COMPARISON OF TWO VIDEO PROMPTING INTERVENTIONS TO TEACH DAILY LIVING SKILLS TO ADOLESCENTS WITH AUTISM

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by

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ABSTRACT

The present study used an adapted alternating treatments design to evaluate and compare the effects of video prompting (VP) and video prompting plus frequency building (VP + FB) to teach daily living skills to three adolescents with autism spectrum disorder. Results demonstrated all three students made substantial improvements over their baseline performance using VP and VP + FB. Furthermore, a strong intervention effect emerged for VP and VP + FB conditions when compared to the control task. However, in terms of one intervention proving superior to the other (e.g., VP to VP + FB), the data offer a mixed interpretation with VP + FB affecting change better for two of the three students. The frequency building component in the VP + FB had strong, consistent gains for all students in terms of retention.

*Keywords*: autism spectrum disorder, daily living skills, video prompting, frequency building
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Chapter 1

Introduction

The ability to function independently represents a quality highly valued in society and an expectation of individuals when they enter into adulthood. As a result, the development of independent behavior embodies one of the primary goals of education for all students (Hendricks & Wehman, 2009; Kavale & Forness, 1999). Research consistently indicates that functional independence and behavioral autonomy play a key role in optimizing post-secondary outcomes for all students (Hume, Boyd, Hamm, & Kucharczyk, 2014). For instance, students who demonstrate greater independence and/or behavioral autonomy during secondary school prove more likely to be employed and live independently after completing high school than students more dependent on staff and/or caregivers (Hume et al., 2014; Wehmeyer & Palmer, 2003).

Although the development of independent behavior constitutes an essential, challenging process for all youth as they pass through the high school environment into adulthood, most high school students gain skills related to independence and successfully transition into adulthood. Yet for many students with disabilities, particularly for students with autism spectrum disorder (ASD), achieving independence remains a daunting task. Many individuals with ASD do not experience the self-determination or behavioral autonomy expected of youth transitioning into adult life (Wehman et al., 2014) with independent behavior often reaching a plateau and declining throughout adulthood (Hume et al., 2014; Smith, Maenner, & Seltzer, 2012). As a result, individuals with ASD experience less favorable post-school outcomes than their peers, specifically in the area of independent living. Recent reports indicate that approximately 19% of adults with ASD live independently compared to over 60% of peers with speech-language
impairment or emotional disturbance and nearly 80% of those with learning disabilities (Newman et al., 2011).

Research suggests the inability to live independently may result in learned helplessness, poor self-esteem, and an overall low quality of life (Hayden, 1997; Parmenter, 1994). Furthermore, lack of independence may lead to heavy reliance on another person for support in completing day-to-day activities thus affecting family and/or caregivers as well (Gray et al., 2015). A vast majority of adolescents with ASD live with their parents and remain dependent on parental support well into adulthood (Hendricks & Wehman, 2009; van Heijst & Geurts, 2015). As a result, parents consistently report higher levels of parenting stress than parents of individuals who have more independence caring for their daily needs (Hauser-Cram et al., 2001; Tomanik et al., 2004).

Instruction in daily living skills can help foster independence for people with ASD. The ability to independently perform daily living skills (e.g., personal hygiene, food preparation, cleaning clothes) enables individuals to care for themselves, decreases their dependence on others, and improves their quality of life (Briggs et al., 1990; Cameron, Ainsleigh, & Bird, 1992). However, many individuals have difficulty acquiring daily living skills (Hendricks & Wehman, 2009). Although improvement can occur with age, many individuals continue to experience significant lifelong impairments in performing daily living skills (Hong et al., 2015). Additionally, researchers have found students with ASD perform daily living skills at lower levels than their IQ-matched peers without ASD (Liss et al., 2001).

Individuals with ASD have unique learning challenges that may contribute to difficulties in acquiring daily living skills and developing independent behavior. Other challenges include deficits in attending skills, difficulties sustaining attention, planning, and memory, as well as difficulties focusing on the most relevant features of instructional materials (Hume, Loftin, & Lantz, 2009; Fabrizio, & Bamond, 2008). Furthermore, many individuals exhibit problems in
fluidity and speed of response, which can result in slow and effortful performance with long latencies to respond (Weiss et al., 2008). Problems generalizing and maintaining skills over time also can accompany an ASD diagnosis (Weiss et al., 2008). Considering the important role daily living skills play in increasing independence, identifying effective educational interventions addressing common learning challenges experienced by those with ASD remains a critical task for researchers and practitioners (Delano, 2007).

**Video Prompting**

Video prompting (VP) represents one instructional approach used to promote acquisition of daily living skills for students with ASD (Domire & Wolfe, 2014; Gardner & Wolfe, 2013). VP involves showing video clips of short segments or steps of a skill sequentially (Cannella-Malone et al., 2006), and immediately after watching the video clip of a step, the student has an opportunity to practice that target step and receive feedback before moving on to the next step in the sequence. VP instruction includes several features that may contribute to the benefits seen when used with individuals having an ASD diagnosis. For instance, research suggests that VP procedures may help address some core deficits and learning challenges associated with ASD (Charlop-Christy, Le, Freeman, 2000). VP uses visually based instruction that aims to improve attention and motivation. Furthermore, VP presents information in small, teachable steps, which may help address difficulties sustaining attention and memory issues (Banda, Dogoe, & Matuszny, 2011; Gardner & Wolfe, 2013).

Researchers have used different perspectives when filming video prompts. These perspectives include: first-person perspective or more commonly referred to as point-of-view perspective (POV), the spectators’ perspective (i.e., third-person perspective), or self-modeling (i.e., clips show the target individual successfully completing a task). Recently, use of VP with a POV perspective has gained popularity when working with students with ASD. The POV perspective typically involves showing just the hands and/or forearms of the performer...
completing a given skill, thereby narrowing the center of focus for the viewer and directing an individual’s attention to the critical feature(s) of a given task (Mason, Davis, & Goodwyn, 2013). Researchers have reported increases in student skill acquisition as a result of VP with a POV perspective in areas such as domestic skills (Bereznak, Ayres, Mechling, & Alexander, 2012; Gardner & Wolfe, 2015; Sigafoos et al., 2007), cooking-related skills (Bereznak et al., 2012; Sigafoos et al., 2005) and clerical skills (Bennett, Gutierrez, & Honsberger, 2013; Bereznak et al., 2012).

**Frequency Building**

Frequency building forms a systematic practice approach that can address common learning challenges faced by individuals with ASD. Frequency building occurs after instruction or acquisition of content and leads to behavioral fluency (Kubina & Yurich, 2012; Kubina & Wolfe, 2005). Behavioral fluency refers to “the fluid combination of accuracy plus speed that characterizes competent performance” (Binder, 1996, p. 164). Frequency building includes the timed repetition of a behavior, where students respond to specific stimuli quickly and accurately, over multiple timed trials in order to increase their rate of responding. Another key component of frequency building includes use of performance feedback following each trial (Kubina & Yurich, 2012; Kubina & Wolfe, 2005). Researchers have successfully used frequency building to behavioral fluency for interventions in reading (Hughes, Beverley, & Whitehead, 2007; Kubina, Amato, Schwilk, & Therrien, 2008; Brown, Dunne, & Cooper, 1996), spelling (Kubina, Young, & Kilwein, 2004) mathematics (Binder, Haughton, & Van Eyk, 1990; Brady & Kubina, 2010) and writing (Datchuk, Kubina, & Mason, 2015; Dermer, Lopez, & Messling, 2009).

Recently, researchers have considered the utility of frequency building for students with ASD and posited that attaining behavioral fluency may increase the functionality of skills as well as serve as a remedy for the issues related to long term maintenance of skills (Kubina & Wolfe, 2005; Ramey et al., 2016; Weiss et al., 2008). Fluency research has supported the positive effects
of behavioral fluency for learners with ASD, including maintenance of skills over time (Lee & Singer-Dudek, 2012; Holding, Bray, & Kehle, 2010; Kelly & Holloway, 2015; Singer-Dudek & Greer, 2005; Twarek, Cihon, & Eshleman, 2010), the ability to perform at a steady pace for a given time in the face of distraction (Lee & Singer-Dudek, 2012; Nopprapun & Holloway, 2014; Twarek et al., 2010), and application of previously learned behaviors to more advanced skills (Holding et al., 2010; Lin & Kubina, 2015; Twarek et al., 2010). Additionally, research suggests generalization may also occur as a result of attaining behavioral fluency (Young, West, Howard, & Whitney, 1986).

**Present Study**

The ability to not only acquire daily living skills, but also demonstrate true mastery or fluency of the skills exemplifies a crucial outcome for individuals with ASD as they transition into adulthood. Moving from acquiring daily living skills to mastering such skills requires systematic practice (i.e., frequency building) leading to behavioral fluency. Although researchers have reported increases in student skill acquisition as a result of VP instruction, researchers have indicated that some individuals may need additional support when acquiring and mastering daily living skills (Goodson, Sigafoos, O'Reilly, Canella, & Lancioni, 2007). Interventions designed to address behavioral fluency may further enhance skill acquisition and maintenance. Therefore, the present experimental study sought to evaluate and compare the effects of two VP interventions, VP and VP plus frequency building (VP + FB). The experimenter posed the following questions: (1) What effects will VP and VP + FB have on student performance with daily living skills? (2) What effect will VP and VP + FB have on students’ rate of learning? And (3) to what extent will VP and VP + FB effects retain across time?
Chapter 2

Method

Students

Three adolescents with autism spectrum disorder (ASD) participated in the present study. The experimenter selected the students based upon age, diagnosis, need for improved performance in daily living skills, and parental consent to participate. All three students received special education services in an autism support classroom where their educational program primarily focused on providing instruction and support in functional life skills. However, none of the students had any prior exposure to video-based instruction or frequency building.

Autumn, a 12-year-old female, had a primary diagnosis of ASD with a secondary diagnosis of speech and language impairment from a licensed psychologist. Information gathered from Autumn’s Individualized Education Plan (IEP) indicated she obtained a score of 55 on the Pictorial Test of Intelligence- Second Edition (French, 2001), suggesting a very poor range of functioning. Autumn produced a general adaptive composite score of 50 on the Adaptive Behavior Assessment System- Second Edition (ABAS-II; Harrison & Oakland, 2003), which translated to an extremely low adaptive performance level. Autumn communicated her wants and needs primarily using one to two word utterances. She received speech and occupational therapy services.

Cameron, a 16-year-old male, received a previous diagnosis from a licensed psychiatrist of Autistic Disorder, Intellectual Disability, and Phonological Disorder. Information gathered from his IEP revealed an IQ score of 58 based on the Stanford Binet Intelligence Scale (Roid, 2003) indicating mildly impaired or delayed cognition. Reports of the Vineland Adaptive Rating Scale (Sparrow, Balla, & Cicchetti, 2005) reported an adaptive behavior composite score of 59, signifying mildly deficient adaptive behavior. Cameron communicated using one- two word
utterances as well as picture icons in a communication notebook. Cameron also received speech and occupational therapy services.

Angelica, a 14-year-old female, received a previous diagnosis by a licensed psychologist of ASD with a secondary diagnosis of Intellectual Disability and Attention Deficit Hyperactivity Disorder. Information gathered from her IEP indicated she obtained a Brief Intellectual Ability score or less than 40 on the Woodcock Johnson Test of Cognitive Ability- 4th Edition (Schrank, McGrew, & Mather, 2014) suggesting her cognitive ability fell in the lower extreme range. Results from the ABAS-II (Harrison & Oakland, 2003) reported a general adaptive behavior composite score of 50. A score of 50 lies in the very low range of functioning. Angelica communicated simple requests using one word utterances such as yes, no, and baby. However, the majority of her vocal language came across as unintelligible. Angelica also had access to a low-tech picture icon communication board however she did not independently seek out or use the board when attempting to communicate. She also received speech, occupational, and physical therapy services.

