:1 ratio intervention. These results suggest that increasing the number of high probability instructions, above the commonly used 3:1 ratio, may be more beneficial at increasing compliance to low-probability instructions.

The results for Paul suggest that the high-p instructional sequence is an effective intervention across all ratio sequences. Of the three participants, Paul’s compliance increased the most across all ratios. Whereas both the 5:1 and 1:1 ratio sequences resulted in 100% compliance to the low-p instruction the first time they were conducted only the 5:1 ratio resulted in 100% compliance both times this sequence was conducted. The second time the 1:1 ratio sequence was conducted, it resulted in a mean compliance of 86%. The 3:1 ratio sequence resulted in a mean compliance of 93% both times this ratio phase was conducted.

Results of Paul’s choice probes suggest that he may prefer the 3:1 ratio intervention. However, during all choice probe training sessions, Paul chose the card associated with the 5:1 ratio sequence. This suggests that when the reinforcers
were visible to him, he had a preference for the card associated with the highest quantity of reinforcers. It is possible that there were not enough prior pairings of the cards and reinforcer ratios for Paul to associate the two when the reinforcers were not visible upon selection. Paul displayed 100% compliance during both generalization probes. Both probes were run by his mother. The first probe represented baseline conditions (presentation of low-p alone) and the second probe was run using the 5:1 ratio sequence intervention.

The results for Jake suggest that the high-p instructional sequence is effective to increase his compliance across all ratio sequences as well. For Jake, the 5:1 ratio increased compliance to the low-p instruction the most, followed by the 3:1 ratio sequence, and finally the 1:1 ratio sequence, which resulted in the lowest compliance increases. These intervention effects were repeated when the ratio sequences were conducted again. His mean compliance was highest in the second 5:1 ratio, reaching 90%. His highest mean compliance in the 3:1 ratio was 77%. Jake’s highest percentage of mean compliance in the 1:1 ratio was 64%.

The results of Jake’s choice probes suggest that he may have a preference for the 1:1 ratio sequence because he chose the card associated with this ratio most often. However, these results may not reflect a true preference for Jake. When running choice training sessions, Jake displayed a preference for sequencing his choices, specifically in a 1, 3, and 5 order. Experimenters tried to break up this
sequencing by having him engage in forced choice response trials for each card before the choice probe. However, these forced choice trials did not seem to have an effect on the association between card and reinforcer quantity, because when the 3 cards were presented in front of him, he would choose the card that came next from where he left off in the 1, 3, 5 sequence order. It appeared that his preference for sequencing his responses was more preferred than any quantity of edible or tangible reinforcers. During generalization, Jake complied to both probes. Each generalization probe was conducted by his mother. He demonstrated 100% compliance when only the low-p was presented, and when the 5:1 ratio intervention was issued before the presentation of the low-p instruction.

The results for Daniel suggest that the high-p instructional sequence may not be an effective intervention to increase his compliance to low-p instructions, seeing as how his compliance during intervention phases did not increase much above his baseline levels of compliance. However, even though the high-p sequence may not be effective to increase compliance to acceptable levels, the same pattern of responding that was noted with the other two participants was noted for Daniel as well. That is, Daniel’s highest increases in responding were observed during the 5:1 ratio, second highest in the 3:1 ratio, and the least amount of compliance increase was observed in the 1:1 ratio sequence. For Daniel, the delivery of an edible item (identified via a preference assessment) contingent upon
compliance to the low-p instruction was necessary to increase compliance.

Daniel’s choice results demonstrate that he may not have a preference for a specific choice ratio. The first time a choice probe was conducted he chose the red card (associated with the 1:1 ratio), the second time he chose the green card (associated with the 3:1 ratio), and on the last choice probe he chose the blue card (associated with the 5:1 ratio). During generalization, Daniel did not comply to either probe. Each generalization probe was conducted by his mother. His compliance was 0% when the low-p was presented alone and 0% when the 5:1 ratio intervention was used before presenting the low-p instruction.

