A Systematic Review of Video Modeling Interventions to Improve the Independent Living Skills of Students with Autism Spectrum Disorder and Intellectual Disability

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Abstract

The purpose of this meta-analysis is to review the single-subject experimental literature and aggregate results across studies investigating the effects of video modeling (VM) to address independent living skill deficits of students with autism spectrum disorder (ASD) and intellectual disability (ID). A total of 20 studies including 67 participants with ASD and/or ID met inclusion criteria. We extracted data from included studies and evaluated each using visual analysis and by calculating the average weighted percentage of non-overlapping data (PND) and confidence intervals (CI). Finally, we stratified results by VM approach and examined moderator variables to determine overall effect sizes, which VM approach appeared to be most effective, and whether specific study-level characteristics moderated the effects of the VM intervention. Results indicated that, overall, VM was an effective treatment for improving independent living skills of students with ASD and/or ID, however, our calculated effect size was somewhat lower than those seen in previous reviews of the VM literature. We found that VM with prompting was most likely to be effective and that study quality and student age likely mediated the effects of VM interventions whereas study setting and disability likely did not. Comparisons between our results and results of similar previously conducted meta-analyses are discussed, implications for practice are reviewed, and directions for future research are recommended.

Keywords: video modeling, independent living skills, autism spectrum disorder, intellectual disability

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According to the National Longitudinal Transition Study (NLTS-2) students with autism spectrum disorder (ASD) and intellectual disability (ID) have among the lowest percentages of obtaining and maintaining employment and attending postsecondary education after high school (Sanford et al., 2011). Therefore, an emphasis has been placed on providing services to young adults with disabilities that result in greater independence, a better quality of life, and reduced societal financial burden as individuals make the transition to adulthood (Burgess & Cimera, 2014). For example, Woodman, Mailick, Anderson, and Esbensen (2014) found that individuals with ID who had higher levels of adaptive behavior were more likely to live semi-independently or independently; by contrast, Klinger, Klinger, Mussey, Thomas, and Powell (2015) reported that poor adaptive behavior in individuals with ASD was the strongest predictor of unemployment, social isolation, depression, and lower overall quality of life in adulthood.

To address independent living skill deficits, research shows that students with developmental and intellectual disabilities must be exposed to evidence-based practices (EBP) such as systematic and highly-explicit instruction, teacher modeling, the use of visual supports, and immediate and ongoing feedback (National Autism Center, 2015). A growing body of evidence also indicates that one of the more promising EBP for teaching students with ASD and ID independent living skills is through the use of video modeling ([VM]; Bellini & Akullian, 2007; Mason, Ganz, Parker, Burke, & Camargo, 2012; Plavnick, 2013). VM combines visual cuing instruction with observational learning (or modeling) for the purpose/s of teaching an observer to imitate a target behavior. It occurs when a student watches a video of a model performing a skill in its entirety and then completes the same skill in the same way (LeBlanc et al., 2003). VM is different than video prompting (VP) in which a student views individual steps of a task, completing each step immediately after it is viewed before viewing the subsequent step of the task (Canella-Malone et al., 2006). VP is a more intrusive intervention, requiring much more prompting and adult guidance (Gardner & Wolfe, 2013).

Under the VM umbrella, variations of the intervention include video self-modeling (VSM), VM with other as a model (VMO), and point-of-view (POV) VM. In VSM, the student watches him or herself completing a task or skill. During VMO, the student may watch an adult or peer model. During POV, the student sees the skill completed from his or her own perspective. For example, they may see a set of hands using materials to complete a task (Mason, Davis, Boles, & Goodwyn, 2013; Mason, Ganz, et al., 2013; Mason et al., 2012). Further, VM may be implemented as an independent intervention or paired with other strategies such as reinforcement, prompting, error correction, social stories, role play, or discrimination training (Mason, Ganz, et al., 2013).

Given the wide variety of ways in which VM may be implemented, it is important to carefully disaggregate the type of VM intervention used as well as student characteristics. More quantitative research is needed to analyze the existing body of research on the use of VM to address independent living skill deficits for students with ASD and/or ID.

Why a Meta-Analysis for VM is Needed?

The present article examines VM intervention studies for students with ASD and/or ID. This review updates and expands upon a series of meta-analyses (Hong et al., 2016; Mason, Davis, et al., 2013; Mason, Ganz, et al. 2013; Mason et al., 2012) completed over the past several years in important ways. First, Mason and colleagues conducted three separate meta-analyses (Mason, Davis, et al., 2013; Mason, Ganz, et al. 2013; Mason et al., 2012). In their first investigation, Mason and colleagues (2012) investigated whether contextual factors such as participant characteristics (e.g., primary disability and age) and targeted outcomes moderated the effects of VMO using individual rate difference (IRD). IRD quantifies the amount of change that occurs between the contrasted phases of single-case design studies (Parker, Vannest, & Brown, 2009). Findings from 42 studies and 126 participants (84% with ASD, 16% with DD) showed that VMO was highly effective for participants with ASD (IRD = .83) and moderately effective for participants with DD (IRD = .68). Moderator analysis confirmed that effect sizes for individuals with ASD were significantly larger than those for individuals with DD, and indicated that VMO is most effective for elementary-aged learners.