Setting

The experimenter conducted the study at a private school located in central Pennsylvania for students with ASD and behavioral support needs. During the study, the experimenter worked individually with each student in a learning suite that consisted of a kitchen, bathroom, and living room area. The kitchen contained two parallel countertops with a sink, microwave, refrigerator, and stove. The bathroom had a sink, toilet, and shower. The living room included two sofa chairs, a coffee table, an end table, a television, shelves with games and toys, and a u-shaped table and chairs. Starting on Day 19 (represented by a dotted vertical line in Figure 1) Cameron’s instructional sessions took place in different settings due to an injury he sustained at home that prevented him from using stairs for the remainder of the study. The new settings for Cameron comprised a small kitchen area on the first floor with a sink and refrigerator, a foyer with a door
and one set of windows, and a small bathroom with a sink and toilet. All sessions took place Monday through Friday between the hours of 9:15 am and 12:30 pm depending on the students’ schedules.

**Materials**

**Task Materials.** Materials included plates, bottles of dish detergent, sponges, drying rack, spray bottles, paper towels, garbage pail, mops, and buckets. During experimental conditions, students viewed videos on an Apple fourth-generation iPad Mini. The device measured 8.0 x 5.31 x 0.24 inches in size and contained a 128GB storage capacity. An Otterbox Defender Series Case surrounded the iPad in order to prevent damage to the device. Additional materials included a digital timer, data collection sheets, procedural integrity checklists, and GoPro HD Hero 960 camera used to video record all sessions.

**Videos.** The experimenter created video recordings for each of the three tasks (i.e., mops floor, washes dishes, washes windows) using a GoPro HD Hero 960 camera and head strap mount accessory. Using the head strap mount, the experimenter filmed the videos from a point-of-view perspective, which primarily featured the experimenter’s forearms and hands completing each task. Once filmed, the experimenter edited the videos using iMovie and then imported the video clips into a Keynote slide presentation.

**Response Measurement and Accuracy**

**Dependent variable.** The primary dependent variable consisted of the frequency of steps performed correctly on a task analysis for each of three target behaviors (i.e., mops floor, washes dishes, washes windows). Prior to the beginning of the study, the experimenter task analyzed each task into multiple steps (Table 1). During each assessment, the experimenter counted the number of steps performed correctly and used a count up timer to monitor the elapsed time. A correct response consisted of the student initiating the target step within 10 s of the instruction or previous behavior and completing the target step within 10 s.
Accuracy. Accuracy describes the extent to which observed values estimate the events that took place in an experiment (Johnston & Pennypacker, 2009). Accuracy involves the application of extra efforts to identify the true value and minimize measurement error. As such, researchers who compare observed values against a carefully identified true value employ the highest form of measurement assessment (Cooper, Heron & Heward, 2007). In order to calculate the accuracy of the dependent variable, the experimenter video recorded experimental sessions for each student. The recorded video sessions and the carefully extracted data became the agreed upon true value (Johnston & Pennypacker, 2009). Additionally, a second observer independently scored 25% of the videos in order to ensure agreement on the extracted data. Agreement came to 98%. Given disagreements, the first author and second observer discussed the discrepancies until they came to consensus and agreement on all ratings. If the raters could not come to a consensus, a third observer evaluated the disagreement. A final decision on the disagreement was then made by two of the three observers. The experimenter then checked the observed scores (i.e., observed values taken during the assessment) for measurement of the dependent variable against 25% of randomly selected videotaped sessions (i.e., the established true value taken from the videos). Accuracy came to 95%.

Independent Variable and Procedural Integrity

Independent variable. The independent variables consisted of video prompting (VP) and video prompting plus frequency building (VP + FB). For each task the experimenter created frequency aims by sampling four adults performing the tasks and recording the total time it took to complete the steps identified in the task analysis (Table 1). A frequency aim represents an optimal rate of behavior depicted with a range (Binder, 1996). Based on the adults average performance, the frequency aims for the three tasks came to: (1) 14-19 correct responses per minute for mopping the floor, (2) 18-23 correct responses per minute for washing dishes, and (3) 16-20 correct responses per minute for washing windows.
**VP.** VP involved creating video clips of a model performing each step of a targeted task from a point-of-view (POV) perspective. The POV perspective involves showing only the forearms and hands of the performer completing a given skill. The experimenter showed the video clips of the steps sequentially, and immediately after watching the video clip of a step, the student had an opportunity to practice that target step and receive feedback before moving on to the next step in the sequence.

**VP + FB.** VP + FB included a combination of video prompting and frequency building. The intervention included presenting the video clip of each step of the task followed by timed repetition of the behavior with corrective or confirmatory performance feedback (Kostewicz & Kubina, 2011; Kubina & Yurich, 2012).

**Procedural Integrity.** To assess procedural integrity, the experimenter developed a checklist specifying the procedural methods described below. A second observer viewed 25% of randomly selected videotaped sessions for each student. Using the checklist, the second observer recorded whether or not the experimenter correctly implemented each procedural component in its proper sequence (Appendix E). The procedure for calculating procedural integrity consisted of dividing the number of procedural steps correctly completed by the total number of possible steps and multiplying by 100 (Gast, 2010). Procedural integrity came to 96%.

**Social validity.** At the end of the study, the experimenter shared the results with the two classroom teachers and one teaching assistant from each classroom by showing the respondents videos of the student’s performance during baseline and their performance at the end of intervention. The two teachers and two teaching assistants then completed a social validity rating using paper-and-pencil questionnaire. The questionnaire used a 5-point Likert scale that required the staff members to rate each statement from 1 (strongly disagree) to 5 (strongly agree). The items mainly addressed the acceptability of the procedures used, the acceptability of the results (Wolfe, 1978), and use of the procedures in the future (Appendix E).
Experimental design. The present study used an adapted alternating treatments design (AATD) to evaluate and compare the effects of VP and VP + FB (Holcombe, Wolery, & Gast, 1994; Sindelar, Rosenberg, & Wilson, 1985; Wolery, Gast, & Ledford, 2014). The AATD has the experimenter apply the interventions to different but equally difficult, independent behaviors or skills. In the AATD, the experimenter introduces two or more treatment conditions in a rapidly alternating fashion with a randomized order of presentation.

For the present study, the design consisted of three conditions including a baseline, comparison phase, and control task condition. The baseline condition served to measure students’ performances on each of three tasks prior to introduction of the two treatments (Sindelar et al., 1985). A third task (i.e., control task) appeared in the baseline condition and received intermittent measurement during the comparison condition to assess possible multiple treatment interference (threat to internal validity), the effects of history and maturation, and to provide intrasubject replication (Wolery et al., 2014). During the comparison condition, the experimenter assigned VP and VP + FB interventions to two separate tasks. The experimenter taught each student a different skill within each condition (Table 2), and the counterbalanced the skills across conditions and students to control for task difficulty. In addition, the experimenter randomly selected the presentation order of the conditions each day.

In order to ensure the tasks contained equal response difficulty, the experimenter conducted a logical analysis of the tasks. A logical analysis requires matching the tasks on the number and nature of the discriminations students would need to make and on the number and nature of the actual movements necessary to perform the task. If the discriminations and response requirements appear similar across tasks, those tasks are considered equally difficult (Holcombe et al., 1994). Three special education teachers and one behavior analyst with at least five years experience independently rated the tasks and deemed them equivalent as they consisted of a
similar number of steps with similar response requirements and comparable effort (Wolery et al., 2014).

**Procedure**

**Baseline.** Baseline sessions assessed the students’ initial performance on each targeted task prior to the start of the comparison condition. The experimenter provided the student with all materials necessary to complete the task, delivered the instruction to engage in the specified task (e.g., “Mop the floor”), and started the count up timer. If the student failed to correctly complete the step within 10 s the instructor completed the step by blocking the student’s view and completing the step as unobtrusively as possible allowing the student an opportunity to perform the subsequent step in the task. During the condition, the students did not receive any prompts or feedback for correct or incorrect responses. Immediately following, the student received a preferred item (e.g., iPad, chocolate, music) regardless of their performance during the condition.

**VP.** VP sessions took place for eight minutes in order to control for the number of practice opportunities that took place during the VP + FB condition. During the VP condition, the experimenter set up all materials required to complete the task (e.g., iPad, spray bottle, paper towels). To begin the session, the experimenter presented the iPad to the student, delivered the instruction “Watch,” and simultaneously started a pre-set timer set for eight minutes. Next, the student saw a video clip of the first step of the task. When the video clip ended, the experimenter provided the instruction, “You do it.” If the student correctly performed the skill as seen in the video, the experimenter provided behavior specific praise (e.g., “Good job picking up the mop”) and directed the student’s attention back to the iPad screen while giving the instruction, “Watch the next step.” If the student failed to initiate the step within 10 s, the experimenter completed the step identically to the procedure used during baseline procedures by blocking the student’s view and completing the step as unobtrusively as possible. If the student began to complete a step incorrectly or failed to complete the step within 10 s, the experimenter interrupted the student,
blocked the student's view, and completed the step as unobtrusively as possible. The student would then see the next clip in the task analysis using the same procedures as the first step. The procedure continued until the timer sounded, signaling the instructional session ended.

**VP + FB.** During the VP + FB condition, the experimenter set up all materials needed to complete the task. To start the session, the experimenter presented the iPad to the student and delivered the instruction, “Watch.” Students then watched a video clip of the first step of the task. When the video clip ended, the experimenter placed the initial set of materials needed to complete the step in front of the student, provided the instruction, “You do it,” and started a timer pre-set for 15 seconds. The student received as many opportunities to imitate the behavior seen in the video clip as possible until the timer sounded. For example, if the student viewed a video clip of the model picking up a sponge, during frequency building the experimenter provided the student with multiple sponges to pick up in a row without interruption during the time period. During the 15 s timing, the students received coaching to “keep going” and to “go fast” and verbal praise for correct responses. If the student did not respond or made an error, the experimenter did not provide any prompts or feedback. When the timer sounded, the experimenter recorded the number of correct responses and provided corrective feedback to the student using a model, prompt, check procedure.

During corrective feedback, the experimenter represented the video model of the step, prompted the student to imitate the behavior seen in the video, and checked the student by having the student perform the step independently. Following the delivery of feedback, the experimenter presented the iPad to the student to watch the video of the model performing the second step of the task following the same procedures as stated above. The procedure continued until the student viewed all the video clips in sequence. Each session lasted approximately eight minutes.

**Control Task Condition.** The experimenter intermittently presented the control task during the comparison condition. Presentation of the control task occurred once per week. The
control task occurred identically to the baseline condition described above. Students did not receive feedback during the control task.

**DV Measurement.** Measurement of the DV followed the same procedures as baseline sessions. Immediately following the VP and VP + FB sessions, the experimenter assessed the student’s performance on the dependent variable by having the student perform the task one more time. After delivering the instruction (e.g., wash windows), the experimenter started the count up timer. During the assessment, the student did not have access to the video model. In addition, students did not receive any prompts or feedback. If the student failed to initiate the target step within 10 s of the instruction or previous behavior or failed to complete the target step correctly within 10 s the experimenter completed the step identically to the procedure used during baseline procedures by blocking the student’s view and completing the step as unobtrusively as possible. Immediately following the assessment, the student received a preferred tangible item regardless of how well he or she performed.

**Retention.** Retention signifies the relationship between performance frequencies measured at two points where learners have not had the opportunity to perform the behavior (Fabrizio & Moors, 2003; Kubina & Yurich, 2012). A retention check occurred 10 days after cessation of intervention. The retention check followed the same procedures as the baseline and skill assessment sessions.

