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COMPARISON OF GENERAL AND HIGH PROBABILITY MOTOR SEQUENCE ATTENTIONAL CUES FOR INCREASING VOCABULARY IDENTIFICATION IN STUDENTS WITH AUTISM

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THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in Education
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By

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ABSTRACT OF THESIS

COMPARISON OF GENERAL AND HIGH PROBABILITY MOTOR SEQUENCE ATTENTIONAL CUES FOR INCREASING VOCABULARY IDENTIFICATION IN STUDENTS WITH AUTISM

The present study assessed if embedding high probability responding (high-p) into an attentional cue, versus a general attentional cue (GA), would result in students with moderate and severe disabilities displaying differential responding for grade level science vocabulary word identification. Using an adapted alternating treatments design, three students with autism spectrum disorder received an intervention involving a GA cue and one with a high-p to determine which is more efficient. Hypothesized results are that the attentional cue with a high-probability motor sequence would be more effective for teaching vocabulary word identification.

KEYWORDS*:* behavior momentum, high probability responding, attentional cues, high-p, autism spectrum disorder

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November 17, 2017

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Section 1: Introduction

Since the creation of the No Child Left Behind Act in 2002, now referred to as the Every Student Succeeds Act (2015), states are required to develop accountability-testing standards for all students including those with autism spectrum disorders (ASD) and moderate and severe disabilities (MSD). States have developed alternate assessments for the 1% of the school population with the most severe disabilities that test these students' academic progress on alternate achievement standards aligned to the core content academic standards.

In recent years, there has been a shift in curriculum for students with MSD, increasing the amount of grade level academic content to which students with MSD are exposed. While historically students with MSD have received primarily a functional education, curriculum has evolved to also include an academic standards-based education for these students (Courtade, Jimenez, Spooner, & Browder, 2011). Courtade et al. (2011) stated the reasons a standards-based curriculum is appropriate for students with MSD include (a) the right to full educational opportunity; (b) the relevance of a standard-based curriculum to today's culture; (c) the unknown potential of students with MSD; (d) the fact that functional skills are essential, but not a prerequisite to academic skills; and (e) the mindset of improved student growth. By teaching academic content to students with MSD, educational equality is promoted and educators hold all students to high academic standards.

While states require educators teach academic standards to students with MSD, more research is needed to find evidence-based practices (EBPs) for teaching this content across academic content areas. Systematic instruction using constant time delay, task

analysis, and system of least prompts, has been shown by research to be effective in teaching students with MSD new academic skills (Spooner, Knight, Browder, Jimenez, & DiBiase, 2011). Researchers also have taught students with MSD vocabulary related to both social studies and science. In one study, Schenning, Knight and Spooner (2013), used the model-lead-test strategy, as well as an error correction procedure to teach students with ASD to use a graphic organizer to answer and problem solve social studies content questions. The researchers indicated that it was essential to teach vocabulary as a prerequisite skill both with and without visual supports prior to teaching the content. In another study teaching science, Browder et al. (2010) used systematic instruction and error correction to teach vocabulary effectively to students with MSD. Students in this study improved their score on a science vocabulary test by 16.1% by reviewing the vocabulary words at the end of each lesson. In 2009, there were 13 states that assessed science content as part of the state alternate assessment testing based on alternate achievement standards (AA-AAS, Altman et al., 2010). The number of states requiring science as part of their AA-AAS will continue to expand, thus increasing the importance of this content area.

In addition to effective teaching strategies, attentional cues are an important component to help ensure students with ASD are attending to the material presented. In a 2008 study by Ledford et al., researchers paired a general attentional cue ("Look") and a specific attentional cue ("Tell me the letters") with CTD to teach students with ASD sight word reading. The study found that even in a small group setting, CTD paired with the attentional cues help students with ASD learn not only the targeted sight words, but also high levels of observational and incidental information. Two of the participants in the

study had difficulties with attention noted was a weakness relevant to the study, and was something that impacted their learning. These students went from 0% correct responding for target information to 100% and 83% correct responding. Additionally they also increased from 0% correct responding for observational information to 100% and 67% correct responding after intervention.

Researchers have also investigated the effectiveness of using a general (e.g., eye contact) or specific (e.g., selected relevant aspect of target skill) attentional cue to gain students' attention prior to delivering a task direction. In a study by Schoen and Ogden (1995), these two types of attentional cues were compared. While both types of attentional cues were effective in gaining the attention of students' attention and increasing their observational learning, the specific attentional cue condition took an average of 65 less sessions to reach criterion. Students responded promptly to the word recognition task under both cuing procedures, averaging a 55% increase in level change between probe and intervention condition under the general attentional cue (GA) and 57% increase under the specific attentional cue. All students also acquired non-target words taught to their peers as a result of observational learning and attentional cueing. While data support the effectiveness of using attentional cues to gain student attention, there is little research to investigate if embedding behavior momentum strategies into an attentional cue would have a similar effect.

Not only is gaining the attention of students an important element of instruction, it is equally as important to ensure students are motivated to learn and are compliant to investigator demands. Behavior momentum and high-p strategies have been shown to help increase compliance in students with disabilities. High probability (high-p)

command sequences involve requesting an individual to perform multiple tasks that they have previously mastered, before asking them to complete a low-p task or more difficult task. (Mace et al. 1988) In a 2008 study, Belfiore, Basile, and Lee used behavior momentum in the form of a high-p command sequence to increase compliance of classroom tasks, such as hand-washing and cleaning up materials, by an elementary student with Down syndrome. Prior to implementing the high-p sequence, the student was only completing 13% of requested tasks; however, after the intervention he completed 80% of the requested tasks.

The use of behavior momentum has been successful in increasing academic tasks and behavioral compliance for students with low incidence disabilities, emotional and behavioral difficulties, and cognitive disabilities (Cowan, Abel, & Candel, 2017). Lee, Stansberry, Kubrina and Wannarka (2005), explored the use of behavior momentum strategies during math academic tasks. The study found that by having participants complete math problems they had previously mastered, participants performed novel math problems with higher acquisition rates than without the high-p problems. Additionally, Vostal and Lee (2011) found that using behavior momentum strategies was effective in increasing continuous reading for students with emotional behavior disorders. In the study, a passage that was two levels below the participants' grade level was read immediately prior to reading one on grade level. Results found that not only were participants more likely to continue reading a passage, but their fluency and recall also was improved.

The purpose of this study was to investigate if embedding high-p into an attentional cue (high-p condition), versus a GA (general cue condition), would result in

differential learning for grade level science vocabulary word identification in students with ASD. The following research question was addressed in the study: What are the differential effects of a GA cue only condition and a high-probability motor sequence attentional cue condition on science vocabulary acquisition of elementary students with ASD?