Next, Mason, Davis, et al. (2013) synthesized interventions targeting POV, and differential effects of participant characteristics, implementation procedures, and targeted outcomes. The review included 17 studies with 54 participants (25 with ASD, and 29 with DD), published between 2001 and 2012. Results yielded an average improvement rate across POV studies of .78 (95% CI [.76 - .80]), with secondary and postsecondary students yielding significantly larger effect sizes than elementary and preschool students. Results also revealed participants with ASD demonstrated larger effect sizes on targeted outcomes (e.g., social-communicative, play, and independent living skills) than participants with DD.

Mason, Ganz, et al. (2013) examined the impact of video-based modeling (VBM), consisting of VSM and VMO, as well as differential effects on variations in treatment protocol. Findings from 56 studies published between 1986 and 2010 indicated an overall effect size of .81 (95% CI [-.26 - .96]). The analysis also revealed that the greatest magnitude of change occurred when the participant was an adult, and when VMO was presented with reinforcement. Despite the size and scope of all three synthesis, Mason, Ganz, et al. (2013) investigated specific types of VM within each synthesis, leaving questions about differential effects among each approach, as well as questions related to which types of VM interventions are most effective for teaching independent living skills (all three syntheses focused on targeted behavioral outcomes including independent living, socio-communicative, and play skills). Moreover, while Mason, Ganz, et al. (2013) examined moderators impacting VM for age and type of disability (ASD or ID), findings for whom and under what circumstances VM is most effective conflicted across all three studies. Further, they did not isolate and analyze results of studies addressing only independent living skills.

More recently, Hong et al. (2016) reviewed 23 studies with 66 participants to investigate the effects of VM on the independent living skills of students with ASD. The results from studies published between 1994 and 2015 showed that VM interventions are moderately effective (Tau-U across studies = .83; 95% CI [0.79 – 0.87]) for improving the independent living skills of students with ASD. Although similar in many respects, the current study differs from previous work in several important ways. First, the present investigation included school-aged participants with ASD and ID whereas Hong and colleagues included participants of all ages with an ASD diagnosis. Participants with ID (without ASD) were excluded from the analysis. Perhaps more importantly, Hong et al. (2016) investigated the effects of what they refer to as the "three basic types…of VBM: VMO, VSM, and POV" (pg. 160). However, Hong and colleagues make no distinction between VM and VP in their analysis, which is important to note because the two interventions are, in fact, different (Gardner & Wolf, 2013). We have chosen to only focus on variations of VM, excluding studies that implemented VP, and have excluded many of the studies included in Hong and colleagues' (n = 16) meta-analysis. Finally, many of the studies included in the present synthesis were not included in previous work because there were only participants with ID (n = 6) in the studies. Thus, accounting for work by Mason, Davis, et al., (2013); Mason, Ganz, et al. (2013); Mason et al., (2012), and Hong et al. (2016), the present analysis adds nine studies not previously reviewed and focuses on using VM to enhance the independent living skills of student with ASD and ID.

Purpose and Research Questions

Students with ASD and/or ID make up the majority of students using VM (Mason et al, 2012; Mason, Davis, et al., 2013); however, given limitations in the prior literature, the present investigation was an effort to add to the field by: (a) examining the design quality of VM intervention studies, (b) extracting data from VM intervention studies, and calculating average weighted PND and CIs, with a focus on the general effectiveness of VM for teaching independent living skills, (c) stratifying results by VM approaches, and (d) examining moderator variables within peer-reviewed literature that mediate outcomes for students with ASD compared to those with ID. Therefore, this meta-analysis was guided by three research questions: (a) Is VM effective for teaching students with ASD and/or ID independent living skills? (b) Which specific approaches to VM (VM alone; VM alone, then with prompting; and VM with prompting) are effective for teaching students with ASD and/or ID independent living skills? (c) Do specific study-level characteristics (e.g., study quality, age, setting, or disability) moderate the effects of VM interventions?

Methods

Consistent with two recent meta-analyses (Bowman-Perrott, Burke, Zhang, and Zaini, 2014; Soares, Harrison, Vannest, & McClelland, 2016), this investigation was performed in four stages. Below, we describe details related to the literature search and inclusion criteria, coding of descriptive information and design quality, ES and CI calculations, stratification across VM approaches, and moderator analysis. Procedures for the four stages are outlined in the following section.