**Data Display and Quantitative Analysis**

All time series data appeared on sections taken from the Standard Celeration Chart (Graf & Lindsley, 2002; Lindsley, 2005; Pennypacker, Gutierrez, & Lindsley, 2003). The SCC provides an accurate depiction of changes in behavior over time and displays behavior change proportionately. Additionally, the SCC quantifies changes in behavior facilitating a statistical analysis. The following measures supplemented visual analysis on the SCC: Level and Celeration.
**Level.** Level represents the mean performance for the frequency of steps performed correctly for each target behavior and appears as a horizontal line on across the data points. In order to calculate the level, the experimenter employed a method using the geometric mean (Kubina, Kostewicz, & Al-Shammari, 2017). Advantages to using the geometric mean include (a) regulation of the range of numbers calculated so one set of numbers does not have more weight than another set of numbers and (b) minimization of the influence of very small or very large numbers that can skew data (Clark-Carter, 2005).

**Level Comparison Analysis.** In the present study, a Level Comparison revealed the difference in levels (average performance) of the frequency of correct steps between baseline and the intervention conditions as well as between the intervention and control conditions. In order to calculate the difference, the larger value divided by the smaller value produces a quotient. The quotient then takes on the multiply or divide sign of the greater initial value depending on the positions of the two compared levels. For example, a student produces a level of 5 for frequency of correct steps during baseline and a level of 8 for frequency of correct steps during an experimental condition. The Level Comparison, or difference in mean performance between the student’s baseline and experimental condition performance, equals a x1.6 (60%) average difference in the frequency of steps correct (i.e., $8 ÷ 5 = 1.6$; apply the x sign because the intervention produced corrects occurring x1.6 greater than baseline).

**Celeration.** Celeration describes the change in frequency of responding over time (Johnston & Pennypacker, 2009). Celeration visually depicted on the charts emerge as trend lines drawn across data points. As an example of a celeration value, a student performs 4 correct responses per minute on Tuesday’s assessment and then accelerates to 6 per minute on the following Tuesday’s assessment, will produce a celeration value of x1.5, a 50% weekly growth rate. Another student who accelerates from 4 correct responses per minute to 8 per minute doubles his or her performance and as a result has a celeration value of x 2.0 or a 100% weekly
growth. The experimenter first calculated trend lines using the split-middle technique (White, 1974) and then quantified the trends into celeration values using a “Finder” (Kubina & Yurich, 2012; Pennypacker, et al., 2003).

**Celeration Comparison Analysis.** The Celeration Comparison Analysis quantifies the differences in speed when comparing the frequency of correct steps for baseline and the intervention conditions as well as between the intervention and control conditions. In addition to accounting for the speed differences, the Celeration Comparison Analysis calculation must account for the directions of the celerations. Hence, the calculation includes the following rules: if both celeration values have the same sign (i.e., both x or both ÷) divide the larger value by the smaller value and use the sign that indicates the comparison of the change (i.e., if the resulting change from baseline to intervention became faster, a x sign would appear; for cases where the speed declined, a ÷ sign would appear).

On the other hand, if the celeration values have different signs (i.e., x to ÷ or ÷ to x) the rule states to multiply the values together and apply the sign signifying the speed difference (i.e., x for accelerating speed difference or ÷ for decelerating speed difference). For instance, a student with a celeration of x1.0 for frequency of correct steps in baseline also has a celeration of x2.0 for frequency of correct steps during the experimental condition. The Celeration Comparison, or speed comparison, of the student’s baseline and experimental condition performance equals x2 (i.e., 2.0 ÷ 1.0 = 2; apply a x sign because the speed accelerated when contrasting baseline to intervention). Therefore, a x2 signifies the speed comparison of the intervention value occurred twice as fast, or x2 faster, when compared to baseline.
Chapter 3

Results

Table 3 contains all of the performance outcomes for each student for Level and Celeration. Table 4 includes the Level and Celeration Comparison Analysis for the baseline condition versus VP and the baseline condition versus VP + FB. Table 5 includes the Level and Celeration Comparison Analysis for the VP versus the control condition and VP + FB versus the control condition. Table 6 contains the retention outcome measures for each student. Figure 1 displays the data of correct steps completed while Figure 2 separately shows the celeration and level lines on segments of the SCC. The three column graphs in Figure 3 summarize the number of steps completed independently by Autumn, Cameron, and Angelica at three points in time (i.e., Day 1, 10, and 34). The line graphs in Figure’s 4-6 display the data for the number of steps completed independently for each student across all conditions.

Traditionally when using an AATD each student’s data would appear on one graph. In the present study, due to similar conventions (i.e., time bars, dots for acceleration data) of the SCC, placing all data on one graph would confuse the visual analysis. Furthermore, the separation of data into separate tiers clearly shows the effects each condition had on behavior and allows for straightforward comparisons. In Figure 1, the dots on the chart segments signify correct performance frequencies and the small horizontal dashes, or time bars, display the time interval for the measured behavior.

The SCC has a dual vertical axis with count on the left and time on the right. The dual vertical axes allow chart users to display behavioral measurements with different recorded intervals of time. In order to calculate the “per minute” frequency, the chart user must multiply the number of counted responses by the time bar value. On the SCC, the time bar value appears visually and mathematically. For instance, in the bottom tier of Figure 1, the time bar expresses a 2-minute observation or “counting time” (i.e., the time Angelica spent performing the behavior
occurred in 2 minutes). The time bar sits on the .5 line. On the SCC, all time bars follow the same convention. A time bar for 2 minutes or 120 s will appear on the .5 frequency line (i.e., \(60 \div 120 = .5\)). The subsequent data, then, measured in the original time interval undergo multiplication to indicate the count per minute. In the top tier of Figure 1, Angelica’s performance data of 2 responses in 120 s transforms into 1 per minute (i.e., \(2 \times .5 = 1\)). In order to facilitate comparisons while maintaining the integrity of the real time measurements conveyed by the time bars, the SCC displays all behavior as a “per minute” frequency.

In Figure 2, the grey dashed lines indicate the level, calculated using the geometric mean, of the frequency of steps performed correctly for each condition and student. The solid black lines designate the celeration or speed of change and provide a visual representation of growth or decay of performance frequencies during each condition (Graf & Lindsley, 2002). The level lines and celeration lines shown together affords a visual reference for the average performance and speed of change for the separate conditions for each student.

**Participant Performance Outcomes**

**Autumn.** The top tier row of SCC segments in Figure 1 displays the data for Autumn. During baseline, Autumn produced an average frequency of correct responses of .25, .26, and .27 for washing windows, mopping floors, and washing dishes respectively. She also produced a flat celeration or trend of \(x1.0\) for all three tasks, indicating the frequency of steps performed correctly neither grew or decayed. During the VP condition, Autumn had an average frequency of 4.32 correct responses for washing dishes and her behavior grew by \(x3.5\) (250% weekly growth). Additionally, Autumn reached the frequency aim for washing windows (i.e., 16-20 correct responses per min) with VP instruction. With VP + FB instruction, Autumn averaged a frequency of 2.01 correct steps for mopping the floor and her behavior grew by \(x2.5\) (150% weekly growth). The skill assessed during the control condition (washing dishes) remained at low levels (.33) with a descending celeration of \(\div1.2\) (17% weekly decay).
When compared to baseline levels, Autumn produced x17.28 (1628%) more correct steps for washing windows with instruction using VP (i.e., Level Comparison). For the Celeration Comparison, the frequency of steps Autumn performed correctly occurred x3.5 faster during VP than during baseline. For VP + FB instruction, Autumn produced a level change of x7.73 (673%) more for the frequency steps performed correctly for mopping the floor compared to baseline. In the Celeration Comparison, Autumn had a x2.5 speed differential in frequency of steps performed correctly during the VP + FB condition compared to baseline.

The Level Comparison Analysis between the VP and control condition showed that Autumn had x12.7 (117%) more correct responses per minute for washing windows. Additionally, the Celeration Comparison showed Autumn’s frequency of correct steps changed x4.2 (320%) faster with VP compared to the control condition. For VP + FB, Autumn produced a level change of x5.9 (490%) more correct responses per minute than in the control. Based on the Celeration Comparison, Autumn’s performance occurred x3.0 faster with VP + FB than during the control condition.

**Cameron.** The middle tier of SCC segments in Figure 1 has the data for Cameron across the three conditions. During baseline, Cameron yielded a level of .70, .82, and .80 correct responses for washing dishes, washing windows, and mopping the floor respectively. The frequency of correct responses Cameron produced during baseline decelerated by ÷1.09 (8.3% weekly decay) for dishwashing, ÷1.7 (41% weekly decay) for washing windows, and ÷2.0 (50% weekly decay) for mopping the floor. Within the first condition, Cameron produced an average frequency of 3.88 correct responses for washing dishes with VP instruction and his behavior grew by x2.1, a 101% weekly growth in performance frequency. During VP + FB instruction, Cameron had an average frequency of 5.61 correct responses and his frequency of correct responses grew by x2.3 (130% weekly growth). Additionally, Cameron reached the frequency aim for washing windows (i.e., 16-20 correct responses per min) with VP + FB instruction. The
skill in the control condition (mopping the floor) remained at a low level (.75) with a flat celeration of x1.0.

The comparison analysis showed that Cameron produced a level of x5.54 (454%) more correct responses per minute during the VP instruction (washes dishes) compared to baseline. During VP, Cameron had a celeration change of x2.3 (130% faster) for frequency of correct steps during the task of washing dishes compared to baseline. For VP + FB, Cameron had a level of x6.84 (584%) more correct responses per minute for washing windows when compared to baseline. The results of the celeration comparison indicated the frequency of steps Cameron performed correctly during VP + FB changed x3.9 faster than during the baseline condition.

When compared to the control condition, Cameron produced x5.2 (420%) more correct steps for mopping the floor with instruction using VP (i.e., Level Comparison). For the Celeration Comparison, the frequency of steps Cameron performed correctly occurred x2.1 faster during VP when compared to the control condition. For VP + FB instruction, Cameron produced a level change of x7.5 (650%) more for the frequency steps performed correctly than the control. In the Celeration Comparison, Cameron had a x2.3 speed differential in frequency of steps performed correctly during the VP + FB condition compared to the control condition.

**Angelica.** The bottom tier of SCC segments in Figure 1 displays the data for Angelica. In the baseline condition, Angelica produced an average frequency of correct responses of .69, .94, and .66 for mopping the floor, washing dishes, and washing windows respectively. For mopping the floor, Angelica’s frequency of correct responses decelerated by ÷2.5 (60% weekly decay). Angelica had a flat celeration of x1.0 for washing dishes and washing windows, indicating her behavior neither grew nor decayed during the baseline condition. During VP instruction, Angelica’s level or average frequency of responses came to 3.01 correct for mopping the floor and had a flat celeration of x1.0. With VP + FB instruction, she produced a level of 5.56 correct responses per minute for washing dishes and her behavior grew by x2.0 (100% weekly
growth). The skill assessed during the control condition (washing windows) remained at a low level (.68) but had a slight accelerating trend of x1.15 (15% weekly growth).

For the level change, Angelica had x4.36 (336%) more correct responses per minute for mopping the floor during VP instruction compared to baseline. The Celeration Comparison indicated Angelica’s frequency of correct responses changed x2.5 (150%) faster during VP than during baseline. For VP + FB, Angelica produced a level change of x5.91 (691%) more correct responses per minute for washing dishes when compared to baseline. The Celeration Comparison indicated Angelica’s frequency of correct responses changed x2.0 (100%) faster with VP + FB instruction compared to baseline.