Section 2: Research Question

The following research question was be addressed in the study: What are the differential effects of a GA cue only condition and a high-probability motor sequence attentional cue condition on science vocabulary acquisition of elementary students with ASD?

Section 3: Methods

Participants and Setting

Inclusion criteria. Inclusion criteria for the participants included students who (a) are between the ages of 7 and 12 years old, (b) are in third through fifth grades, (c) are identified as having a intellectual disability with an IQ and adaptive scores below 70, (d) have a diagnosis of ASD, (e) have sight word identification listed as a weakness on his or her IEP and a corresponding IEP goal, (f) have a functional form of communication and ability to respond to questions verbally, (g) have vision and hearing within functional limits, (h) have a response time of 5 s or less seconds when presented with a known item, (i) have an average of 90% or better attendance over the course of a school year, (j) have the ability to match like items, (k) have parental/guardian consent to participate in the study, and (l) have given participant assent. Each participant's ability to perform the identified prerequisite skills were assessed by investigator observation and record review.

Students. Four participants from a self-contained special education classroom were recruited to participate in the study. Participants' grade levels ranged from third to fifth. These participants attended a public elementary school.

Lola was a 9-year-old female with ASD who was in the fourth grade. She received special education services in a self-contained classroom for 75% of her school day. During her most recent evaluation at age 7, Lola was given the Stanford-Binet Intelligence Scales, Fifth Edition (Roid, 2003) and had a total battery score of 46. She scored highest in Quantitative Reasoning and lowest in Working Memory. A Vineland Adaptive Behavior Scales-II (ABS-II, Sparrow, Cicchetti, & Balla, 2005) also was completed. Lola had a total battery score of 69 with her highest area being Motor Skills

and the lowest being Communication. Based off these assessments, she qualified for participation in alternate assessment. Lola could read some high frequency sight words from index cards, but struggled to read them when they are in a sentence. She was able to identify 10 survival signs. Lola could write her first name independently and with minimal prompting, the alphabet, numbers up to 9, and some three letter words (cat/dog). She correctly answered "what" questions about a story or activity and is beginning to also answer "who". She could trace short words, numbers, letters, and short sentences. She could draw basic shapes and pictures. Lola could identify all colors, basic shapes, numbers up to 20, and count to 20 before she starts skipping numbers. She could sort objects by two attributes (size/shape, color/size). Lola was able to count manipulatives set out in front of her, but struggles to count out a requested number of items independently. She received related services from the occupational therapist and speech language pathologist. The teacher noted that Lola demonstrated limited problem behaviors and was able to work on a moderate schedule of reinforcement. Her reinforcement system throughout the day was delivering an edible on a VR3 schedule and an earned break after completing all of her assigned work during a scheduled time.

Silas was an 8-year-old male with ASD who is in the third grade. He received special education services in a self-contained classroom for 70% of his school day. During his most recent evaluation in at age 6, he was given the Battelle Developmental Inventory, 2nd Edition (BDI-2, Newborg, 2004) and received a total battery score of 61 with his highest scores in Adaptive/Personal-Social and his lowest in Communication/Cognitive. He also was evaluated using an Adaptive Behavior Assessment System-II and received a total battery score of 69. Silas scored highest in

Conceptual/Social and lowest in Practical Domain. Based off these assessments, he qualifies for participation in alternate assessment. Silas was currently able to identify 80% of the words on the Kindergarten sight words list correctly. He was able to identify all letters of the alphabet, both upper and lowercase, and identify letters based off the sound they make. Silas could identify pictures of common items and answer basic questions about a story with the help of visual supports. He was able to complete matching tasks independently. Silas also was able to identify basic colors and shapes. He received related services from the occupational therapist and speech language pathologist. Based on observations and teacher interviews, Silas demonstrates deficits in his attention span. Teachers and therapists both noted that his progress in academic work was affected by his lack of ability to focus on a task for an extended period of time. Silas required high levels of frequent reinforcement throughout the day in the form of books, tickles, and verbal praise.

Louise was an 11-year-old, female with ASD who was in fifth grade. She received special education services in a self-contained classroom for 75% of her school day. During her most recent evaluation at age 8, she was given the Stanford-Binet Intelligence Scale, 5th edition and received a total battery score of 48, with her highest score being in Quantitative Reasoning and her lowest in Fluid Reasoning. An ABAS-II also was completed and Louise received a total battery score of 66. Based off these assessments, she qualified for participation in alternate assessment. Louise was able to read the majority of second and third grade level sight words. She knew sounds of each letter and was able to sound out most words shown to her. When Louise wrote a word she would sound it out and wrote the sounds she heard, generally her spelling is correct.

Reading was a preferred activity for her and she enjoys earning time with books or to complete reading type activities (e.g. Starfall). When writing, Louise used proper capitalizations and punctuation, but needed prompting to capitalize words when she types. Louise received related services from an occupational therapist and speech language pathologist. The teacher noted that Louise demonstrates limited problem behaviors and is able to work on a thin schedule of reinforcement. Her reinforcement system was delivering an edible on a VR3 schedule and an earned break after completing all of her assigned work during a scheduled time.

Grace was an 11-year old, female with ASD who was in fifth grade. She received special education services in a self-contained classroom for 75% of her school day. During her most recent evaluation at age 10, she was given the Stanford-Binet Intelligence Scale, 5th edition and received a total battery score of 69. An ABAS-II also was completed and Grace received a total battery score of 42. A Language Severity Scale given in 2014 indicated a profound mixed receptive and expressive language impairment that adversely affected her ability to interact with others, answer questions, follow directions, communicate information orally, and participate in educational activities across all academic areas. Based off these assessments, Grace qualified for participation in alternate assessment. Grace was able to recognize all pre-primer Dolch words and could read most three-letter words. She was able to identify all letters and letter sounds. Grace received related services from an occupational therapist and speech language pathologist. Based off a functional behavior assessment conducted in 2017, Grace also demonstrated problem behavior in the form of non-compliance and attention seeking through elopement. She had a behavior intervention plan in place to address these

behaviors. Grace's reinforcement system was primarily a token economy system in which she could earn highly reinforcing item such as iPad or computer.

Others. The investigator, who had 5 years of experience teaching students with MSD, was also the participants' special education teacher. She has a bachelors of science in education and is working towards completing her master's in Teacher Leadership in Special Education MSD with an additional ASD certificate. The investigator conducted all sessions of the study and collected data for each phase. The study was conducted during the investigator's third year working with her students. She had experience teaching at both elementary and middle school level in two different states. A teaching assistant that worked in the classroom was trained on data collection and the instructional procedures in order to collect inter-observer agreement (IOA) and procedural reliability data. The teaching assistant has worked in the classroom for 2 years.