Stage 1: Literature Search and Inclusion Criteria

Studies were located by conducting a computerized search using the PsycINFO, PsycArticles, and ERIC databases. Search terms included *autism, ASD,* or *Asperger,* and *intellectual disability(s), developmental disability(s), cognitive disability(s), mental retardation,* or *Down syndrome,* and *independent living, daily living, functional, adaptive, self-care,* or *self-help,* and *video modeling* or *videotape modeling.* The initial search resulted in 2,236 total articles. The lead author reviewed all titles and abstracts and created a pool of 417 potential articles. Initially, 10 articles met inclusion criterion. Ancestral searches of these 10 articles led to an additional three articles meeting criterion. Next, 12 pertinent literature reviews were searched yielding four more articles. Finally, four relevant journals were hand searched, leading to three more articles. The third author coded 12% of the 417 potential articles according to inclusion criteria and agreement was 94%. All disagreements were resolved through discussion and consensus.

Inclusion Criteria. Overall, the literature search resulted in 20 studies with 67 participants published in 9 education and psychology journals (see Tables 1 & 2). Articles included in this review were selected based on the following final criteria: researchers (a) used a single-subject or group experimental design, (b) conducted the study in the United States, (c) published findings in a peer-reviewed journal, (d) included at least one school-aged (i.e., grade K-12 or age 5-21) participant with ASD or ID, (e) employed the independent variable to investigate the effects of VM or compared VM to VP, (f) collected data on student performance of independent living skills (i.e., dependent variable) (g) created custom-made video models, and (h) required the student to perform a task immediately following the viewing of the video (i.e., within 15 minutes) or while watching the video.

Studies conducted outside the U.S. were excluded as socio-technical systems have cultural practices attached to them and it is difficult to disentangle these practices from the research. Also, there is a social context to school systems within different countries that may affect how technology is adopted. Studies were also excluded if: (a) all participants were younger than 5 or older than 21 years of age, (b) the focus was only on the effects of VP interventions, (c) the dependent variable was aimed at decreasing problem behavior, (d) only commercially made videos were used, and (e) the time between a student's viewing of a video model and performance of a target skill was greater than 15 minutes.

Stage 2: Coding and Evaluation of Design Quality

Participants in each study were coded by disability, age, race/ethnicity, family income, and IQ score. Studies were coded by experimental design, target independent living skill(s), video components, and intervention components. Specifically, we identified three basic approaches to VM: (a) studies employing VM alone (VMA), (b) studies employing VM alone, then with prompting (VMA&P) and, (c) studies employing VM with prompting (VM+P). First, we defined VMA as an intervention in which the student was shown a video model and was then asked to perform the task demonstrated in the video model. Students were not provided with prompts or error correction procedures while completing the task. Second, we defined VMA&P as an intervention in which VM alone was implemented initially, however, the participant did not respond as expected. Therefore, the researchers employed VM with prompting after a varied number (i.e., between five and 30) of VM alone sessions. Finally, we defined VM+P as an intervention in which the student viewed a video model, was asked to perform the task, and was then provided with a series of adult-delivered prompts or error correction procedures while completing the task, as needed, beginning during the first intervention session. Table 1 displays relevant descriptive data.

Quality Indictors. To evaluate the methodological quality of studies all articles were reviewed according to CEC's standards for classifying special education practices in single-subject research designs (Cook et al., 2015). Each study was reviewed and coded by the first author as meeting or not meeting the quality indicators in each of the following areas: context and setting; participants; intervention agent; description of practice; implementation fidelity; internal validity; outcome measures/dependent variables; and data analysis.

Reliability. The third author coded 32% of the included studies for descriptive information, potential moderators, visual analysis, PND, and quality indicators. Overall agreement was 94.9% and all disagreements were resolved through discussion and consensus.

Stage 3: ES and CI Calculations

As recommended by Horner et al. (2005), the first and third author performed a visual analysis of graphs in each study by level, trend, and variability. Given the difficulties associated with synthesizing findings based on visual analysis of multiple studies (Scruggs & Mastropieri, 2013), the 20 studies included were also analyzed by calculating the percentage of non-overlapping data (PND; Scruggs, Mastropieri, & Castro, 1987). While disagreement exists over which methods are best for the analysis of data from single-case research designs (Parker, Vannest, & Davis, 2011) PND has been widely used in synthesis articles (Rogers & Graham, 2008; Solis et al.,

2012; Wanzek, Wexler, Vaughn, & Ciullo, 2010). To calculate PND in experimental designs, we first identified the highest baseline data point for each participant, then determined the extent to which scores in treatment were higher than that data point. Next, the number of treatment sessions above the highest baseline point was divided by the total number of treatment sessions to yield a percentage (Scruggs & Mastropieri, 1998). For comparison designs, PND was calculated for each intervention involved in the comparison, relative to the preceding baseline (Schlosser, Lee, & Wendt, 2008). The interpretation of PND was: 90 percent or above is a very effective treatment; 70–90 percent was an effective treatment, 50–70 percent was a questionable treatment, and below 50 percent was ineffective (Scruggs & Mastropieri, 1998). Average PND across participants was also calculated for each study.