The comparison analysis between intervention conditions and the control condition showed that Angelica produced a level of x4.4 (340%) more correct responses per minute during the VP instruction (washes dishes). During VP, Angelica had a celeration change of ÷1.15 (13%) slower for frequency of correct steps during the task of washing dishes than the control. For VP + FB, Angelica had a level of x8.2 (720%) more correct responses per minute for washing dishes when compared to the control condition. The results of the Celeration Comparison indicated the frequency of steps Angelica performed correctly during VP + FB changed by x1.7 faster than during the control condition.

**Number of Steps Performed Independently**

Figure 3 includes column graphs for each student that show the number of steps they performed correctly for each skill during VP, VP + FB, and control conditions across three points in time (Day 1, 10, and 34 or the first day, approximately the middle day, and the last day). The column graphs provide a visual display of changes that took place in the student’s performance across time. For example, the top column graph in Figure 3 shows the number of steps Autumn performed independently for each task. On Day 1, Autumn completed one step for washing dishes, zero steps for washing windows, and zero steps for mopping the floor. At Day 10,
Autumn’s performance of independent steps remained the same during the control task condition (one step for washing dishes). However, the number of steps she completed independently increased for washing windows (VP), and mopping floors (VP + FB) with her performing four and two steps respectively. And on Day 34, the number of steps Autumn completed independently during the control condition and VP + FB condition did not show any improvement, with her continuing to complete one and four steps respectively. Further, during VP Autumn’s performance of steps completed independently substantially increased to completion of all 12 steps for washing the windows.

Retention Measures

The results of the retention measures for each student appear in Table 6. Additionally, the experimenter conducted an analysis between the intervention phase and retention measure. The experimenter used a retention frequency multiplier to quantify the change between two frequencies (Kubina & Yurich, 2012; Pennypacker et al., 2003). Specifically, the experimenter measured the change from the last data point of intervention and the retention measure taken 10 days later. The calculation for the change measure involves dividing the larger value by the smaller value. The quotient then takes on the multiply or divide sign of the greater initial value depending on the positions of the two compared frequencies. For instance, Cameron’s retention frequency multiplier for VP came to ÷1.1, which means from his last data point in intervention to 10 days later, his behavior decayed by 10%. The data show all three students performance grew in the VP + FB condition. In the VP condition, one student’s performance grew (i.e., Autumn), one remained the same (i.e., Angelica), and the other decayed (i.e., Cameron).

Social Validity

Results from the social validity assessment indicated the teachers and teaching assistants had favorable opinions concerning the VP and VP + FB procedures. The respondents had a mean rating 4.5 out of 5 for acceptability of the procedures used. All respondents agreed both
procedures helped the students improve their performance on the targeted daily living skills with a mean rating of 4 out of 5. In addition, the majority of the respondents agreed they would like to implement VP and/or VP + FB in the future (M=3.75 out of 5), however they indicated they would feel more comfortable implementing procedures if provided instruction first.

Due to expressive and receptive communication deficits, the experimenter could not formally assess the student’s opinions of the procedures used and the results. However, anecdotal evidence suggests all three students enjoyed participating in sessions with the experimenter. For instance, when the experimenter arrived at Cameron’s and Angelica’s classroom each day, the students would immediately stand up, walk over to the experimenter, smile, and lead her upstairs to the setting where the study took place. Initially, Autumn would scream, attempt to hit and pinch, as well as walk away from the experimenter when instructed to complete any task. However, after approximately five days, Autumn began to hold the experimenters hand while walking to sessions and the above-mentioned behaviors decreased without implementation of an intervention. Additionally, when Autumn saw the experimenter around the school building she would approach the experimenter and give her a hug.

Anecdotal evidence also suggests the students showed interest in the VP procedures used during instruction. For example, Cameron would pick up the iPad and hand it to the experimenter when it was time to begin the sessions. Additionally, over the course of the intervention, Angelica and Cameron began to touch the iPad screen after completing a step in order to advance to the next video clip during VP and VP + FB sessions. Furthermore, during VP + FB instruction, when the timer sounded indicating the end of the 15 s timing, all three students would stop and watch the experimenter record the number of correct responses they had performed.
Chapter 4

Discussion

The present study used a single case experimental design called an adapted alternating treatments design (AATD) to evaluate and compare the effects of VP and VP + FB on student performance with daily living skills. The results indicated all students made substantial improvements over their baseline performance using VP and VP + FB. Furthermore, a strong intervention effect emerged for VP and VP + FB conditions when compared to the control task. However, in terms of one intervention proving superior to the other (e.g., VP to VP + FB), the data offer a mixed interpretation with VP + FB producing stronger gains for two of the three students.

Intervention Effects

The comparison of level and celeration (i.e., learning rates) between baseline and intervention conditions offers change statistics demonstrating an intervention effect for VP and VP + FB. With the implementation of VP, all three students demonstrated substantial increases in the average frequency of steps completed correctly when compared to baseline. The level change from baseline to intervention ranged from $x4.36$ to $x17.28$ indicating the students had, on average, a 536% to 1628% increase in the frequency of correct responses respectively over a two-week period. Also, the Celeration Comparison indicated that all three students showed positive changes in celeration during the VP condition compared to the baseline condition. As a result, the speed at which students learned the daily living tasks occurred 2.3 to 3.5 times faster when compared to the baseline condition. Interventions that can double and triple students’ learning rate indicate robust change effects (Kubina & Yurich, 2012).
Similarly, all three students had considerable increases in the average frequency of steps completed correctly during VP + FB when compared to baseline. The Level Comparison between baseline and VP + FB showed a x5.91 to x7.73 (491%-673%) increase in the frequency of correct responses across all students. Positive changes in celeration also occurred with VP + FB for all three students. Based on the Celeration Comparison, the speed the students learned occurred 2.0 to 3.9 times faster when compared to baseline. Meaningful level changes and potent celeration changes from baseline to intervention over a two-week period contribute to the demonstration of intervention effects (Kazdin, 2011).

The last finding marking the presence of a strong intervention effects appears with the control task condition. The control task shows what would have happened if the interventions did not occur. For all three students no meaningful changes occurred in the level and only one student showed a modest gain in learning rate. The average correct steps produced per minute and the degree to which the students learning rate grew at convincingly high speeds all point to an intervention effect and superior efficiency for the VP and VP + FB conditions within the adapted alternating treatments design (Wolery, Gast & Ledford, 2014).

**Point-of-view Video Prompting**

Beyond the direct intervention effects, the results of the current study support and contribute to the evidence base for daily living skills for individuals with ASD (e.g., Domire & Wolfe, 2014; Gardner & Wolfe, 2013). In particular, researchers have recently begun investigating the use of VP with a POV perspective (i.e., showing just the hands and/or forearms of the performer completing a given skill) with favorable results (e.g., Bereznak et al., 2012; Sigafoos et al., 2005). All three students in the current study produced larger gains with VP when compared to baseline and control task conditions. Therefore, the findings lend further support to the overall effectiveness of VP with a POV perspective with students with ASD.
The majority of research demonstrating the effectiveness of VP with a POV perspective to teach daily living skills for individuals with ASD uses voice-over narration (Domire & Wolfe, 2014). However, Rayner, Denholm, and Sigafoos (2009) speculated that video-based instruction with voice-over narration could inhibit the performance of some individuals with ASD. When including voice-over narration with a video model, students must simultaneously attend to multiple stimuli that affect different learning channels, which may interfere with responding (Rayner et al., 2009). Additionally, many individuals have difficulties processing auditory information (O’Connor, 2012) therefore using narration may further contribute to differences found in responding during acquisition and maintenance with VP (Domire & Wolfe, 2014).

The present study did not include voice-over narration as a component of the video clips and found all students made substantial improvements compared to the control task condition. By eliminating the voice-over narrative, the presented instruction affected only one learning channel, thus increasing the student’s attention to the most relevant features of instruction. Furthermore, presenting instructional stimuli through purely a visual means mirrors the learning strengths (McCoy & Hermansen, 2007) and sometimes preferred instructional style of individuals with ASD (Arthur-Kelly, Sigafoos, Green, Mathisen, & Arthur-Kelly, 2009; Cihak, 2011; Cihak & Schrader, 2009; Quill, 1997).

**Frequency Building and Behavioral Fluency**

One feature of the current study that differentiates it from previous studies within the VP literature includes the addition of frequency building, a systematic practice procedure including timed repetition of behavior followed by corrective feedback. By including procedures where students have multiple opportunities to respond to specific stimuli quickly and accurately, students can increase their rate of responding (Kubina & Yurich, 2012). Additionally, immediate corrective feedback during multiple trials increases fluency and learning (Carnine, Silbert, Kame’enui, & Tarver, 2009; Miller, Hall, & Heward, 1995); the previous point illustrated in
Cameron and Angelica’s data as displayed in Figures 1 and 2. By adding frequency building, Cameron and Angelica demonstrated meaningful improvement in their performance (i.e., greater level change and faster celeration) within a two-week period than with VP alone. Frequency building maximizes the opportunities for the students to respond, focuses attention on the targeted skill at hand, and reduces prompt dependency (Scott, Clark & Brady, 2000). Therefore, the addition of frequency building with key instructional methods holds promise for remedying acquisition problems experienced by many individuals with ASD.

Frequency building leads to an important outcome: behavioral fluency (Hughes et al., 2007). A performance standard represents a certain rate or frequency range of behavior suggesting the person has attained behavioral fluency (Binder, 1996). A strong evidence base exists supporting performance standards (Johnson & Street, 2013). Before determining a performance standard, one must set a frequency aim and measure those aims for critical learning outcomes such as long-term retention, endurance, and application (Binder, 1996). Because few frequency aims for activities of daily living exist, the present study sampled adult performers on each daily living skill in order to identify a frequency aim. Two of the three students (Cameron and Angelica) reached the frequency aim with VP + FB and one student (Autumn) reached the frequency aim with VP. The three students performed their targeted skills as competent adults. Therefore, the frequency aim served as a useful guide signaling proficiency and functionality for each behavior.

Behavioral fluency asserts that when students reach a frequency aim or performance standard, critical learning outcomes such as retention occur (Holding et al., 2011; Nopprapun & Holloway, 2014). For individuals with ASD, retention represents an especially critical learning outcome given the well-documented difficulties many have with maintaining skills (e.g., Sigafoos et al., 2005). Researchers have found regardless of whether frequency building to behavioral fluency proved more effective for skill acquisition when compared to another intervention (e.g.,
discrete trial training), strong retention effects came about with frequency building (Holding et al., 2011; Nopprapun & Holloway, 2014). Moreover, when students met accuracy criteria alone, sufficient maintenance of the skills did not occur (e.g., Holding et al., 2011; Lee & Singer-Dudek, 2012; Nopprapun & Holloway, 2014). Therefore, achieving accuracy will not necessarily result in long-term retention of skills (Kubina & Wolfe, 2005). As a result, students need instruction geared toward all levels of response competency (i.e., acquisition, fluency, maintenance, generalization) in order to maintain skills long-term (Albert & Troutman, 2003).

In the current study, VP + FB resulted in all three students not only maintaining performance but also improving their performance at the retention check. Improvements ranged from x1.1 to x2.0, indicating a 10%-100% increase in the frequency of steps completed correctly from the last day of intervention, with the largest increase seen in Autumn’s data. Interestingly, during VP + FB Autumn did not reach the frequency aim, however her performance during the retention measure resulted in a x2 (100%) increase in the frequency of steps performed correctly thereby lending support to the utility of frequency building. The retention data corroborates behavioral fluency by demonstrating superior recall and use of a skill after termination of the intervention (Lee & Singer-Dudek, 2012; Holding et al., 2010; Singer-Dudek & Greer, 2005).