Setting and instructional arrangement. This study took place in an urban elementary school in the southeastern region of the United States. The demographics of the school were the following: 80% White, 7% Hispanic, 5% African American, 5% Two or more races, 3% Asian/Pacific Islander, and 1% American Indian. The school was 47% female, 53% male, and had 27% students participating in a free or reduced lunch program. All sessions for the study occurred in a self-contained classroom for students with MSD. Sessions were completed in a one-to-one instructional arrangement. The participant and investigator sat side-by-side at a kidney table in the front of the room during all sessions of the study. There also were other teaching assistants in the classroom working with students at separate tables while the investigator conducted the study. There were a total of nine students in Kindergarten through fifth grade, who also

received daily services in this classroom. The room measured 10.67 m x 7.82 m. See Appendix A for a diagram of the instructional setting.

Materials

Throughout the entire study, index cards of different words were used to perform discrete trial sessions with the participants. The science vocabulary words were typed onto individual 5.08 by 8.89 cm cards in black Times New Roman with font size 36. Words were selected from each participant's grade level science vocabulary words (i.e., 4th grade participants learned 4th grade content science vocabulary).

Table 1
Stimuli Assigned to Students by Condition

	Lola	**Silas**	**Louise**	**Grace**
GA	Repel, parent, strength, glucose compare	Climate, volume, oxygen, protein, solution	Atmosphere, species, observation, velocity, membrane	Reproduction, predator, current, attraction, human
High- P	Matter, species, climate, protein, force	Erosion, particles offspring, membrane, system	Reproduction, predator, current, attraction, human	Atmosphere, species, observation, velocity, membrane
Control	Fossil, energy, trait, system, control	Temperature, degrees, animal, speed, organ	Pollen, consumer, ecosystem, instinct, solution	Pollen, consumer, ecosystem, instinct, solution

To ensure equal difficulty of content in each condition, the length of the words selected were within 2 letters of each other and had no more than two syllable difference. Two words beginning with the same letter were not assigned to the same condition. Additionally, two general education teachers assessed the words assigned to each condition to determine if they considered the words taught in one condition to be as equally difficult to learn as the words taught in the other condition. By using these criteria to assign the stimuli, it ensured equal difficulty across treatments. Additionally, words assigned to participant s in the same grade level were counterbalanced in different conditions. During sessions, the investigator used data sheets to record participant responses and a stopwatch to record the duration of each session.

Dependent Variable

The dependent variable of this study was the percentage of correctly identified science vocabulary words by each participant. A correctly identified vocabulary word was defined as the participant verbally responding with the correct word within 4 s of presentation of the stimulus and the task direction. A no response was defined as the participant not giving any verbal response after 4 s of the task direction. Additionally, efficiency measures were calculated for each condition. Efficiency measures included number of trials to criterion, duration of session, and number of errors to criterion. The frequency and duration of any problem behaviors was noted in the comment section of the data set to be considered when calculating the duration of each session. The instructional objective for the study was: When presented with a collection of flash cards containing science vocabulary words, the participant will correctly state each word, within 4 s of the task direction, for 10/10 trials for two consecutive sessions.

Experimental Design

An adapted alternating treatments design was used during this study (Gast & Ledford, 2014). Each condition was applied to a different set of stimuli that were of equal response difficulty but also were functionally independent. Experimental control was demonstrated by a consistent level or trend difference occurred between the two intervention conditions and when no change occurred in the control set of stimuli in the comparison phase. The control set of words helped detect potential threats to internal validity including maturation or history effects.

General Procedures

An adapted alternating treatments design was used to compare the efficiency of three different conditions with varying attentional cues: high-p condition, GA condition, and control condition. Participants underwent three sessions each day, and each session consisted of 10 trials. To begin the study, participants underwent a probe condition to establish baseline performance on their ability to verbally identify 15 science vocabulary words selected from a screening. After a minimum of five baseline sessions and when data were stable, a comparison phase was initiated. During this phase, participants were exposed to three different sets of science vocabulary words. The first set of words was taught in a GA condition to gain the participants' attention. The second set was taught in an attentional cue with a high-p motor sequence condition. The third set of words was presented in a control condition. An error correction procedure was used to teach participants vocabulary word identification in both the GA and high-p conditions, while no intervention was applied to the control set of words. The session for each condition took place at three different times during the school day. One session for all three

conditions took place during each data collection day. The session time for each condition was also counterbalanced across different times of day, with at least an hour between sessions, to help prevent multi-treatment interference. The order of the conditions was selected using a computerized randomizer, with the same condition occurring at the same time of day, no more than twice in a row. After participants reached criterion (two consecutive sessions at 100%) in the GA and high-p condition, maintenance probes will be periodically conducted. Additionally, after participants reached criterion in both GA and high-p, the control set of words was taught using the most efficient attentional cue. If data did not show one to be more efficient than another for a particular participant, the participant was given the choice as to which attentional cue they wanted to be used.

Procedures

Screening. Prior to baseline, the investigator conducted a screening session with each participant to determine which science vocabulary words they did and did not know. Each participant was shown 20 grade level science vocabulary words from the Tennessee alternate assessment vocabulary list (i.e., TCAP-Alt). Each participant underwent three screening session consisting of 20 trials. Any word the participant got correct in at least two of the three sessions was excluded from the study. During each trial the investigator held up an index card with a typed word on it and give the task direction of "What word?" A correct response was recorded if the participant verbally stated the correct word on the card within 4 s of the task direction. An incorrect response was recorded if the participant verbally responded with any response other than the word on the card. A no response was recorded if the participant did not say any word within 4 s of being

given the task direction. Reinforcement was given for each correct response in the form of verbal praise. Incorrect responses were not corrected and verbal praise (e.g., ”Good job working”) was given to participants intermittently after approximately every other trial (VR-2). See Appendix B for the data sheet that was used during screening. Words were selected to be stimuli in the program based on incorrect responses during screening. A total of 15 words were selected and assigned to the three different conditions.

A screening also was done to find brief motor tasks that each participant had a high probability of completing for the high-p condition of the study. Each participant was asked to perform 10 different tasks that took relatively the same amount of time to complete (e.g., touch your nose, touch your head, stand up, sit down). If a participant was unable to perform a task, or did not perform it correctly within 2 s of the direction being delivered, it was excluded from the high-p condition of the study. Each participant was able to complete all the movement tasks that were part of the screening. See Appendix C for the data sheet used during the motor sequence screening.