It was interesting to note that when returning to baseline phases, responding was somewhat variable across all 3 participants. However, any persistence, or lack thereof, of responding in baseline that was seen may not be a true measure of response persistence, because the treatment and baseline sessions were not run back to back. Instead there was at least a day in between all treatment and baseline sessions. For example, Paul’s compliance immediately dropped down to 0% in each baseline phase after the 5:1 ratio. This appears interesting since his response persistence to the low-p was highest in the 5:1 ratio. However, since there was not temporal contiguity between the 5:1 treatment phase and subsequent baseline phase, it would be hard to attribute the effects of the intervention to the levels of responding in baseline. Jake’s levels of responding in baseline do not start out low
initially, but instead, start high then drop as the phase continues. This could be due to the fact that Jake was manding for his edible reinforcer during baseline phases, even though there was no history of pairing edibles with compliance for his low-p instruction. He would comply with the low-p instruction (putting a toy in a box) then stare at the experimenter and say, “Dorito please”. It is possible that the change in conditions between phases was not salient enough to exert control over his responding. Daniel’s responding in baseline are the only data that start low and remain low throughout the entirety of the experiment. However, his responding during treatment sessions did not demonstrate much of an increase in compliance over baseline levels of responding. Overall, the results of the choice were surprising, given that none of the participants selected the condition including the most reinforcers.

Ratio training sessions were conducted before choice probes in order to better help the participants associate the ratio with the specific number of reinforcers they would receive in that ratio. It was also possible that ratio training could have been conducted by asking the participants the specific number of instructions, with reinforcer delivery, when the card was chosen. However, it would be difficult to determine if the participant was making their choice based on preference for instruction quantity or reinforcer quantity. Due to the reason that the instructions were high-probability instructions and compliance was likely (response
rates over 80% in pre-assessment) experimenters decided to correlate the ratio cards with reinforcer quantity for the participants. It was hypothesized that the 5:1 ratio would be chosen most often since responding was met with reinforcement most often in this ratio. However, none of the participants demonstrated a preference for this ratio sequence. This could be due to multiple reasons.

As mentioned before, one of the participants, Jake, showed a clear preference for sequencing his choices over any edible or tangible preference. Paul choose the 5:1 card most often during ratio training, however he only chose that card once during the choice probes when the reinforcers were not visible. This could be due to insufficient pairings of the cards with the specific reinforcer quantity beforehand. A greater frequency of pre-choice pairing trials may have led to an increased association between the ratio cards and reinforcer quantity. Daniel’s low levels of responding during intervention suggest that most of the high-p ratios were not effective at building up enough momentum to increase compliance to the low-p instruction. In other words, the amount of reinforcement delivered prior to presentation of the low-p did not differentially affect his responding across ratio sequences. Given these data, Daniel may not have a preference for different reinforcer quantities. Thus, he would not display a preference during the choice probes. This was supported by his results of choosing a different card for each choice probe. It is important to note that all ratio training sessions were conducted
post intervention phases and immediately prior to running choice probes. It is possible that results would have differed if training sessions were conducted in the beginning, or continuously throughout the study. Even though participants were made to engage in an observing response of the card prior to running the corresponding phase, this may not have been enough to help the participants associate the card and the ratio sequence.

During the last phase of the study the experimenter programmed and tested for generalization by having a parent run one baseline probe and one probe of the ratio that resulted in the highest increase in compliance (5:1 ratio for each participant). The baseline probe was conducted in order to determine if the effects of the intervention could be generalized to a novel person without the use of the intervention. The results for both Jake and Paul suggest that there was a spread of effects of the intervention, seeing as how both participants had 100% compliance when it was conducted. Daniel’s results suggest that the effects of the intervention did not generalize when a baseline probe was conducted with his parent. However, for this participant, there was not much of an increase in compliance when the intervention was used throughout the study. A 5:1 ratio probe was conducted as well to determine if the intervention could be run with a novel individual, and the same results could be obtained. The results for both Jake and Paul suggest that the 5:1 ratio intervention could be effectively conducted with a novel individual, seeing
as how their compliance was 100% during this probe. However, even though both participants demonstrated that the effects can spread to a parent while the session is conducted in the clinic, it is unknown whether we would see the same effects in different environments. Daniel’s results suggest that the intervention that resulted in the highest increases in compliance for him may not be effectively run with a novel person. His compliance was 0% during the 5:1 ratio probe run by his mother. Although, once again, Daniel’s responding did not persist during intervention phases, so it was likely that his responding would not persist in the presence of a novel person.