Another feature that distinguishes the present study from previous research in VP includes use of the Standard Celeration Chart (SCC) and precision measurement. In light of the call for augmenting single case designs with statistical analysis (Parker, Cryer & Burns, 2006; Shadish, Hedges, Horner, & Odom, 2015), the SCC permitted the experimenter to calculate personalized statistics such as celeration or the speed in which behavior changed (Graf & Lindsley, 2002; Lindsley, 2005; Pennypacker et al., 2003). Celeration provides an accurate, numerical measurement of learning (Datchuk & Kubina, 2011). Typically, single case design qualitatively describes learning change with words such as rapidly or moderately increasing
(Kennedy, 2005). However by measuring celeration, one can determine precisely, quantitatively how fast a student learns.

As an example of a quantified learning rate, VP and VP + FB produced changes in learning \(x2.3\) to \(x3.5\) faster than baseline performance, indicating robust changes in learning within a short period of time (i.e., two-weeks). Considering many students with ASD experience slow acquisition rates, specifically in the area of daily living (Cullen & Alber-Morgan, 2015), using celeration to determine a students’ personal rate of learning can better help teachers guide their decision-making and judge the significance of behavior change (Kubina & Yurich, 2012). The SCC could have many positive benefits for researchers using single case designs without the need to apply separate statistical tests.

**Limitations**

Although the results of the present experimental study demonstrated positive effects for VP and VP + FB, a number of limitations do exist. First, the study only included three individuals with ASD. This may limit the extent to which the results might apply to other students with ASD, as well as students with other disabilities. Second, the major feature of the AATD involves the identification of equivalent but functionally independent behaviors (Sindelar et al., 1985), which can prove very difficult. In order to ensure equivalence of the targeted tasks the experimenter conducted a logical analysis in which the three tasks were deemed equivalent in terms of number of steps and response effort. In addition, the experimenter included a baseline condition that established the equivalence of performance on the three tasks for each student.

Another possible limitation includes the increased number of opportunities to respond as well as opportunities for feedback during the VP + FB condition. In order to attempt to control for the increased number of opportunities, the experimenter equated the VP and VP + FB conditions based on duration of instruction. However, VP + FB instruction may still have produced more opportunities to respond and provide feedback. And therefore may have affected
the results. Additionally, during the comparison condition the experimenter periodically measured the task assigned to the control condition. Therefore, the number of data points in the control did not match the number data points in the intervention conditions. Lastly, Cameron’s setting changed midway through the experiment. The setting change may have affected him though that limitation seems tempered by the fact that his control task performance did not change.

**Future Research**

The results of the present experimental study provide initial support for combining VP and frequency building. Future research should continue to explore the efficacy of VP + FB and its use to teach daily living skills. In addition, future research should continue to examine the use of frequency aims for daily living skills in order to determine if meeting the high frequencies will result in critical learning outcomes such as retention, endurance, and application.

The present study also provided support for VP with a POV perspective without voice-over narration for teaching daily living skills with individuals with ASD. Future research should continue to examine the use of VP with different perspectives as well as without and without voice-over narration in order to determine which components and/or combination of components produce the most effective and efficient results. Lastly, the majority of research examining the use of VP involves the researchers or members of the research team implementing the interventions. Future research should focus on training teachers to implement VP instruction in order to better inform practice.
References


Appendix A

Tables

**Table 1. Task Analysis of Daily Living Skills**

<table>
<thead>
<tr>
<th>Mops Floor</th>
<th>Washes Dishes</th>
<th>Washes Windows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Picks up mop</td>
<td>1. Turns on water (both hot and cold)</td>
<td>1. Picks up spray bottle</td>
</tr>
<tr>
<td>2. Puts mop into bucket</td>
<td>2. Picks up soap</td>
<td>2. Sprays top of window from left to right</td>
</tr>
<tr>
<td>3. Lifts mop out of bucket</td>
<td>3. Opens top</td>
<td>3. Puts spray bottle down</td>
</tr>
<tr>
<td>5. Squeezes sponge into bucket</td>
<td>5. Pours soap on sponge and puts soap down</td>
<td>5. Puts paper towel on top left window and wipes window from top to bottom moving left to right (5 times)</td>
</tr>
<tr>
<td>6. Snaps handle back</td>
<td>6. Picks up plate and wipes top of plate (3 times)</td>
<td>6. Throws paper towel away</td>
</tr>
<tr>
<td>7. Puts mop on floor near bathtub and moves mop back and forth from left to right (5 times)</td>
<td>7. Turns plate over and wipes bottom of plate (3 times)</td>
<td>7. Picks up spray bottle</td>
</tr>
<tr>
<td>8. Puts mop on floor near toilet and moves mop back and forth from left to right (5 times)</td>
<td>8. Puts sponge down</td>
<td>8. Sprays top of second window from left to right</td>
</tr>
<tr>
<td></td>
<td>10. Turns over and rinses top of plate for at least 3 seconds</td>
<td>10. Gets paper towel</td>
</tr>
<tr>
<td></td>
<td>11. Puts plate in dish rack</td>
<td>11. Puts paper towel on top left window and wipes window from top to bottom moving left to right (5 times)</td>
</tr>
<tr>
<td></td>
<td>12. Turns off water</td>
<td>12. Throws paper towel away</td>
</tr>
</tbody>
</table>
Table 2. Intervention Assignments

<table>
<thead>
<tr>
<th>Student</th>
<th>VP</th>
<th>VP + FB</th>
<th>Control Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autumn</td>
<td>Washes windows</td>
<td>Mops floor</td>
<td>Washes plate</td>
</tr>
<tr>
<td>Cameron</td>
<td>Washes plate</td>
<td>Washes windows</td>
<td>Mops floor</td>
</tr>
<tr>
<td>Angelica</td>
<td>Mops floor</td>
<td>Washes plate</td>
<td>Washes windows</td>
</tr>
</tbody>
</table>

Table 3. Student Performance Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Level</th>
<th>Celeration</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>BL</td>
<td>VP</td>
</tr>
<tr>
<td>Autumn</td>
<td>.25</td>
<td>4.32</td>
</tr>
<tr>
<td>Cameron</td>
<td>.70</td>
<td>3.88</td>
</tr>
<tr>
<td>Angelica</td>
<td>.69</td>
<td>3.01</td>
</tr>
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</table>
### Table 4. Comparison Analysis Between Baseline and Intervention

<table>
<thead>
<tr>
<th></th>
<th>Level Comparison</th>
<th>Celeration Comparison</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>BL compared to</td>
<td>BL compared to</td>
</tr>
<tr>
<td></td>
<td>VP</td>
<td>VP + FB</td>
</tr>
<tr>
<td>Autumn</td>
<td>x17.28</td>
<td>x7.73</td>
</tr>
<tr>
<td>Cameron</td>
<td>x5.54</td>
<td>x6.84</td>
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<tr>
<td>Angelica</td>
<td>x4.36</td>
<td>x5.91</td>
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</table>

### Table 5. Comparison Analysis Between Intervention and Control Task Condition

<table>
<thead>
<tr>
<th></th>
<th>Level Comparison</th>
<th>Celeration Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VP compared to</td>
<td>VP+FB compared to</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Control</td>
</tr>
<tr>
<td>Autumn</td>
<td>x12.7</td>
<td>x5.9</td>
</tr>
<tr>
<td>Cameron</td>
<td>x5.2</td>
<td>x7.5</td>
</tr>
<tr>
<td>Angelica</td>
<td>x4.4</td>
<td>x8.2</td>
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Table 6. Retention Measure

<table>
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<tr>
<th>Condition</th>
<th>Last Intervention Data Point</th>
<th>Retention Data Point</th>
<th>Retention Frequency Multiplier</th>
</tr>
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</tr>
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<td>VP</td>
<td>9</td>
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<tr>
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</tr>
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</tr>
<tr>
<td></td>
<td>VP+FB</td>
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Appendix B

Figures

Figure 1. Frequency of Steps Performed Correctly
Figure 2. Level Lines and Celeration Lines
Figure 3. Number of Steps Performed Independently
Figure 4. Autumn’s Number of Steps Performed Independently
Figure 5. Cameron’s Number of Steps Performed Independently
Figure 6. Angelica’s Number of Steps Performed Independently
Appendix C

Review of Relevant Literature

Over the past decade the Centers for Disease Control and Prevention (CDC) has reported a marked increase in the rates of children diagnosed with autism spectrum disorder (ASD). The lifelong neurodevelopmental disorder affects an estimated 1 in 68 children, which is approximately 30% higher than the estimate for 2008 (1 in 88; CDC, 2014). The striking increase in prevalence has contributed to a growing awareness of the needs of adolescents and adults with ASD (Ratto & Mesibov, 2015), with acquisition of independent living skills constituting a primary concern for parents and families of individuals with ASD (Heiman, 2002). However, many individuals with ASD exit high school lacking the ability to care for their daily needs (Gray et al., 2015).

Individuals with ASD have unique learning characteristics that contribute to the challenges faced when developing independent behavior (Hume, Boyd, Hamm, & Kucharczyk, 2014). Other challenges include deficits in attending skills, difficulties sustaining attention, planning, and memory, as well as challenges focusing on the most relevant features of instructional materials (Hume, Loftin, & Lantz, 2009; Weiss, Fabrizio, & Bamond, 2008). Problems in the previously mentioned areas pose significant challenges in terms of acquisition of skills. Further, even with successful acquisition of skills, many individuals with ASD struggle with fluidity and speed of response. As a result, individuals with ASD engage in slow and effortful performance with long latencies to respond (Weiss, 2001; Weiss et al., 2008). Lastly, individuals with ASD often have difficulties maintaining skills and can lose skills over time (Weiss et al., 2008).
Given the poor post-school outcomes for individuals with ASD, identifying effective and efficient interventions geared toward supporting the learning needs of the population has great importance. Video-based instruction and frequency building to behavioral fluency represent change strategies that support the learning needs of individuals with ASD. In addition, targeting daily living skills (e.g., self-care, domestic, community) can allow individuals with ASD to become more independent, increase participation in the community, as well as increase one’s overall quality of life (Hong et al., 2015). By combining the two research bases, video-based instruction and frequency building to behavioral fluency, instruction may result in faster acquisition, improved maintenance of skills over time, or other critical learning outcomes. To examine the concept further, the present review seeks to explore and critically examine the current body of literature of video-based instruction to teach daily living skills and frequency building to behavioral fluency for individuals with ASD. The following questions guide the review: What effect does point-of-view video prompting have on acquisition and maintenance of daily living skills for individuals with ASD? And, what effect does frequency building to behavioral fluency have on skill retention for individuals with ASD?

**Video-based instruction**

Video-based instruction has emerged as an effective and efficient method for teaching daily living skills to individuals with ASD (Ayres & Langone, 2005; Banda, Dogoe, & Matuszny, 2011; Bellini & Akullian, 2007; Delano, 2007; Gardner & Wolfe, 2013; Hume et al., 2009; McCoy & Hermansen, 2007; Mechling, 2005). Video-based instruction provides a means of delivering visual and auditory examples of stimulus and response requirements through the presentation of video footage in order to assist with task performance (Columna, Arndt, Lieberman, & Yang, 2009; Haegele & Kozub, 2010; Rayner, Denholm, & Sigafos, 2009; Wissick, Gardner, & Langone, 1999). Researchers have identified a number of advantages of video-based instruction for teaching students with ASD, including durability and reuse across
instructors and settings, realistic representations of natural environments, consistency of models for quality instruction, and controllability of stimuli to reduce distractions (Ayres & Langone, 2005; Delano, 2007; McCoy & Hermansen, 2007; Mechling, 2005; Ramdoss et al., 2011; Shukla-Mehta, Miller, & Callahan, 2010).