Baseline. Baseline sessions were conducted prior to beginning the comparison phase of the study. Sessions occurred in the special education classroom during instructional times throughout the day. During baseline, 15 words were selected for each participant (five words for each condition) based off the screening data and inclusion criteria. Baseline sessions were conducted with each participant individually. The investigator told the participant it was time to work, waited for eye contact with the participant, gave the task direction, “What word?” and held up one card at a time. If the participant verbally responded with the correct word within 4 s of the task direction, the investigator recorded a “+” and delivered non-descriptive verbal praise (i.e., “Good

job!"). If the participant verbally responded with the wrong answer within 4 s of the task direction, the investigator recorded a "-" and praise the participant for working. If the participant did not respond with an answer within 4 s, the investigator recorded a "NR" and did not deliver any feedback. Verbal praise was provided to participants for attending to the task on a variable ratio of 3 (VR3) schedule. After the participant completed 15 trials (each word once), the session ended and the investigator praised the participant for working and delivered a tangible reinforcer based off the participant's behavior management plan. Each participant underwent a minimum of five baseline sessions that continued until baseline data were stable. See Appendix D for a sample data sheet.

Instructional Procedures

The comparison phase of the study consisted of three different conditions (e.g. GA cue, high-p motor sequence attention cue, and control). One session for each condition took place during each data collection day, with at least 1 hour between sessions. The times of the trials for each condition were rotated each day. During GA and high-p sessions, the investigator used an error correction procedure to teach the words. The investigator presented the stimulus and provided 4 s for the participant to respond. For correct responses the investigator delivered descriptive verbal praise (e.g., "Good job, this word is energy"). For incorrect responses, the investigator said the correct answer and had the participant repeat back the answer. For no responses, the investigator delivered the same consequence as an incorrect response. In order to help the participants distinguish between conditions, different colored data sheets were used for each condition. The GA condition used yellow data sheets, the high-p condition used pink data sheets, and the control condition used green data sheets.

General attentional cue. In the GA condition, participants were individually brought to the front table and told that it is time to work on science. Once the participant was seated, the investigator gave the attentional cue of "PARTICIPANT, look at me when you're ready." Once the participant was looking, the investigator held up the word card and asked, "What word?" If the participant did not look within 4 s of the attentional cue the investigator repeated the direction up to three times until the participant looked at them. If the participant did not look at the investigator after the third direction, a no response was recorded for that trial. A sample data sheet for all comparison conditions is included in Appendix E. Each session consisted of 10 trials (2 trials per word). At the conclusion of the session, the investigator verbally praised the participant, and delivered a tangible reinforcer based off the participant's behavior management plan. Criterion for this condition was two consecutive sessions with 100% (10/10 trials correct) accuracy. Participants continued with sessions until they reached criterion.

High-probability motor sequence attentional cue. Sessions for the high-p condition were similar to the GA condition; however, the attentional cue consisted of three motor movements that the participant had mastered based off screening data. These movements were randomly chosen from the list generated during in the screening phase of the study. Once the participant was seated at the front table, the investigator delivered the attentional cue with three movements, "PARTICIPANT, touch your _____, touch your _____, and touch your _." These directions were given at a brisk pace (i.e., less than 1 s between each command) and the next direction was given as soon as the participant had completed the previous request. The only condition to the order of selecting the movements from the screening was that if the participant was told to "stand

up" then "sit down" was always delivered in the same sequence. If the participant did not complete a part of the motor sequence chain, the investigator modeled the movement and had the participant repeat it. Once the participant completed all three tasks, the investigator immediately held up one of the word cards and asked, "What word?" Like in the GA condition, an error correction procedure was used and the definition of responses and the delivered consequences was also defined the same as in the GA condition. Each session consisted of 10 trials (2 trials per word). At the conclusion of the session, the investigator verbally praised the participant, and delivered a reinforcer for participating. Criterion for this condition was two consecutive sessions with 100% (10/10 trials) accuracy. Participants continued with sessions until they reached criterion.

Control. Each participant also completed a control condition. No intervention was applied to the control condition. Procedures for the control condition were identical to those used in baseline sessions. The only difference was the words used during this condition. Each session consisted of 10 trials (2 trials per word). Participants continued sessions in the control condition until they reached criteria for both the GA and high-p word sets. After participants reached criterion for both GA and high-p cue, they were taught the control set of words using the most efficient attentional condition. If one attentional cue was not more efficient than other, the participant was able to choose which they preferred.

Maintenance procedures. After a participant reached criterion in a condition, maintenance sessions were conducted once a week until the end of the study. These sessions were identical to baseline probes. Participants were shown the words from the mastered condition 1 time for a total of 5 trials each session. If a participant met criterion

in one condition but not another, the condition that met criterion received maintenance trials once a week while the other condition continued to receive instructional trials until criterion was met.

Generalization procedures. Two generalization pre and post-tests were conducted prior to beginning the comparison condition and after criterion was reached in a condition. Sessions were identical to baseline, except a teaching assistant instead of the investigator conducted the sessions. Additionally, the investigator assessed each participant's ability to read the vocabulary words within a sentence. The investigator read a sentence to the participant and paused at the stimulus to see if the participant could read it in the context of that sentence.

Reliability

A teaching assistant that worked in the classroom was taught how to collect IOA and procedural fidelity prior to the study. The investigator first verbally explained the data sheets and procedures to the teaching assistant and then role played sessions until the teaching assistant was collecting reliability data with 100% accuracy. The trained observer collected reliability data in at least 20% of the sessions in each condition. Acceptable reliability data was set at 80% for both IOA and procedural fidelity. IOA data were figured using point-by-point agreement between the investigator's data and the trained observer's IOA data sheets. IOA was calculated using the following equation: $\frac{number\ of\ agreements}{number\ of\ disagreements} \times 100$ (Gast & Ledford, 2014). A task analysis was used to collect data on the investigator's procedural fidelity. The trained observer marked whether or not the investigator performed that steps listed in the task analysis. Procedural reliability was

calculated using the following equation: $\frac{observed\ completed\ steps}{planned\ number\ of\ steps} \times 100$ (Gast & Ledford, 2014). The data sheet used for both IOA and procedural reliability (Appendix F) was provided to the trained observer prior to the start of observed session. Procedural fidelity during baseline consisted of a check on the following investigator behaviors: gained attention of participant, showed the stimulus, gave the task direction "What word?", waited 4 s for a response, and recorded the participant's response. Procedural fidelity during GA consisted of a check on the following investigator behaviors: provided general attentional cue, showed the stimulus, gave the task direction "What word?", waited 4 s for participant response, provided correct the consequence and recorded the participant's response. Procedural fidelity during high-p conditions consisted of a check on the following investigator behaviors: provided 3 high-p motor tasks, showed the stimulus, gave the task direction "What word?", waited 4 s for participant response, provided correct the consequence and recorded the participant's response.

Section 4: Results

Reliability

Reliability data were collected in 20% of sessions for every condition. IOA and procedural fidelity was 100% for baseline. For the GA condition, IOA was 95% and procedural fidelity ranged from 98%-100%. For the High-P condition, IOA was 100% and procedural fidelity ranged from 95%-100%. For the control condition, IOA was 98% and procedural fidelity ranged from 95%-100%. Reliability data were also collected once during the maintenance phase. IOA was 95% and procedural fidelity ranged from 90%-100% for this phase. The mean reliability data for each teacher behavior is shown in Table 2.