The results of the social validity survey showed that all parents found the high-p sequence preferable to other compliance interventions they have previously tried. This preference for the high-p instruction sequence may be due to the fact that it is a relatively simple procedure to implement, and does not involve much effort on behalf of the parent to gain compliance. Jake’s mom reported that she found the 5:1 sequence to be most effective and most preferred. This is most likely because this is the ratio sequence that increased her child’s compliance to the low-p instruction the most. Paul’s mom reported that she found the 1:1 sequence to be the most effective and the most preferred. It is reasonable that the 1:1 sequence would be most preferred, due to the fact that the least amount of effort is associated with the implementation of this sequence. Additionally, even though her child’s
compliance may have increased the most during the 5:1 ratio sequence, it is possible that she chose the 1:1 as the most effective ratio since Paul’s compliance greatly increased across all ratio sequences. Daniel’s mom reported that she found the 5:1 sequence to be most effective and the 1:1 sequence to be most preferred. These are reasonable results seeing as how Daniel’s compliance increased the most in the 5:1 ratio, but the 1:1 ratio is easiest to implement.

The results for all 3 participants suggest that, in order to increase compliance to a low probability instruction, it may be necessary to increase the amount of high-p’s that are typically used in the high-probability instruction sequence. These results are in accordance with the idea behind behavioral momentum theory (the more reinforcement provided before the disruptor the more the response will persist) as well as in accordance with previous research. The two studies that have looked at different high-p ratios have found that responding is more likely when there are a greater number of high-p’s presented before the low-p. Axelrod & Zank (2012) tried fading the number of high-p’s in the sequence from 3:1 to 1:1 and found that compliance to the low-p instruction only maintained for one out of their three participants. Additionally, Belfoire, Basile, & Lee (2008) conducted a study in which they attempted to fade the amount of high-p demands. In their first intervention researchers presented 3-5 high-p’s before the low-p and in their second intervention they presented 1 high-p before the low-p. They found that compliance
dropped from a high of 85% to a high of 77% when switching interventions. The current study is in alignment with this previous research, in that it provides support for the idea that presenting more high-p’s before presenting the low-p may lead to a greater increase in compliance. Furthermore, for two out of the three participants in the present study, the 3:1 ratio was more effective at increasing compliance compared to the 1:1 ratio, providing additional support for this idea. Given that the high-probability instruction sequence is such a widely used intervention in clinics, clinicians should take these results into consideration when implementing the high-p sequence with clients. As mentioned before, a 3:1 ratio is what is most commonly used. However, given the results of the present study combined with the results of previous literature, clinicians should consider increasing this ratio to a 5:1 ratio.

The current study is not without limitations. Given that no participant chose the same card for all three choice probes, it is possible that the relation between the ratios and cards may not have been well established enough for them to exert control over the participants responding. Ratio training sessions were only conducted before choice probes and after all intervention phases had been completed. It may have been more beneficial to run the ratio training sessions throughout the entirety of the experiment, in order to help the participants better establish this association. Second, it was determined in the beginning of the experiment that edibles did not function as a reinforcer for Paul. Due to this, praise
was delivered contingent upon compliance to the high-p instruction. However, in order to keep consistent with how baseline was run, praise was also delivered contingent on compliance to the low-p instruction. While it is still possible that his persistence in responding to the low-p instruction was due to the buildup of reinforcement embedded in the high-p sequence, it may also be possible that the response persistence was due to the reinforcement delivered contingent on compliance to the low-p instruction. Third, the high-p sequence was only effective for two out of the three participants. A contingent access phase was needed in order to increase Daniel’s compliance. Due to his low levels of compliance during the intervention phases, there is not much differentiation in responding across the three different ratios. Nevertheless, even though there is not much of an increase in responding, his results do show that the 5:1 ratio was most effective.

Fourth, the recommended interprompt time of 1-2 seconds was sometimes difficult to keep consistent when the participants were given 10 seconds to comply with the high-p instructions. This was not a problem for both Paul and Daniel, but was challenging for Jake. Given that Paul received praise as a reinforcer, this was easy to deliver quickly to ensure a 1-2 second interprompt time. Additionally, Daniel’s edible reinforcers were cut into very small pieces, and he was able to consume them within the 1-2 seconds between the instructions. However, even though Jake’s edible reinforcers were also cut into small pieces, he took more time
consuming them than did Daniel. Contingent on compliance to the high-p instruction Jake would be given his highest preferred edible. Then before eating it he would examine the edible for a few seconds, which occasionally disrupted the interprompt time. Experimenters tried to fix this by guiding Jake’s hand to his mouth immediately when the edible was delivered. This physical prompt brought the interprompt time back down to 1-2 seconds. However, the initial delays in consumption affected the interprompt time treatment integrity. Finally, the present study included three participants in the experiment. It would have been more beneficial to increase the sample size, in order to note the effects across a larger range of individuals.