To avoid overinflating the importance of a single study, it is recommended that a single effect size is calculated for each study (Lipsey & Wilson, 2001). Although we computed more than one PND for many studies, this basic concept was followed. For all but one of the treatments, only one effect size from each study was used to calculate summary PNDs. In all instances, we were only able to calculate a summary PND for a single measure for each treatment. PND was calculated for all studies by the first author, and the third author calculated PND for 32% of randomly selected studies established reliability. PND calculations were 99%. After coding, the spreadsheet was imported to the Comprehensive Meta-analysis (CMA; Version 3.0) program (Borenstein, Hedges, Higgins, & Rothstein 2009). The CMA software was used to generate an unbiased mean effect size (ES) for the 20 studies included in this review. The third author conducted ES and CI calculations and the moderator analysis.

Stage 4: Moderator Analysis

Moderator data were coded for the following four categories: (a) study quality [high quality, low quality]), (b) age of participant [elementary students between the ages of 8 and 12 years, and middle and high school students between the ages of 13 and 21 years]), (c) setting [traditional, nontraditional], and (d) disability [students with ASD, students with ID]). Consistent with procedures in two recent meta-analyses with single-subject and single-case research (e.g., Bowman-Perrott, Burke, Zhang, & Zaini, 2014; Soares, Harrison, Vannest, & McClelland, 2016), we examined moderator effects by dichotomously coding the moderator variables within the studies and examining differences between the ES (PND) of studies within each category.

Based on the formula outlined in Soares et al. (2016), we calculated a reliable difference (i.e., differences that cannot be accounted for by chance) for each moderator pair to examine whether differences were statistically significant. The formula is as follows: $(\mathrm{L1} - \mathrm{L2})/\sqrt{[SE\ \mathrm{PND}\ 1^2] + SE\ \mathrm{PND}\ 2^2}$, where LI is the first level of the moderator (e.g., study quality) and L2 is the second level of the moderator (e.g., age). In particular, we compared effects for VM interventions in high and low quality studies, for students between the ages of 8 and 12 years (elementary age) and 13 to 21 years (middle and high school), in traditional (public/private school classroom) and nontraditional (community, or residential facility) settings, and among students with ASD and ID. Reliable-difference z-test scores and p-values are reported in the Results section.

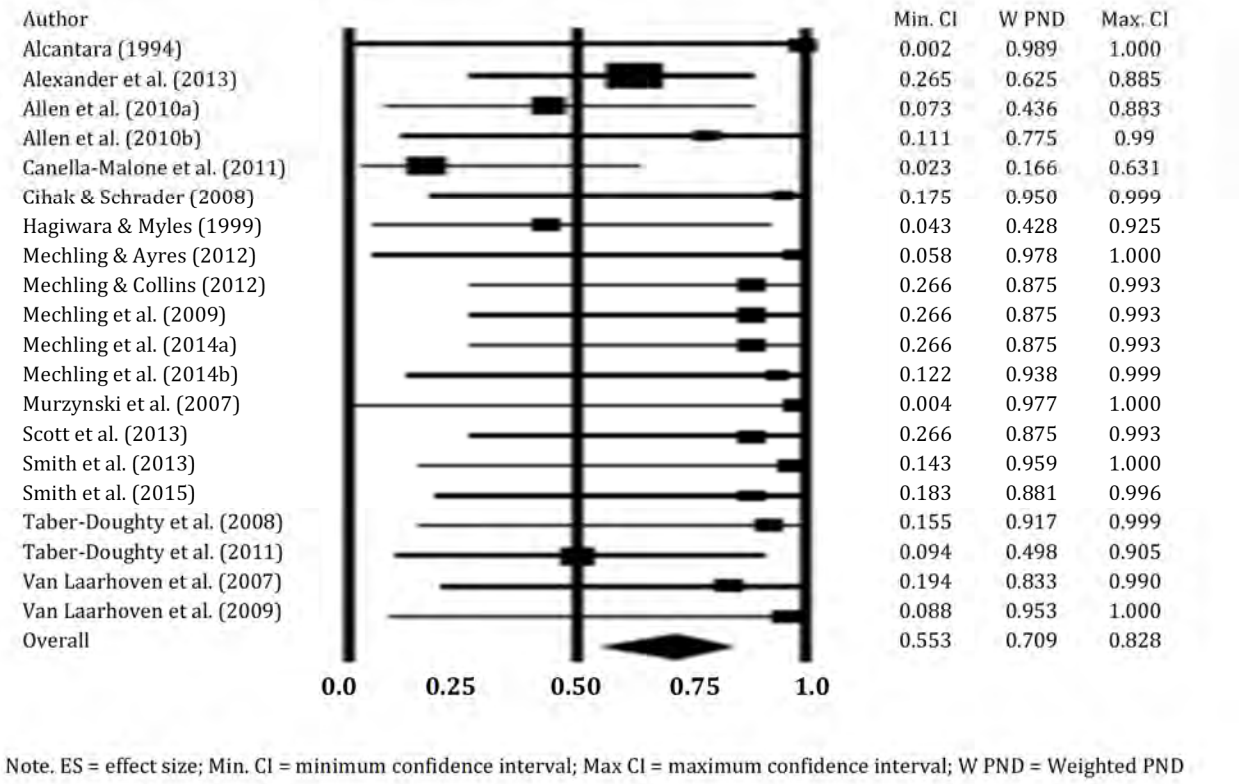
Results

Figure 1 displays a forest plot of ESs for the 20 included studies and overall the weighted ES. The results were organized into three sections to connect findings to each research question.