Table 2

	Gain attention appropriately	Show Stimulus	"What word?"	Waits appropriate delay	Student response **(IOA)**	Provides correct consequences
Baseline	100%	100%	100%	100%	100%	100%
GA	98%	100%	98%	100%	95%	98%
High-P	98%	100%	100%	95%	100%	100%
Control	100%	100%	98%	98%	98%	95%
Maintenance	95%	100%	90%	95%	95%	90%

Effectiveness Data

Student responding data for Lola, Silas, Louise and Grace are shown in Figure 1. During baseline, Lola's data were stable and zero-celerating. She correctly identified the science vocabulary words with a mean of 0 out of 15. At the end of intervention, her responding increased to 100% in the GA condition, 100% in the high-p condition and 0% in the control condition. She reached criterion in the GA condition before she reached

criterion in the high-p condition. Lola's immediacy of effect was at a slower rate compared to the other participants in the study. She required 7 sessions in the comparison phase before she showed progress in both the GA and high-p conditions. Her data was also more variable than other participants. Prior to session 13 and after session 25, Lola had high rates of overlapping data across the GA and high-p conditions. After session 13, she displayed an accelerating trend in the GA condition while high-p remained zero-celerating until session 15. Data in the control condition remained zero-celerating in for all sessions. Lola met criterion for both the GA and high-p condition. After meeting criterion, a "best-alone" condition was also completed in which GA was used to teach Lola the control set of words. He went from 0% correct responding to 80% correct responding in the time frame of the study. Sessions for all conditions lasted between 1 and 3 minutes.

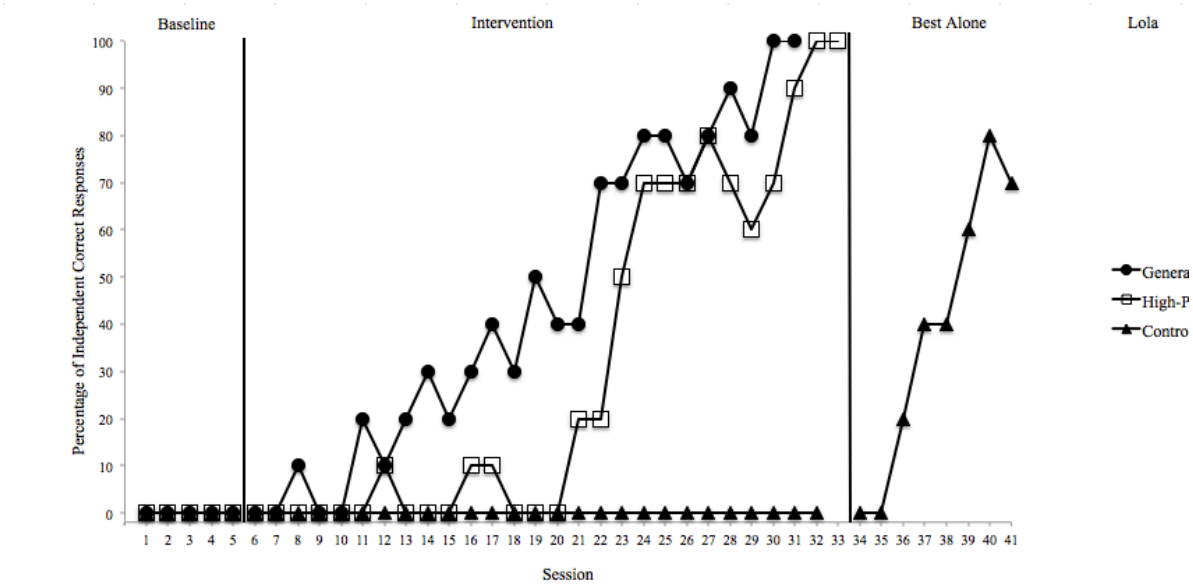
During baseline, Silas' data were stable and zero-celerating. He correctly identified the science vocabulary words with a mean of 0 out of 15. At the end of intervention, his responding increased to 100% in the GA condition, 100% (mean of 10/10) in the high-p condition and 0% (mean of 0/10) in the control condition. During maintenance probes, his responding was 100%. Prior to instruction, Silas was noted as having significant difficulties with attention and focus. Silas showed an increase in trend in the high-p condition first, and also first reached criterion in the high-p condition. He also showed a steady accelerating trend in the GA condition. There was very little overlapping between the data in the GA and high-p condition. Data in the control remained zero-celerating throughout all sessions. Silas met criterion for both the GA and high-p conditions. After meeting criterion, a "best-alone" condition was also completed in which high-p was used to teach Silas the control set of words. He went from 0% correct

responding to 100% correct responding. Sessions for all conditions lasted between 1 and 3 minutes.

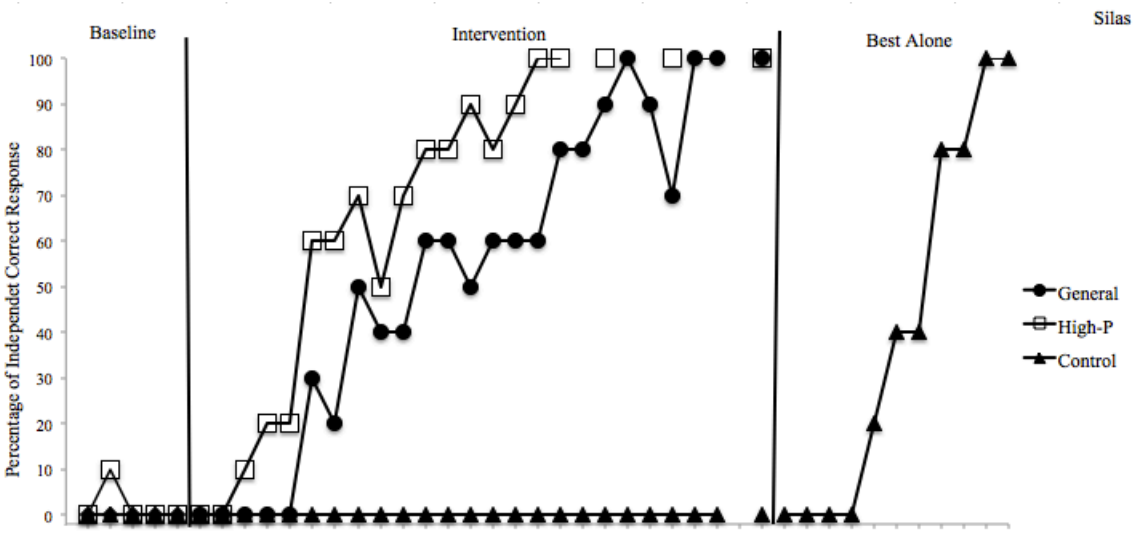
During baseline, Louise's data were stable and zero-celerating. During that time, She correctly identified the science vocabulary words with a mean of 0 out of 15. At the end of intervention, her responding increased to 100% (mean of 10/10) in the GA condition, 100% (mean of 10/10) in the high-p condition and 0% (mean of 0/10) in the control condition. During maintenance probes, her responding was 100% for both GA and high-p (mean of 10/10). Louise showed an increasing trend in the GA condition first, but reached criterion for both GA and high-p in the same number of sessions. She also had higher rates of correct responding in the GA condition until the last two sessions and there was minimal overlapping data between conditions. Data in the control condition remained zero-celerating throughout all sessions. Louise met criterion for both the GA and high-p conditions. After meeting criterion, a "best-alone" condition was also completed in which Louise choice GA to be used to teach her the control set of words. She went from 0% correct responding to 100% correct responding. Sessions for all conditions lasted between 1 and 3 minutes.