This study opens up a few directions for future research. In terms of determining a ratio preference, it may be better (and easier) to assess this with individuals who have good language skills. All three of the participants in the current study displayed deficits in spoken language, which is why experimenters used colored cards to associate the ratios. However, future researchers could conduct the same intervention phases with individuals who have more developed language, this way they could simply ask participants about their preferences. Additionally, future research could be done on different ratio sequences. The current study used 1:1, 3:1, and 5:1 because 3:1 is the most widely used ratio, and experimenters wanted to pick ratios that were evenly above and below 3:1.
However, if future research helps confirm that more high-p’s lead to a greater increase in compliance, then experimenters could examine ratios even larger than 5:1.

Furthermore, given that the high-probability sequence is such a widely used intervention it may be beneficial to create a brief ratio assessment for clinicians to use with their clients. Even though the results of the present study provide support for the idea that the 5:1 ratio is most effective at increasing compliance, it is possible that different ratio sequences will be effective for different individuals. A brief high-p ratio assessment may be a useful tool for clinicians to determine a most effective ratio. Additionally, to improve upon the current experiment, researchers could conduct a probe at the beginning of the experiment with a novel individual, in order to compare to the results of the probe at the end of the experiment. This way researchers could be more sure that the behavior would still occur at the end, if the intervention had not been conducted first. Future researchers could also look at response persistence to different instructions using the varied ratio intervention. It would be interesting to use this intervention, then run a generalization phase to see if the effects of the high-p intervention generalize to different low-p instructions. Finally, researchers could look at delivering varied amounts of reinforcement for compliance to the high-p instructions in the sequence. They could look at comparing the same ratio sequence, but with differing magnitudes of
reinforcement. For example, future research could compare a 5:1 ratio sequence in which a reinforcer is delivered for compliance with every high-p, to a 5:1 sequence in which a reinforcer is delivered for compliance to every other high-p. This would be interesting to help determine if every high-p needs to be reinforced with a highly preferred item, or if it is possible for reinforcement quantity to be faded.
References


Appendix
Social Validity Survey

Name: _______________________________

Please answer the following questions regarding the study.

1. The purpose and procedures of the high- p sequence have been thoroughly explained to me?

   1  2  3  4  5

      Not at all Neutral Very much so

2. How effective do you think the high- p sequence is at increasing compliance?

   1  2  3  4  5

      Not at all Neutral Very much so

3. How effective do you think the 1:1 high-p ratio is?

   1  2  3  4  5

      Not at all Neutral Very much so
4. How effective do you think the 3:1 high-p ratio is?

1 2 3 4 5

Not at all Neutral Very much so

5. How effective do you think the 5:1 high-p ratio is?

1 2 3 4 5

Not at all Neutral Very much so

6. Does the high-p sequence sound preferable to other procedures you may have used to increase compliance?

1 2 3 4 5

Not at all Neutral Very much so

7. What is the likelihood of you using the high-p sequence to increase compliance?

1 2 3 4 5

Not at all Neutral Very much so

8. Which ratio sequence do you prefer?

1:1 Sequence 3:1 Sequence 5:1 Sequence
Figure 1: Results of the low probability instruction pre-assessment for Paul.
Figure 2: Results of the low probability instruction pre-assessment for Jake.
Figure 3: Results of the low probability instruction pre-assessment for Daniel.
Figure 4: Results of the high probability instruction pre-assessment for Paul.
Figure 5: Results of the high probability instruction pre-assessment for Jake.
Figure 6: Results of the high probability instruction pre-assessment for Daniel.
Figure 7: Results for Daniel’s compliance to the low-p instruction during baseline, high-p instruction sequences, choice probes, and generalization probes. The first data point in the generalization probes phase represents baseline conditions and the second data point represents the 5:1 ratio intervention.
Figure 8: Results for Jake’s compliance to the low-p instruction during baseline, high-p instruction sequences, choice probes, and generalization probes. The first data point in the generalization probes phase represents baseline conditions and the second data point represents the 5:1 ratio intervention.
Figure 9: Results for Daniel’s compliance to the low-p instruction during baseline, high-p instruction sequences, choice probes, and generalization probes. The first data point in the generalization probes phase represents baseline conditions and the second data point represents the 5:1 ratio intervention.
Figure 10: Mean percentage compliance for each participant across both phases of the 1:1, 3:1, and 5:1 ratios.
Figure 11: Results of each participant’s choice preference during the choice phase.