Summary effects are reported for VM interventions, and within three approaches to VM. Table 1 displays descriptive information (e.g., study authors and the setting in which the study was conducted, participant age, gender, type of disability, and IQ score, and VM approach implemented in the study), PNDs (e.g., individual and summary effects), and quality scores for each study. Table 2 displays, results from moderator analysis are described and reported.

Figure 1.

Forest Plot of ESs for 20 Included Studies and Overall Weighted ES



Note. ES = effect size; Min. CI = minimum confidence interval; Max CI = maximum confidence interval; W PND = Weighted PND

Question #1: Is video modeling, in general, effective for teaching students with ASD and ID independent living skills?

In 20 studies, researchers evaluated the effectiveness of teaching students with ASD or ID independent living skills through a type of video-based modeling (VM) intervention. Data from 67 participants were extracted to calculate effect sizes. In total, the results indicated that video modeling is an effective treatment for teaching functional living skills to students with ASD and/or ID (average weighted ES = 0.71; 95% CI [0.55 – 0.83]). The average weighted PND for VM was statistically significant ($p < .05$). Effect sizes ranged from 0.17 to 0.99. Among the 20 studies, eight indicated that VM was a very effective treatment (PND = 90% or above), seven studies indicated VM was effective (PND = 70% to 90%), two studies indicated VM was a

questionable treatment (PND = 50% to 70%), and three studies indicated VM was ineffective for teaching independent living skills to students with ASD and/or ID (PND = 50% or less). The point estimate I^2 indicated that 21% of the observed variance between PND was due to true variance between studies. While this is considered a median I^2 estimate of heterogeneity in the Cochrane Library (Von Hippel, 2015), the confidence intervals ranged broadly (95% CI: 0.55 to 0.83). Therefore, we conducted additional analysis within variable and moderator categories to explain excess variance.

Question #2: Which specific approaches to VM (VM alone, VM alone, then with prompting, and VM with prompting) are effective for teaching students with ASD and/or ID independent living skills?

The 20 studies were analyzed and organized into three categories: (a) VM alone, (b) VM alone, then with prompting, and (c) VM with prompting. The average weighted PND for the three approaches to VM containing four or more PNDs were positive (see Table 1). However, only one of the three approaches to VM (i.e., VM with prompting) had statistically significant effects on the independent living skills of students with ASD and/or IDs.

VM Alone. The impact of using VM alone to teach students with ASD (n = 30) and/or ID (n = 8) independent living skills was tested in 12 studies. In total, VM alone was a questionable treatment for teaching students with ASD and/or ID independent living skills (average weighted PND = 0.66; 95% CI [0.46 – 0.82]), but this effect was not significant ($p = 0.115$). Two studies indicated that VM alone was very effective (PND = 90% or above), seven studies suggested that VM alone was effective (PND = 70% to 90%), one study indicated that VM alone was questionable (PND = 50% - 70%), and the remaining two studies suggested that VM alone was ineffective (PND = 50% or below) for teaching independent living skills to students with ASD and/or ID.

VM Alone, then with Prompting. Four studies examined the effects of video modeling alone, then with prompting. A total of 12 students were involved in interventions that incorporated a combination of VM alone, then with prompting (ASD = 6, and ID = 6). Teaching students with ASD and/or ID through VM alone, then with prompting had a questionable (average weighted PND = 0.68; 95% CI [0.32 – 0.91]) impact on their learning of independent living skills. The effect for VM alone, then with prompting was not significant (p = 0.332). Two studies reported that VM alone, then with prompting was a very effective treatment (PND = 90% and above), and the remaining two studies suggested that VM alone, then with prompting was a questionable treatment (PND = 50% to 70%).

Video Modeling with Prompting. Researchers evaluated the effects of video modeling with prompting in seven studies with a total of 14 students with ASD (n = 5) and/or ID (n = 9). Video modeling with prompting had a statistically significant effect ($p < .05$) on the learning of independent living skills of students with ASD and/or ID. Overall, VM with prompting was an effective treatment (average weighted PND = 0.81; 95% CI [0.53 – 0.94]). Four of the seven studies indicated that VM with prompting was a very effective treatment (PND = 90% or above), three suggested VM with prompting was effective (PND = 70% - 90%), and one study indicated

that VM with prompting was ineffective (PND = 50% or below) for teaching independent living skills to students with ASD and/or ID.

Question #3: Do specific study-level characteristics (e.g., study quality, age, setting, or disability) moderate the effects of VM interventions?