During baseline, Grace's data were stable and zero-celerating. She correctly identified the science vocabulary words with a mean of 0 out of 15. At the end of intervention, her responding increased to 100% (mean of 10/10) in the GA condition, 100% (mean of 10/10) in the high-p condition and 0% (mean of 0/10) in the control condition. During maintenance probes, her responding was 100% for both GA and high-p (mean of 10/10). Prior to instruction, Grace was noted as demonstrating frequent problem behaviors and non-compliance. Grace showed an increasing trend in the high-p condition first and also first reached criterion in the high-p condition. Data in all conditions had

high rates of overlapping until session 10. After session 10, Grace's percentage of correct responding was higher in the high-p condition than others, and continued to display and accelerating trend until criterion was reached in session 16. Data in the control condition remained zero-celerating throughout all sessions. Grace met criterion for both the GA and high-p conditions. After meeting criterion, a "best-alone" condition was also completed in which high-p was used to teach Grace the control set of words. She went from 0% correct



responding to 100% correct responding. Sessions for all conditions lasted between 1 and 3 minutes.



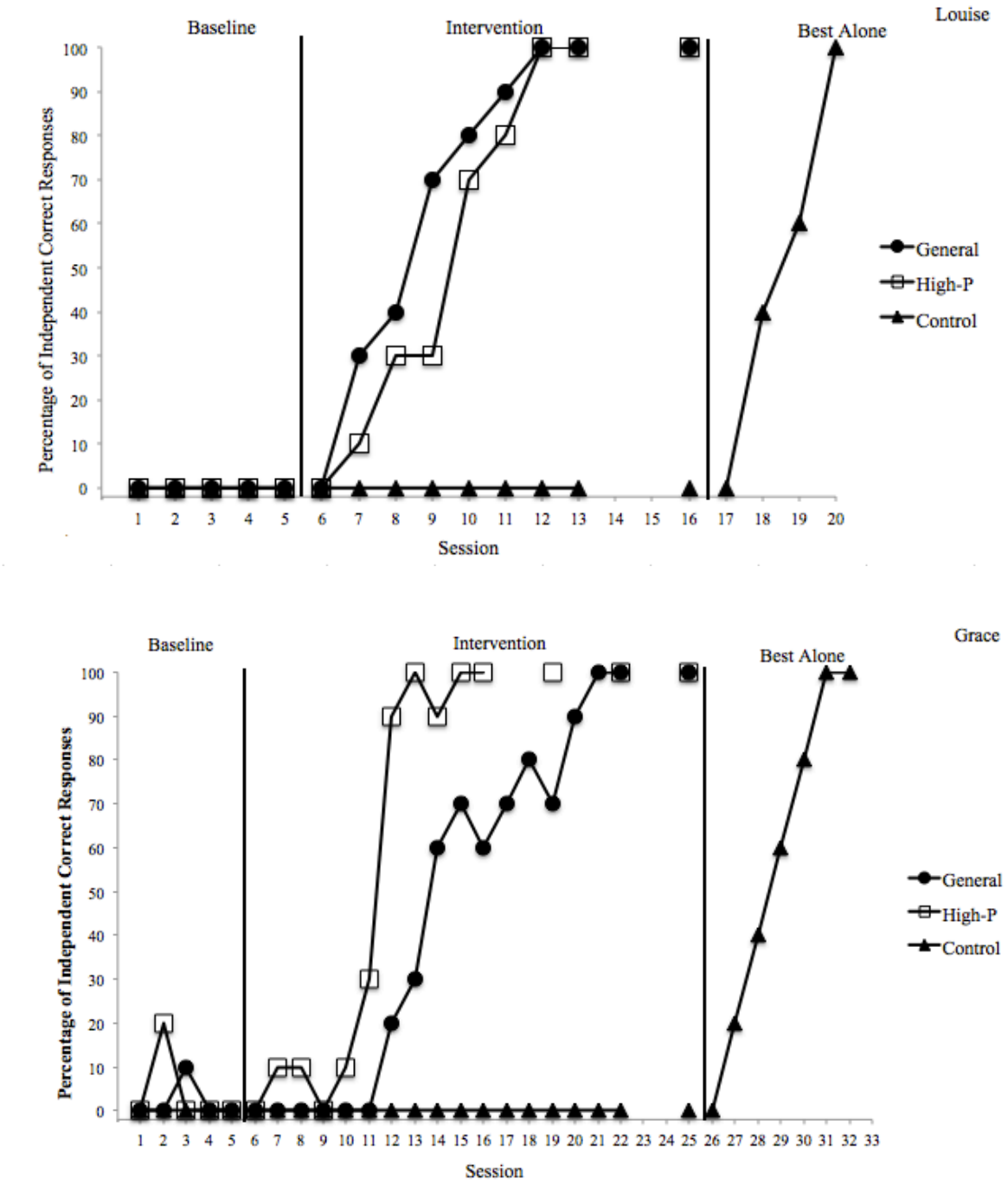


Figure 1. Graph of Results. Graphs are in participant order of Lola, Silas, Louise and Grace. Percentage of independent correct responses. Circles represent the GA condition, open squares represent the high-p condition and triangles represent the control condition.