**Video modeling.** One strategy commonly used in the video-based instruction literature includes video modeling (VM). VM consists of showing an individual a pre-recorded video of a model performing a task sequence from start to finish. Immediately following, the individual has the opportunity to practice performing the task in its entirety (Charlop-Christy, Le, & Freeman, 2000). Researchers have used different perspectives when filming video models. The perspectives include: first-person perspective or more commonly referred to as point-of-view perspective (POV), the spectators’ perspective (i.e., third-person perspective), or self-modeling (i.e., clips show the target individual successfully completing a task).

Recent meta-analyses have reported large effect sizes for VM interventions (Bellini & Akullian, 2009; Mason et al., 2013a; Mason et al., 2013b). Additionally, Bellini and Akullian (2009) concluded that VM interventions meet the quality indicators for single subject research set by Horner and colleagues (2005) as being an evidence-based practice. VM has also emerged as an effective instructional technique to teach individuals with ASD. Researchers have identified VM as an established, evidence-based intervention by the National Autism Center (Wilczynski et al., 2009). Furthermore, researchers have documented strong evidence to support the use of VM in teaching a variety of daily living skills such as grooming/hygiene tasks (e.g., Charlop-Christy et al., 2000), household chores (e.g., Van Laarhoven, Zurita, Johnson, Grider, & Grider, 2009), and cooking-related activities (e.g., Shrestha, Anderson, & Moore, 2013).

More specifically, researchers have demonstrated the effectiveness of VM with a POV perspective for daily living skill instruction. For example, Shipley-Benamou, Lutzker, and Taubman (2002) assessed the efficacy of VM with a POV perspective to teach a variety of daily
living skills (i.e., making orange juice, preparing a letter to mail, putting the letter in the mailbox, pet care, cleaning a fish bowl, and setting the table) to three children with ASD. During instruction, the researchers delivered verbal praise to increase the student’s attention to the video. For two of the three students, presentation of the VM produced rapid skill acquisition for each task. However, the third student’s responding initially remained at baseline levels during the first two weeks of intervention and she required the addition of gestural prompts to attend to the video model. Once the researchers added the prompting procedure, the student’s correct responding increased significantly. At the one-month follow up, all three students maintained higher levels of performance compared to baseline. However, the percentage of correct responding decreased with two out of the three tasks for two of the students and for one out of two tasks for the third student.

As another example, Aldi et al. (2016) examined the effects of VM with a POV perspective with two male adolescents with ASD. The researchers filmed the arms and hands of the model performing the task and included a verbal description of each step. During the VM condition, the students viewed the entire video showing the task from start to finish. If the student made an error, the researcher reset the video and the participant reviewed the segment in the video that modeled the response and then had the opportunity to perform that behavior. If the student did not respond or responded incorrectly again, the researcher provided a gestural prompt. If a correct response still did not occur, the student re-watched the video segment of the step performed incorrectly up to two more times before moving on to the next step. For student 1, the researchers provided no feedback for correct responses, but delivered verbal praise for student 2 upon completion of setting the table. Results indicated that both students met criterion (i.e., 100% for three sessions) for all tasks. However, neither student maintained the performance criterion at a 1-month follow-up. Although both students performance decreased, the percentage of steps they completed correctly did remain above baseline levels.
VM instruction includes several features that may contribute to the benefits seen when used with individuals with ASD. For instance, VM procedures use visually cued instruction that aims to improve attention to the modeled behaviors. In order to compensate for stimulus over-selectivity, video technology enables the instructor to restrict the field of focus by having the camera zoom in closely on the relevant stimuli associated with the task and remove any irrelevant details from the video (Bellini & Akullian, 2007; Charlop-Christy et al., 2000). Additionally, VM procedures can promote response generalization by having the individual perform the skill in different settings after watching the video, having different instructors facilitate the instructional session, or creating different videos of the same skill in various settings (Mechling, 2005). And researchers have suggested that VM has the potential to motivate individuals with ASD through the use of technology and the modes for showing the video (e.g., laptop or iPad).

Although VM has many benefits, some researchers have indicated that VM does not address the well-documented memory impairments experienced by many individuals with ASD (Matson & Smiroldo, 1999; Quill, 1997). Specifically, VM requires an individual to watch the entire skill before having an opportunity to imitate the behaviors observed in the video. For some individuals with ASD, the task can prove demanding with regards to attention and retention, especially when the videos may last several minutes in length or when the tasks increase in complexity in term of number of steps (Sigafoos et al., 2007). The deficits pose particular concern for using VM to teach daily living skills because such behaviors often include complex tasks with a large number of steps. Therefore, researchers have begun to investigate the versatility of implementing VM in terms of implementation and with regards to the organization and presentation of the videos.

**Video prompting.** Stemming from VM, video prompting (VP) involves the student watching a portion of a video segment or a video clip of each step in the behavioral chain and performing the step before advancing to the next task in the chain (Mechling, 2005). The main
The difference between VM and VP lies in the number of steps shown in each video clip. VM consists of essentially one step, showing the entire video of the target behavior. On the other hand, VP involves breaking the entire task into a video clip of each component (Cannella-Malone et al., 2006).

The benefits of using VP closely match those of VM with the added benefit of breaking down an overall, complicated skill into smaller, simpler, and sequential steps for individuals to learn and perform (Banda et al., 2011). Several researchers have compared the effects of VP and VM to teach daily living skills. For instance, Cannella-Malone et al. (2006) compared the effects of VP and VM in teaching six adults with developmental disabilities how to set a table and put away groceries. The VP condition involved the adults watching 10 separate video clips, each showing one step of the task analysis. The researchers filmed the video clips through a POV perspective and included a one-sentence voice-over instruction. In contrast, the VM condition involved the adults watching a single video showing all 10 steps from beginning to end. Like the VP video, the video model included a one-sentence voice-over instruction, however filming occurred from a third-person perspective. The researchers found VP promoted rapid acquisition across both tasks for five out of the six adults. However, VM resulted in little to no improvement in the percentage of steps performed correctly making it generally ineffective.

Similarly, Cannella-Malone et al. (2011) compared the efficacy of VP and VM to teach seven students with ASD and moderate intellectual disabilities to do laundry and wash dishes. However, unlike Cannella-Malone and colleagues (2006), the researchers filmed each task from a POV perspective thus controlling for any differences that may have occurred in the previous study from the videos being filmed from different perspectives. Videos in both conditions also included a one-sentence voice-over instruction. Results indicated VP proved more effective than VM for all seven students. Furthermore, the researchers found VM to have no effect for five of the seven students.
Researchers have also compared the use of VP with static picture prompts (i.e., photographs of an individual completing the target skill). Mechling and Gustafson (2008) compared VP with picture prompts to teach six high school-aged males cooking related-tasks. The researchers used an adapted alternating-treatment design with baseline, comparison, withdrawal, and final treatment conditions to measure the percentage of steps completed independently by each student across the two treatments. The researchers filmed the VP video from a third person perspective and included verbal cues corresponding to each step of the task analysis. Results indicated that both procedures demonstrated an increase in correct task performance for all students from baseline levels. However, students independently completed a greater number of tasks when using video prompting. Furthermore, during the final treatment phase each student further increased his level of performance when using VP with sets of tasks receiving static picture prompts during the comparison phase.

Van Laarhoven et al. (2010) also compared VP with static picture prompts for teaching daily living skills to two adolescents with ASD. Like Mechling and Gustafson (2008), the researchers used an adapted alternating treatments design to compare the two interventions. Videos used during the VP condition included zoom and wide-angle shots (i.e., combination of third person and POV perspective) as well as voice-over narration to describe the actions being depicted in each video clip. Results suggested that VP proved slightly more effective in terms of independent correct responding, fewer external prompts for task completion, and fewer prompts to use instructional materials.

**Point-of-view Video Prompting**

Although many experimental studies demonstrate the effectiveness of VP with third person and POV perspectives, the POV perspective may provide added benefits to VP procedures. POV perspective typically involves showing just the hands of the performer completing a given skill, thereby narrowing the center of focus for the viewer and directing an
individual’s attention to the critical feature(s) of a given task (Mason et al., 2013a). Given the added benefits of using a POV perspective with VP procedures, researchers have begun to assess the efficacy of POV VP to teach daily living skills to individuals with ASD.

Although a number of studies have focused on the use of POV VP, to date only five studies have addressed using POV VP with daily living skills. Sigafoos and colleagues (2005), for example, investigated the use of POV VP to teach individuals with developmental disabilities and ASD to use a microwave oven to make popcorn. In addition to each video clip demonstrating the actions required for completing the step, each included a one-sentence voice-over instruction. For the student with ASD, POV VP resulted in an increase in the percentage of steps completed independently within five sessions. Additionally, the student reached acquisition criteria (i.e., 5-6 sessions with 100% of steps completed independently). Upon withdrawal of the video prompt, the participant maintained performance of 100% of steps completed independently for four sessions. However, during two, six, and 10-week maintenance probes, the students’ performance decreased with a mean performance of 85% steps completed independently.

Bereznak Ayres, Mechling, and Alexander (2012) used POV VP via an iPhone to teach three male high school students with ASD to use a washing machine, make noodles, and use a copy machine. Similar to Sigafoos et al. (2005), each video clip included a voice-over description of the recorded action. The researchers also reported gains with the introduction of VP, with all three students demonstrating an immediate increase in the percent of steps performed correctly for the targeted tasks. In addition, two of the three students navigated through the video prompts independently. However, unlike the findings of Sigafoos et al. (2005), all three students displayed a decrease in performance upon the withdrawal of the VP procedure.

Given previous findings (i.e., Sigafoos et al., 2005), Sigafoos et al. (2007) implemented VP with a fading procedure to teach dishwashing skills. The researchers filmed videos from a POV perspective and included a one-sentence voice-over description of the task being shown in
each video clip. The researchers noted an immediate increase in the percentage of steps correct with introduction of VP for all students. Although all students acquired high levels of performance quickly, after removing VP, performance deteriorated for all three students. As a result, the researchers implemented a fading procedure consisting of a three-level sequence (e.g., four chunks, then two chunks, then one video for the entire sequence). Results suggested that the video chunking procedure better maintained task performance at levels of 80-100% for all students.

And last, Gardner and Wolfe (2015) investigated the effectiveness of POV VP plus an error correction procedure on skill acquisition when teaching dishwashing. As in previous research, the researchers included a one-sentence voice-over instruction. However for the final step in the task analysis, the students viewed a video clip in fast-forward speed that showed all of the steps leading up to the targeted step and ended with the last step (i.e., targeted step). The researchers decided to include this step in order to enable the student to see the entire task sequence at least one time through during an instructional lesson. POV VP also included an error correction procedure consisting of a system of least prompt hierarchy (i.e., verbal/visual, model, physical). Upon introduction of POV VP intervention, the student with ASD exhibited a rapid increase in the number of steps completed independently and met mastery criteria (i.e., at least 90% accuracy for 4 consecutive sessions) after six sessions. Additionally, performance maintained at one and two week post-intervention measures without access to the video prompts.

Recently, researchers have also begun to investigate the combination of variables that will result in the most effective and efficient implementation of VP. For example, Bennett, Gutierrez, and Honsberger (2013) compared the effects of POV VP with and without voice-over narration on the acquisition of clerical skills among secondary students with ASD. Results indicated that all students made substantial improvements over their baseline performances on
each task with the introduction of both independent variables. However, no clear differences emerged between POV VP with and without voice-over narration.