Study Quality. Each of the 20 studies was evaluated using the CEC's standards for classifying special education practices in single-subject research designs (Cook et al., 2015). Thirteen studies with 48 participants were coded as high quality studies (met 5 or more quality indicators) and seven studies with 19 participants were coded as low quality studies (met less than 5 quality indicators). The results indicated that studies coded as high quality had a larger ES (0.89; SE = 0.023; 95% CI [0.84 – 0.94]) than studies coded as low quality (ES = 0.61; SE = 0.115; 95% CI [0.32 – 0.89]). Parameter estimates showed that CIs overlapped; however, values from the reliable difference formula were statistically significant ($z = 2.58$; $p = .009$), indicating that study quality mediated the effects of VM interventions.

Age. The elementary category of children between the ages of 8 – 12 years contained five studies and 14 participants. The middle and high school category for individuals between the ages of 13 – 21 years contained 15 studies and 53 participants. The results indicated that studies using VM with elementary aged students produced a lower ES (0.61; SE = 0.161; 95% CI [0.17 – 1.06]) than studies using VM with middle and high school aged students (ES = 0.85; SE = 0.036; 95% CI [0.77 – 0.93]). When the two categories were compared for parameter estimates, overlapping CIs indicated that differences might not be statistically significant. The reliable- difference formula did indicate that ES differences between elementary and middle and high school aged students were statistically significant ($z = 2.45$; $p = .015$), which suggests that students' age played a role in the effects of VM interventions.

Setting. Twelve studies with 46 participants were coded as traditional education (i.e., public school classroom), and eight studies with 21 participants were coded as nontraditional education (i.e., residential facility, community instruction, classroom-based, then community instruction). Results indicated that studies where VM was implemented in a traditional education setting had lower ESs (0.76; SE = 0.755; 95% CI [0.59 – 0.92]) than studies implemented in a nontraditional setting (ES = 0.84; SE = 0.062; 95% CI [0.69 – 0.98]). Comparisons between parameters seemed to indicate that differences may not be statistically significant as CIs overlapped across setting categories. Values from the reliable-difference formula confirmed that study setting did not moderate the effects of VM interventions ($z = -0.81$; $p = .420$).

Disability. Five of the twenty studies in this review contained both students with ASD or ID (Alcantara, 1994; Cannella-Malone et al., 2011; Mechling et al., 2014a; Mechling et al., 2014b, and Van Laarhoven et al., 2007); therefore, we disaggregated PNDs by disability-type, then calculated two separate average PNDs for students with ASD and ID in each of the five studies. As a result, we report ESs for 25 studies in this section.

Fourteen studies with 42 participants were coded for the ASD category and 11 studies with 25 participants were coded for the ID category. Results indicated that studies where VM interventions were implemented with students with ASD had lower ESs (0.76; SE = 0.074; 95%

CI [0.60 – 0.92]) than studies where VM interventions were implemented with students with ID (ES = 0.85; SE = 0.037; 95% CI [0.76 – 0.93]). When the two categories were compared for parameter estimates, overlapping CIs seemed to indicate that differences would not be statistically significant. Values from the reliable-difference formula confirmed that disability type (ASD or ID) did not mediate the effects of VM interventions ($z = 0.96$; $p = .338$).

Table 1.
Study Setting, Participant Characteristics, and VM Approach; Effect Size by Participant & Study and Quality Ratings

Study authors	Age/ Gender	ASD or ID	IQ Score	VM Approach (VMA, VMA&P, or VM+P)	PND: ES (Participants)	PND: ES (Study)	Number of Quality Indicators Met (out of 8)
Alcantara (1994)	9.11/M	ASD	-	VMA&P	96.7%: HE	98.9%: HE	5
	8/F	ASD	-	VMA&P	100%: HE		
	9.11/M	ID	55	VMA&P	100%: HE		
Alexander et al. (2013)	18.7/M	ASD	48	VMA&P	91.4%: E	62.5%: Q	5
	17.2/F	ASD	57	VMA	85.7%: E		
	17.6/M	ASD	47	VMA&P	12.5%: NE		
	15.1/M	ASD	64	VMA	100%: HE		
	17.8/M	ASD	44	VMA	85.7: E		
	17.11/M	ASD	32	VMA&P	62%: Q		
	17.6/M	ASD	-	VMA	0%: NE		
Allen et al. (2010a)	16/M	ASD	-	VMA	15%: NE	43.6%: NE	2
	17/M	ASD	-	VMA	32.1%: NE		
	18/M	ASD	-	VMA	83.8%: E		
Allen et al. (2010b)	19/M	ASD	-	VMA	75%: E	77.5%: E	2
	17/M	ASD	-	VMA	80% E		
Cannella-Malone et al. (2011)	12/M	ASD	-	VMA	0%: NE	16.6%: NE	4
	13/F	ASD	-	VMA	0%: NE		
	12/M	ASD	-	VMA	0%: NE		
	11/F	ASD	-	VMA	0%: NE		
	12/M	ASD	-	VMA	0%: NE		
	13/M	ASD	-	VMA	0%: NE		
	13/M	ID	-	VMA	87.5%: E		
Cihak & Schrader (2008)	21/M	ASD	45	VM+P	100%: HE	95%: HE	6
	16/M	ASD	50	VM+P	100%: HE		
	17/M	ASD	30	VM+P	89%: E		
	20/M	ASD	35	VM+P	100%: HE		