Generalization Data

Prior to instruction, each participant received two pre-tests to assess their ability to read the science vocabulary words embedded in a sentence. Students were given 10 sentences with the vocabulary words embedded into them (e.g. Magnets have an attraction to metal). The investigator read the sentences to Lola and Silas and paused when she came to the targeted vocabulary word and waited 4 s for the participant to respond. If the participant did not respond within the 4 s or responded with the correct word an incorrect response was recorded. A correct response was recorded if the participant responded with the correct word within 4 s. Louise and Grace were given the opportunity to read the entire sentence. The investigator would tell help read the sentence if they were unsure of a word, but did not read the targeted vocabulary word. All participants responded with 0% accuracy during both pre-tests. Upon reaching criterion in both conditions, two post-tests were given to the participants with the same procedures as the pre-tests. Additionally, students underwent two sessions with a teaching assistant with procedures identical to baseline. Lola's correct responding increased from 0% in the pre-tests to 70% in the post-test and had 70% and 80% correct responding in the generalization session with the teaching assistant. Silas' correct responding increased from 0% in the pre-tests to 90% in the post and had 80% correct responding in both sessions with the teaching assistant. Louise's correct responding increased from 0% in the pre-tests to 100% in the post and had 100% correct responding in both sessions with the teaching assistant. Grace's correct responding increased from 0% in the pre-tests to 90% in the post and had 100% correct responding in both sessions with the teaching assistant.

Table 3

Generalization Data

Participant	Pre-test	Post-Test	Generalization Session 1	Generalization Session 2
Lola	0%	70%	70%	80%
Silas	0%	90%	80%	80%
Louise	0%	100%	100%	100%
Grace	0%	90%	100%	100%

Efficiency Data

The efficiency of the two different attentional cues was assessed throughout this study. The number of sessions to criterion, the number of errors made prior to reaching criterion and the average duration of each session are shown in Table 3. Silas and Grace met criterion first in the high-p condition. Louise reached criterion for GA and high-p in the same number of sessions, and Lola reached criterion for the GA criterion before high-p. For number of sessions to criterion, the high-p condition was more efficient for two participants (Silas and Grace), and the GA was more efficient for one participant (Lola). For percentage of errors to criterion, the high-p criterion was more efficient for one participant (Grace), and the GA condition was more efficient for three participants (Lola, Silas, and Louise). For minutes to criterion, the GA condition was more efficient for three participants (Lola, Silas and Louise), and the high-p condition was more efficient for one participant (Grace). The average session duration for all participants was less in the GA condition.

Table 4

Participant / Condition	Efficiency Measure			
	Number of Sessions to Criterion	Percentage of Errors to Criterion	Minutes to Criterion	Average Session Duration
Lola				
GA	26	55%	38 m 55 s	1 m 32 s
High -P	28	67%	57 m 20 s	2 m 11 s
Silas				
GA	24	48%	38 m 31 s	2 m 8 s
High -P	17	41%	37 m 8 s	2 m 3 s
Louise				
GA	8	36%	13 m 8 s	1 m 38 s
High -P	8	47%	18 m 20 s	2 m 16 s
Grace				
GA	17	56%	33 m 8 s	1 m 8 s
High -P	11	43%	31 m 3 s	2 m 7 s
Total				
GA	75	57%	123 m 42 s	1 m 36 s
High-P	64	47%	142m 7 s	2 m 9 s

Section 5: Discussion

The purpose of the study was to determine if a general attentional cue versus one with a high-probability motor sequence embedded would be more efficient in teaching elementary students with ASD grade level science vocabulary words. Results from the study provided evidence that both types of attentional cues were effective in teaching elementary students with ASD vocabulary words. For efficiency measure, the results were mixed across participants. The high-p attentional cue was more efficient to teach two of the four participants the vocabulary word; they were equally efficient for one participant; and the GA was more efficient for the last participant. All but one of the participants went from performing the skill with 0% accuracy to 100% accuracy in both the GA and high-p conditions.

While the high-p condition had a longer average session time, two students (Grace and Silas) were able to reach criterion for that condition in less time and made fewer errors. It is possible that the high-p condition helped the participants to focus their attention more efficiently and thus learn the stimuli more rapidly, even though reinforcement was the same for both conditions. Sessions in both the high-p and GA took less time as students approached reaching criterion compared to at the beginning of instruction. This is due to the fact that students had higher levels of correct responding and did not need the 4 s response interval and not as many errors were being corrected.

One limitation of the study is that an error correction procedure was used instead of a more effective instructional method such as constant time delay. This was done so that the effect of the different attentional cues would be strengthened. However, because of this, it allowed participants to make more frequent errors than they would have if

constant time delay had been used. This potentially caused the participants to take longer to reach criterion.

Fewer instances of inappropriate behaviors were seen in the high-p condition compared to the GA condition for Silas. He was able to stay engaged in the session longer and respond to more consecutive trials in the high-p condition before getting distracted and needing a break between words. During sessions in the GA condition, Silas would often look away after the task direction and give an incorrect response because he did not look at the whole word, only the first letter (e.g., if the word was protein he often said particle). Because of this time, was given between trials to allow him to refocus. However, during the high-p condition he responded quickly after the last motor sequence and did not look away from the investigator as often. Grace also had fewer instances of inappropriate behaviors in the high-p condition than the GA condition. In the GA condition there were 3 sessions with inappropriate behaviors noted. There were no sessions with inappropriate behaviors in the high-p condition.