Overall, all studies reported improved performance in daily living skills for each student using POV VP. Across the studies, students performed more steps in the tasks after intervention than during the initial baseline phase. However, in three studies students’ performance declined upon the removal of the video prompt (Bereznak et al., 2012; Sigafoos et al., 2005; Sigafoos et al., 2007). The findings suggest video prompts require systematic fading in order to maintain performance. Furthermore, only one study found positive maintenance results (Gardner & Wolfe, 2015) with maintenance measures collected one and two weeks post intervention. Therefore, future research should continue to evaluate the effects of POV VP for daily living skills with a focus on procedures that will result in long-term maintenance of skills.

**Behavioral Fluency**

Individuals with ASD often demonstrate problems in fluidity and speed of response as well as deficits in application and retention of skills even after achieving accuracy. Deficits in such areas can have negative impacts for students’ learning rates and result in poor learning outcomes (Weiss, 2001; Weiss et al., 2008). Researchers have recently considered the utility of procedures geared towards producing behavioral fluency when educating students with ASD (Fabrizio & Moors, 2003; Kubina, Morrison, & Lee, 2002; Kubina & Wolfe, 2005; Ramey et al., 2016; Weiss, 2001) in order remedy the issues related to long term maintenance of skills (Kubina & Wolfe, 2005; Weiss et al., 2008).

Behavioral fluency refers to a behavior performed to a high level of accuracy plus speed that reflects competent performance (Binder, 1996). Behavioral fluency facilitates an individual functioning effectively and efficiently within their environment (Binder, 1996). The theory of behavioral fluency indicates that when a student engages in practice until meeting a predetermined performance standard, or fluency aim, critical learning outcomes will occur
(Kubina, 2010). The critical learning outcomes include: (1) long-term retention or the ability to retain information for long periods of time after instruction has ended, (2) endurance or the lack of fatigue when performing a behavior over some time interval, and (3) application or extension of one skill to a compound behavior (Binder, 1996; Kubina & Yurich, 2012; Lindsley, 1991). As a result, students who exhibit high levels of behavioral fluency tend to function efficiently and effectively in their natural environments (Binder, 1996).

**Retention.** Retention constitutes a critical learning outcome with many implications for individuals with ASD. Retention refers to the ability to retain information after a period of time during which a person has not had an opportunity for practice (Binder, 1996). Results from behavioral fluency research shows that as students become more accurate and/or attain fluency, they show high degrees of retention (Berens, Boyce, Berens, Doney, & Kenzer, 2003; Brown, Dunne, & Cooper, 1996; Bucklin, Dickinson, & Brethower, 2000; Ivarie, 1986; Peladeau, Forget, & Gagne, 2003; Shimamune & Jitsumori, 1999). Without adequate retention, the ability to perform a behavior for any significant period of time after the intervention diminishes (Kubina et al., 2002).

In order to achieve behavioral fluency and obtain the associated outcomes (e.g., retention), explicit or deliberate practice must occur. Frequency building represents the core process for achieving behavioral fluency. Frequency building includes timed repetition of a behavior and performance feedback (Kubina & Wolfe, 2005). Researchers have successfully used frequency building procedures for interventions in reading (Hughes, Beverley, & Whitehead, 2007; Kubina, Amato, Schwilk, & Therrien, 2008; Brown, Dunne, & Cooper, 1996), spelling (Kubina, Young, & Kilwein, 2004) mathematics (Binder, Haughton, & Van Eyk, 1990; Brady & Kubina, 2010) and writing (Datchuk, Kubina, & Mason, 2015; Dermer, Lopez, & Messling, 2009). Building frequencies of behavior to a high enough degree would increase the
likelihood that the student would become fluent and would be able to retain, endure, and apply
the behavior (Binder, 1996; Johnson & Layng, 1992; Johnson & Street, 2013).

**Effects on Retention**

Individuals with ASD exhibit well-documented difficulties maintaining skills after
learning them and tend to lose skills over time (Weiss et al., 2008). As a result, teachers often
need to review previously acquired material and students spend a significant amount of
instructional time on previously learned material. Difficulty with skill retention also significantly
affects the student’s ability to progress through curricular areas, as foundational skills may
weaken or dissipate (Weiss et al., 2008). Thus, incorporating frequency building to fluency may
serve as a remedy for the issue of retention of skills exhibited by individuals with ASD (Weiss,
Pearson, Foley, & Pahl, 2010).

Kelly and Holloway (2015) reported an example of the effects of frequency building on
retention for three children with ASD. The researchers evaluated the effectiveness of behavioral
momentum and frequency building on the acquisition of tacts (i.e., labeling items in pictures) and
associated fluency outcomes. Behavioral momentum procedures involved presenting 20
flashcards of “mastered stimuli” (i.e., high probability response sequence) immediately prior to
the onset of the one-minute timing of target stimuli (i.e., low probability response sequence). The
results demonstrated positive fluency outcomes on low probability tacts across all children. The
children in the study successfully reached their frequency aims for tacts and furthermore
demonstrated retention of the tacts learning in intervention following a four-week period post-
intervention.

Lin and Kubina (2015) examined the effect of accuracy building and frequency building
to a performance criterion (FBPC) on the accuracy and speed of motor imitation of a four-year-
old girl with ASD. First, the researchers implemented an accuracy building condition, which
contained the use of discrete trial instruction with a high exit criterion of 100%. After the student
achieved the exit criterion, the researchers implemented FBPC, which included the timed repetition of a behavior with corrective or confirmatory performance feedback. Results revealed that accuracy building lead to a high level of accurate responding and FBPC lead to high frequency, high accuracy behavior, or behavioral fluency. Additionally, 19 days post intervention, the student continued to perform the previously learned motor imitations at 100% accuracy and at a high frequency.

In addition to examining the effects of frequency building on the retention of academic skills for individuals with ASD, researchers have also targeted functional skills. For instance, Young, West, Howard, and Whitney (1986) tested the effects of accuracy and frequency building procedures on dressing skills for students with developmental delays using a multiple baseline design. First, the researchers implemented whole task training and graduated guidance to teach independent dressing skills. After the students acquired the basic dressing skills, the researchers implemented a frequency building procedure. Frequency building consisted of repeated practice on the responses in the chain that the students performed with the most difficulty and continued until students met frequency aim. Maintenance measures, conducted one month following intervention, showed that the skills taught to the frequency aim were maintained; however, the researchers did not evaluate the effects of accuracy training alone.

Twarek, Chion, and Eshelman (2010) assessed the effects of repeated timed practice of component motor skills on speed and accuracy of composite skills and the effects of fluent component motor skills on the completion of daily living composite skills for three students with ASD. The researchers taught the component skills of reaching, pulling, grasping, and placing: skills all necessary for dressing behavior. After achieving frequency aims on the skills, the researchers assessed the students’ performance on task analyses related to dressing skills. Without specific training, the students improved performance on the dressing skills from baseline
levels. Furthermore, all students performed most of the component skills at frequency aims during the one-week retention check.

**Comparison Studies**

In order to further examine the utility of frequency building, researchers have compared the effects of meeting a frequency aim versus an accuracy criterion. Lee and Singer-Dudek (2012) examined the effects of frequency versus accuracy building on two hardware assembly tasks by adolescents with developmental disabilities. The two conditions involved different procedures for instruction followed by two different criteria for mastery. For frequency building condition, the researchers used a rate criterion of 1 min 30 s for completing one task for five consecutive sessions. For the accuracy building condition the researchers used a criterion of 100% for five consecutive sessions. Overall, results suggest that the frequency condition produced greater work productivity. Data on retention showed that although all students maintained accurate performance on both frequency and accuracy tasks over six weeks without practice, the frequency condition resulted in better retention as evidenced by higher rates of correct task completion for three of four students during post-training sessions.

Singer-Dudek and Greer (2005) compared the efficacy of frequency and accuracy building to teach individuals with developmental disabilities component math skills (i.e., single-digit multiplication facts through the 3s tables, single-digit addition facts with sums 10 or less, single-digit addition facts with sums greater than 10, and reading word lists). The researchers also tested for performance on a composite task (i.e., identification of place value to the 100s place, reading sight words on word lists, and comprehension of those sight words) two months post intervention. During mastery instruction, students received reinforcement for accuracy and in the fluency condition students received reinforcement for rate of responding on component math skill tasks. The study procedures controlled for the number of stimulus exposures and found that the rate-building instruction did not result in fewer learn units to criterion. However,
only the students in the frequency building maintained the composite skills after a two-month period of no practice.

Researchers have also compared the effects of discrete trial training (DTT) with frequency building for students with ASD. Holding, Bray, and Kehle (2010) compared the efficacy of DTT and frequency building for teaching noun labels in children with ASD. The researchers taught teachers to implement both procedures. The teachers delivered instruction via a Microsoft PowerPoint slide presentation on a laptop computer. The researchers controlled for both number of practice opportunities as well as rate of reinforcement. They found all four students required significantly less instructional time with frequency building than with DTT to learn the same number of or more total nouns. Furthermore, frequency building resulted in better retention for three of the four students at six weeks post intervention, resulting in a large effect size (d = .84) indicating frequency building had a stronger effect for retention across all students. Accuracy alone, therefore, could not sufficiently maintain the targeted behavior.

Similarly, Nopprapun and Holloway (2014) investigated the efficacy of frequency building and DTT to teach phonic reading to four students with ASD, with particular emphasis on the acquisition of correct letter-sound correspondence and the learning outcomes associated with behavioral fluency. During both frequency building and DTT conditions, the researchers delivered instruction via a Microsoft PowerPoint slide presentation on a laptop computer. The results showed that for two students, frequency building proved more efficient for the acquisition of correct letter-sound correspondence. For the remaining two students, DTT resulted in more rapid acquisition. However, for all four students, frequency building produced better results during the six-week post-intervention retention measure. For two out of the three students, the retention measure demonstrated noticeable decreases in retention of phonics learned with DTT. For example, student 3’s retention measure resulted in 37 correct responses and 2 incorrect
responses while DTT resulted in 18 correct responses and 17 incorrect. Additionally, three out of the four students continued to perform above the frequency aim six weeks post intervention.

**Frequency Building Components**

Frequency building procedures include several components. Two of the main components assessed throughout the literature drive the consistencies and differences within the independent variable. The two components assessed included: (1) use of feedback during frequency building trials, and (2) the different methods for establishing the performance criteria for each of the skills.

**Use of Feedback.** Throughout the literature seven out of the eight studies reported use of feedback for the students. Across the studies, when researchers delivered feedback and the forms of feedback varied. Researchers in three studies delivered feedback immediately following each timing (Lee & Singer-Dudek, 2012; Lin & Kubina, 2015; Singer-Dudek & Greer, 2005). For instance, Singer-Dudek and Lee (2005) delivered feedback for both correct and incorrect responses following each session however the researchers did not specify the precise correction procedures or reinforcement used.

Similarly, Kelly and Holloway (2015) delivered feedback after the timing but only in regards to corrective feedback. Corrective feedback procedures included presenting the student with the incorrectly tacted stimulus and a vocal verbal model. The researcher then required the student to repeat the model and then represented the trial and provided the student the opportunity to emit the tact independently.

On the other hand, two others focused on delivering feedback for correct responding only following the timed trials. Lee and Singer-Dudek (2012) provided students with a preferred edible item and verbal praise for accurate completion of the task. If the student performed a given task faster than his previous record, the researcher provided additional verbal praise (e.g., “You just beat your record”). Lin and Kubina (2015) implemented a similar feedback procedure
including use of praise for completing the timed trial and delivering a preferred tangible item when the student met her pre-determined performance criterion for the session.

Researchers in three studies delivered feedback during the timed trial as well as immediately following. During the timing, Kelly and Holloway (2015) provided verbal praise for students remaining on task. Immediately following the trial, the researchers provided the students with corrective feedback. Corrective feedback procedures included presenting the student with the incorrectly labeled stimulus and a vocal verbal model. The researcher then required the student to repeat the model and following this, represented the trial and provided the student the opportunity to emit the tact independently.