Hagiwara & Myles (1999)	7.11/M 9.11/M	ASD ASD	- -	VMA VMA	39.7%: NE 45.8% NE	42.8%: NE	3
Mechling & Ayers (2012)	19.9/M 19.9/M 21.7/M 20.8/M	ASD ASD ASD ASD	51 40 64 54	VMA VMA VMA VMA	91.7%: HE 100%: HE 100%: HE 100%: HE	97.9%: HE	5
Mechling et al. (2014a)	15.5/M 15.7/F 17/F	ASD ID ID	48 44 40	VMA&P VMA VMA&P	100%: HE 100%: HE 100%: HE	100%: HE	7
Mechling et al. (2014b)	15.1/M 15.7/F 17/F	ASD ID ID	48 44 40	VMA VMA VMA	93.8%: HE 100%: HE 87.5%: E	93.8%: HE	6
Mechling & Collins (2012)	20.1/M 21/M 19.7/F	ID ID ID	- 39 44	VMA VMA VMA	100%: HE 100%: HE 100%: HE	100%: HE	6
Mechling et al. (2009)	19.3/F 19.4/M 21.3/F	ID ID ID	52 46 45	VMA VMA VMA	100%: HE 100%: HE 100%: HE	100%: HE	6
Murzynki, & Bourret (2007)	9/- 8/-	ASD ASD	- -	VM+P VM+P	100%: HE 95.4%: HE	97.7%: HE	4
Scott et al. (2013)	19.1/F 20.9/F 18.2/F	ID ID ID	64 40 54	VM+P VM+P VM+P	100%: HE 100%: HE 100%: HE	100%: HE	7
Smith, M. et al. (2013)	14.6/M 16.5/M 16.6/M 15.2/M	ASD ASD ASD ASD	58 60 86 58	VMA VMA VMA VMA	91.7%: HE 100%: HE 100%: HE 91.7%: HE	95.9%: HE	6
Smith, K. A. et al. (2015)	15.1/M 16.6/M 16.4/M	ASD ASD ASD	- - -	VMA VMA VMA&P	100%: HE 100%: HE 64.3%: Q	88.1%: E	6

Taber-Doughty et al. (2011)	12/F 13/F 12/M	ID ID ID	72 61 63	VM+P VM+P VM+P	33%: NE 83.3%: E 33%: NE	49.8%: Q	4
Taber-Doughty et al. (2008)	15/M 13/M 13/M	ID ID ID	46 50 57	VM+P VM+P VM+P	100%: HE 87.5%: E 87.5%: E	91.7%: HE	6
Van Laarhoven et al. (2007)	18/M 18/M	ASD ID	78 47	VM+P VM+P	100%: HE 100%: HE	100%: HE	6
Van Laarhoven et al. (2009)	17/M 15/F 12/F	ID ID ID	40 30 -	VM+P VM+P VM+P	93%: HE 100%: HE 93%: HE	95.3%: HE	4

Note: M = male; F = female; VMA=VM alone; VMA&P=VM alone, then with prompting; VM+P=VM with prompting; - =not reported; PND = percentage of non-overlapping data; ES = effect size.

Discussion

The present meta-analysis synthesized and investigated the findings from intervention studies targeting the use of VM to teach independent living skills to students with ASD and/or ID from 1994 to 2015. In particular, we set out to (a) calculate average weighted PND and CIs, with a focus on answering the question of the general effectiveness of VM for teaching independent living skills, (b) evaluate which specific approaches to VM (e.g., VM alone; VM alone, then with prompting; and VM with prompting) are most effective for teaching independent living skills, and (c) examine moderator variables of peer-reviewed literature that moderate outcomes for students with ASD and/or ID. Adding to and extending the findings of recent previous investigations on VM (Hong et al., 2016, Mason, Davis, et al., 2013; Mason, Gantz, et al., 2013, Mason et al., 2012;), this analysis provides a broader basis for making evidence-based recommendations for using VM with students with ASD and/or ID.