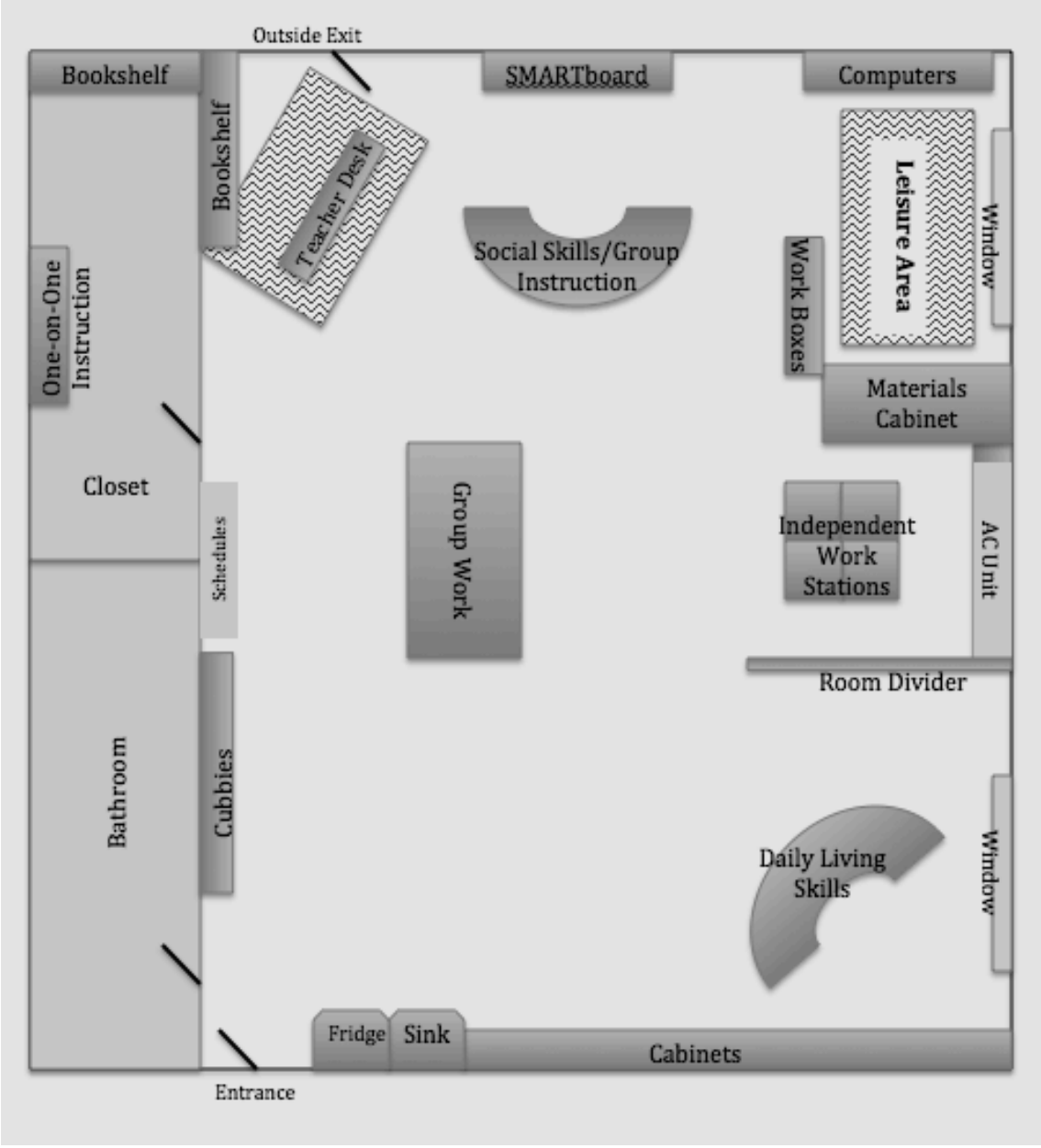
Both Silas and Grace reached criterion first in the high-p condition. The high-p motor sequence gave them the momentum necessary to stay focused and on task, which resulted in fewer instances of inappropriate behavior. Based on these results, using a high-p attentional cue was most effective on participants that often display inappropriate behaviors during instructional times. Participants with a longer attention span (Louise) were less affected by the differences in attentional cues since maintaining her attention was not an area of concern. Further research is needed to examine specific participant characteristics to identify differential responding in the different conditions.

Additionally, future research could examine the effects of different attentional cues on other academic skills such as math facts and picture identification. The relationship between the tasks completed in the high-p condition and the target behavior could also be investigated to see if the type of task makes a difference. For example, if the high-p tasks were verbal ("Say your name, Say the day, Say the month") and the target skill was also verbal ("What word?") if the responding would be differentially affected. Additionally, since the high-p condition had longer durations, the number of motor movements could be adjusted so that sessions took less time.

Appendix A

Room Layout

All Sessions for the study took place at the front table labeled "Social Skills/Group Instruction."



Appendix B

Word ID Screening Data Sheet

Name:_____ Instructor:_____
Objective:_____ Response interval:_____

	Probe	Probe	Probe	Probe	Probe	Probe	Probe	Probe
Stimuli Date								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
%/# NR								
%/# Errors								
%/# Correct								

Comments:

Key:
+ Correct
- Incorrect
NR No Response

Appendix C

Motor Sequence Screening Data Sheet

Name:_____ Instructor:_____

Objective:_____ Response interval:_____

	Probe	Probe	Probe	Probe	Probe	Probe	Probe	Probe
Motor Behavior Date								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
%/# NR								
%/# Errors								
%/# Correct								

Comments:

Key:
+ Correct
- Incorrect
NR No Response

Appendix D

Baseline Data Sheet

Name:_____ Instructor:_____

Condition: _____ Objective: _____

Date:		Date:		Date:	
Session #		Session #		Session #	
Start time		Start time		Start time	
Stop time		Stop time		Stop time	
		Total time		Total time	
Stimulus	Participant Response	Stimulus	Participant Response	Stimulus	Participant Response
1		1		1	
2		2		2	
3		3		3	
4		4		4	
5		5		5	
6		6		6	
7		7		7	
8		8		8	
9		9		9	
10		10		10	
11		11		11	
12		12		12	
13		13		13	
14		14		14	
15		15		15	
%/# NR		**%/# NR**		**%/# NR**	
%/# Errors		**%/# Errors**		**%/# Errors**	
%/# Correct		**%/# Correct**		**%/# Correct**	

Key: + = correct, - = incorrect; 0 = no response

Comments:

Appendix E

Word Identification Data Sheet

Participant: _____ Instructor: _____

Objective: _____ Condition:_____

Date:		**Date:**		**Date:**		**Date:**	
Duration:		**Duration:**		**Duration:**		**Duration:**	
Stimulus	**Response**	**Stimulus**	**Response**	**Stimulus**	**Response**	**Stimulus**	**Response**
# correct		# correct		# correct		# correct	
% correct		% correct		% correct		% correct	
# incorrect		# incorrect		# incorrect		# incorrect	
% incorrect		% incorrect		% incorrect		% incorrect	
# NR		**# NR**		**# NR**		**# NR**	
% NR		**% NR**		**% NR**		**% NR**	

Date:		**Date:**		**Date:**		**Date:**	
Duration:		**Duration:**		**Duration:**		**Duration:**	
Stimulus	**Response**	**Stimulus**	**Response**	**Stimulus**	**Response**	**Stimulus**	**Response**
# correct		# correct		# correct		# correct	
% correct		% correct		% correct		% correct	
# incorrect		# incorrect		# incorrect		# incorrect	
% incorrect		% incorrect		% incorrect		% incorrect	
# NR		**# NR**		**# NR**		**# NR**	
% NR		**% NR**		**% NR**		**% NR**	

Key: += Correct -= Incorrect NR= No Response

Appendix F
Interobserver Reliability Data Collection Sheet

Participant Name_____

Name of Observer:_____ Date: _____

General

Trial	Provide general attention cue	Show Stimulus	"What word?"	Waits 4 s before prompt	Participant response	Provide correct consequences	Record response
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
IOA percentage							
Observed/Planned							
Percent Accuracy							

High-P

Trial	Provide 3 high-p motor tasks	Show Stimulus	"What word?"	Waits 4 s before prompt	Participant response	Provide correct consequences	Record response
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
IOA percentage							
Observed/Planned							
Percent Accuracy							

Control

Trial	Gain attention	Show Stimulus	"What word?"	Waits 4 s for response	Participant response	Record response
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
IOA percentage						
Observed/Planned						
Percent Accuracy						

Key: + = correct, - = incorrect; 0 = no response Comments:

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