Holding and colleagues (2010) also provided feedback to the students during the timing. The teachers “coached” the students to “go fast” during the timing and delivered verbal praise for the student responding quickly at a variable ratio rate of approximately every two to three trials. Similarly, Nopprapun and Holloway (2014) gave students verbal praise at a variable ratio rate of approximately every two to three trials however delivery of praise was contingent on correct responding. Following the timed trials, both studies indicated the use of corrective feedback occurred, however, neither specified the procedures used (Holding et al., 2010; Nopprapun & Holloway, 2014).

Twarek et al. (2010) reported use of feedback only during the timed trial. The researchers delivered verbal praise contingent on every one to three correct responses. Although the researchers did not report use of corrective feedback, two the three students occasionally did not make progress on a newly introduced skill and required “warm up” activities before each timed trial. The activities consisted of a short timed interval where the instructor used full hand over hand prompting to assist the students in emitting the skills. Overall, review of the included studies indicates little consistency in the use of feedback with frequency building with few studies delivering feedback on correct and incorrect responses. Considering delivering feedback
represents a key component of frequency building, research should focus on including feedback immediately following timed trials as well as specifically stating the feedback procedures used.

**Establishing Performance Criteria.** While research has established frequency aims for certain skills, established frequency aims do not exist for many skills. Therefore, researchers have used a variety of ways to determine frequency aims such as assessing the performance of adults (Lee & Singer-Dudek, 2012; Singer-Dudek & Greer, 2005) or peers (Young et al., 1986) on the same task and calculating the average performance. Researchers have also assessed the participant’s performance on similar “mastered” skills and used the overall highest rate of responding across all students as the frequency aim (Holding et al., 2010; Kelly & Holloway, 2015; Nopprapun & Holloway, 2014). Others have established frequency aims based on their own research. For instance, Lin and Kubina (2015) set an initial frequency aim using the frequency measure obtained from the last accuracy building condition and moved the students up to a frequency aim of eight correct responses per 10 seconds. Only one of the studies did not give a rationale for how they established their performance criteria of skills assessed (Twarek et al., 2010).

Overall, findings from the current literature demonstrate using frequency building to an identified frequency aim leads to retention (Holding et al., 2010; Kelly & Holloway, 2015; Lee & Singer-Dudek, 2012; Lin & Kubina, 2015; Nopprapun & Holloway, 2014; Singer-Dudek & Greer, 2005; Twarek et al., 2010; Young et al., 1986). Students who reached high frequencies retained rates of performance after a period without practicing the skill. Considering individuals with ASD experience difficulties maintaining behavior over time, frequency building represents a promising practice for remediating challenges with long-term maintenance of skills.

**Conclusion**

Mastery of daily living skills exemplifies a crucial outcome for individuals with ASD as they transition into adulthood. Moving from acquisition of daily living skills to true mastery, or
fluency, requires frequency building. Although researchers have reported increases in skill acquisition as a result of POV VP, the results of maintenance measures are mixed. Additionally, not all researchers have included maintenance measures. Furthermore, researchers have suggested that some individuals may need additional support in order to achieve high levels of accuracy and maintain behavior long-term (Goodson, Sigafoos, O'Reilly, Canella, & Lancioni, 2007). Frequency building to behavioral fluency has the potential to produce critical learning outcomes for individuals with ASD, specifically in long-term retention (Kubina & Wolfe, 2005). Therefore, combining interventions designed to address behavioral fluency with POV PV may further enhance skill acquisition and maintenance.
References


frequency building to a performance criterion on elementary-aged students with
behavioral concerns and EBD. Exceptionality, 23, 34-53.

Special Education, 28, 33-42.


teaching daily living skills to individuals with autism spectrum disorders: A review.
Research and Practice for Persons with Severe Disabilities, 38, 73-87.

living skills using point-of-view modeling plus video prompting with error correction.
Focus on Autism and Other Developmental Disabilities, 30, 195-207.

video-based error correction procedure for teaching a domestic skill to individuals with

Gray, K. M., Keating, C. M., Taffe, J. R., Brereton, A. V., Einfeld, S. L., Reardon, T.C., &


Appendix D

Recruitment Letter

Dear Parent or Caregiver:

I am writing to inform you of an opportunity for your child to participate in a research study. This study will examine which instructional method (i.e., video prompting, video prompting plus frequency building) best improves activities of daily living- essential skills necessary for positive functional outcomes as adults. Your child will have the opportunity to engage in activities designed to increase accurate, independent performance.

To date, there has been little experimental research comparing two instructional methods with activities of daily living. Your child’s participation will help establish the research base for determining which instructional method will lead to improvements in accurate performance.

If you allow your child to participate he or she will be asked take part in daily instruction/practice sessions lasting approximately 15-20 minutes. The session will occur at your child's school. I will present three tasks to your child (e.g., tooth brushing, face washing, putting on deodorant). Your child will then systematically practice the task using either a procedure utilizing a video prompting procedure or a video prompting procedure combined with additional practice opportunities for each step of the task. Students will receive feedback for correct and incorrect responses. I will arrange periodic small rewards for participation. I will also explain to your child that he or she can withdraw from the study at any time without penalty (I will explain this in very basic terms). You will be asked to sign the enclosed informed consent form because your child is a minor. If you have questions regarding our study please feel free to contact me, Jennifer Wortalik at 973-626-4179 or jlw1170@psu.edu.

Sincerely,
Jennifer L. Wortalik, M.A., BCBA
Doctoral Candidate in Special Education
The Pennsylvania State University
## Appendix E
### Assessment Materials
Dependent Variable Measurement

<table>
<thead>
<tr>
<th>Mops Floor Data Sheet</th>
<th>Date:</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Picks up mop</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Puts in bucket</td>
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</tr>
<tr>
<td>3. Lifts mop out</td>
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<tr>
<td>4. Pulls handle</td>
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</tr>
<tr>
<td>5. Squeezes sponge into bucket</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Snaps handle back</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Puts mop near bathtub &amp; move mop up &amp; down from left to right (5 times)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Puts mop near toilet &amp; moves mop up &amp; down from left to right (5 times)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Lifts mop &amp; puts in bucket</td>
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<td></td>
</tr>
<tr>
<td># Correct</td>
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<tr>
<td>Time</td>
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</tr>
</tbody>
</table>
### Washes Dishes Data Sheet

<table>
<thead>
<tr>
<th>Date:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Turns on water (both hot and cold)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Picks up soap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Opens top</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Pick up sponge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Pour soap on sponge &amp; put soap down</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Picks up plate &amp; wipes top at least 3 times</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Turns plate over &amp; wipes bottom of plate at least 3 times</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Puts sponge down</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Rinses bottom of plate for at least 3 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Turns over &amp; rinses top of plate for at least 3 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Puts plate in dish drain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Turns off water</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># Correct</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td></td>
</tr>
<tr>
<td>Washes Windows Data Sheet</td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Date:</td>
<td></td>
</tr>
<tr>
<td>1. Picks up spray bottle</td>
<td></td>
</tr>
<tr>
<td>2. Sprays top of window from left to right</td>
<td></td>
</tr>
<tr>
<td>3. Puts spray bottle down</td>
<td></td>
</tr>
<tr>
<td>4. Gets paper towel</td>
<td></td>
</tr>
<tr>
<td>5. Puts paper towel on top left window &amp; wipes up and down from left to right (5 times)</td>
<td></td>
</tr>
<tr>
<td>6. Throws paper towel into garbage can</td>
<td></td>
</tr>
<tr>
<td>7. Picks up spray bottle</td>
<td></td>
</tr>
<tr>
<td>8. Sprays top of window from left to right</td>
<td></td>
</tr>
<tr>
<td>9. Puts spray bottle down</td>
<td></td>
</tr>
<tr>
<td>10. Gets paper towel</td>
<td></td>
</tr>
<tr>
<td>11. Puts paper towel on top left window &amp; wipes up and down from left to right (5 times)</td>
<td></td>
</tr>
<tr>
<td>12. Throws paper towel into garbage can</td>
<td></td>
</tr>
</tbody>
</table>

# Correct

<p>| Time |          |          |          |</p>
<table>
<thead>
<tr>
<th>Video Prompting Condition Procedural Integrity Checklist</th>
</tr>
</thead>
<tbody>
<tr>
<td>The experimenter presented iPad to student (say “watch/watch video” if necessary)</td>
</tr>
<tr>
<td>After watching video clip, experimenter provided instruction “you do/do what you saw in video/you’re turn” (student could begin task while video was still playing)</td>
</tr>
<tr>
<td>If student engaged in a correct response, the experimenter delivered verbal praise</td>
</tr>
<tr>
<td>If student did not initiate step within 10 seconds, experimenter completed step as unobtrusively as possible</td>
</tr>
<tr>
<td>If student began to make an error, the experimenter interrupted and completed the step as unobtrusively as possible</td>
</tr>
<tr>
<td>Experimenter represented iPad and showed the next video clip</td>
</tr>
</tbody>
</table>
Video Prompting plus Frequency Building Procedural Integrity Checklist

<table>
<thead>
<tr>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>The experimenter presented iPad to student (say “watch/watch video” if necessary)</td>
<td></td>
</tr>
<tr>
<td>After watching video clip, experimenter provided student with materials and conducted 15 sec timing</td>
<td></td>
</tr>
<tr>
<td>If student engaged in a correct response, the experimenter delivered verbal praise</td>
<td></td>
</tr>
<tr>
<td>If student made an error or did not respond, the experimenter did not prompt or provide any type of feedback</td>
<td></td>
</tr>
<tr>
<td>When timer sounds, the experimenter provided corrective feedback if applicable following a model, prompt, check procedure</td>
<td></td>
</tr>
<tr>
<td>Experimenter represented iPad and showed the next video clip</td>
<td></td>
</tr>
</tbody>
</table>
Baseline/DV Measurement Procedural Integrity Checklist

<table>
<thead>
<tr>
<th>Condition</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The experimenter delivered the instruction to engage in the specified task (e.g., “Mop the floor”), and started the count up timer</td>
<td>No Observation</td>
</tr>
<tr>
<td>If student did not initiate step within 10 seconds, experimenter completed step as unobtrusively as possible</td>
<td>No Observation</td>
</tr>
<tr>
<td>The experimenter did not provide the students with any other prompts or feedback for correct or incorrect responses</td>
<td>No Observation</td>
</tr>
<tr>
<td>Session/measurement ended when the student had the opportunity to complete all steps in the task</td>
<td>No Observation</td>
</tr>
</tbody>
</table>
Social Validity Questionnaire

Directions: Please rate your agreement with the following statements about the VP and VP + FB interventions, with 1 = “completely disagree” and 5 = “completely agree”. Make any comments in the space provided about how you think the interventions went for your student(s).

1. The VP procedures used were appropriate for my students.

   1 2 3 4 5

2. The VP + FB procedures were appropriate for my students.

   1 2 3 4 5

3. I believe I would implement (or use) the VP procedures in my classroom.

   1 2 3 4 5

4. I believe I would implement (or use) the VP + FB procedures in my classroom.

   1 2 3 4 5

5. I feel that my student(s) perform the targeted daily living skills better after receiving VP and VP + FB.

   1 2 3 4 5

Comments: ____________________________________________________________
__________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
VITA

Jennifer L. Wertalik

EDUCATION

Ph.D. in Special Education
The Pennsylvania State University 2017

M.A. in Applied Behavior Analysis with an Emphasis in Autism
Ball State University 2013

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Long Island University; Southampton College 2003

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Approved BACB Supervisor, Behavior Analyst Certification Board
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Certificate for Online Teaching, The Pennsylvania State University (World Campus)

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PUBLICATIONS