Table 2
Summary of Study Moderators

Study Characteristics	Categories	Studies *n*	*n*	PND	SE	95% CI	*z* score	*p* value
Quality	High	13	48	0.89	0.023	[0.84, 0.94]		
	Low	7	19	0.61	0.115	[0.32, 0.89]	2.58	.0099**
Age	Elementary	5	14	0.61	0.161	[0.17, 1.06]		
	Middle & High	15	53	0.85	0.036	[0.77, 0.93]	2.45	.0145*
Setting	Traditional	12	46	0.76	0.755	[0.59, 0.92]		
	Nontraditional	8	21	0.84	0.062	[0.69, 0.98	-0.81	.420
Disability	ASD	14	42	0.76	0.074	[0.60, 0.92]		
	ID	11	25	0.85	0.037	[0.76, 0.93]	0.96	.338

Note. *n* = the number of participants in each category; Reliable difference z-test scores and corresponding *p* values are reported for the moderators. * indicates significant at the .05 level ** indicates significant at the .01 level

Our initial question centered on evaluating the effectiveness of VM for teaching students independent living skills. Consistent with two previous meta-analyses (Bellini & Akullian, 2007; Hong et al., 2016), we found that VM is an effective intervention strategy for enhancing students' ability to learn independent living skills. However, while Bellini and Akullian (2007) reported a magnitude *of* PND of 0.89, and Hong et al. (2016) an omnibus Tau-U of 0.83, we found the average effects of VM across 20 studies to be much lower (average weighted ES = 0.71). Part of these differences can be explained by the fact that Bellini and Akullian's analysis only included eight studies directly targeting the use of VM to teach functional skills to students with ASD; moreover, and in contrast to Hong et al., we excluded 16 studies from our analysis that only implemented VP. Evidence seems to suggest that VP is a more effective intervention for teaching a range of skills to students with developmental disabilities (see Sigafoos et al., 2007; Cannella-Malone et al., 2006); however, VP is a more intrusive intervention approach, requiring greater levels of resources, prompting, and adult training (Gardner & Wolf, 2013). Thus, this meta-analysis provides a broader base for making evidence-based recommendations for using VM to teaching independent living skills.

The second question addressed which approach to VM was most effective? We found that VM paired with prompting strategies from the onset of the intervention was more likely to lead to a successful intervention when addressing independent living skill deficits of students with ASD and/or ID. This is contradictory to the findings of Mason et al. (2013a & b) who found that POV alone and VMO alone appeared to be more effective than POV and VMO with prompting to address a range of skill areas. Our findings suggest that, when specifically addressing independent living skills, it may be more effective to use VM with prompting.

Our third question asked whether specific study-level characteristics (e.g., study quality, age, setting, or disability) moderate the effects of VM interventions. First, while most studies were of high quality, no authors reported information related to the socioeconomic status of participants and very few authors reported demographic information such as race/ethnicity or language. Reporting such information is important when answering the question: which intervention is best for whom (Horner et al., 2005)? Further, very few authors reported information about the intervention agents including education level, position or role, relationship to the participants, or whether any additional training on implementing VM or creating video models was provided (Cook et al., 2015). According to Cook and colleagues, "the role of the interventionist [should be] noted or reasonably inferred" (p.225) and that if no additional training was required or provided to the intervention agents, authors of the study should state as much. Most studies included in the review were missing critical information regarding the interventionists implementing VM. Knowing for whom VM may be most effective and by whom VM should be implemented by are essential questions that drive intervention research. If we are not provided with some level of detailed information in these areas, identifying evidence-based practices for students with ASD and/or ID is very challenging to predict.

While the setting in which VM was implemented did not appear to play a major role in the intervention's effectiveness, participant age was another important finding relevant to practitioners. Our findings were consistent with the findings of Hong et al. (2016) suggesting that VM interventions are more likely to be effective when addressing the independent living skills of

older students. However, findings are contradictory with Mason et al. (2012) that VMO interventions may be more effective for elementary aged students when addressing a variety of skill areas. In the current study, the majority of participants were in middle or high school, yet there was a statistically significant difference in the effect size when compared to their elementary-aged counterparts. More research is needed that includes elementary school students with ASD and/or ID to determine why VM may be more effective for older students in addressing independent living skills.

Finally, although the type of disability did not have a statistically significant effect, this is the first study to consider disability type as a potential moderator to specifically address independent living skills. Further, decades of research suggest that VM is commonly used and effective intervention for students with ASD and our findings showed that higher effect sizes were seen in participants with ID without ASD. While this population is also often included in VM studies, findings suggests that more studies should focus on students with ID and students in other disability categories. Practitioners should not discount that fact that VM interventions may be effective for students with disabilities other than ASD.

Limitations and Future Research

Limitations tie directly to areas for future research. First, there were twice as many participants with ASD than ID included in the studies reviewed. While we feel we were still able to draw conclusions based on the given populations, future research should continue to include students with ID in VM intervention studies aimed at improving independent living skills. Especially given that our findings suggest that VM is just as if not more effective for students with ID over ASD. A second major limitation is that we did not analyze the effects of VM on skill generalization or maintenance. Identifying interventions that promote skill generalization and maintenance is critical, especially for students with ASD and ID who often have difficulty generalizing and maintaining skills (Neely et al., 2016). Identifying specific variations of VM that are most likely to lead to successful skill generalization and maintenance for individuals with ASD and/or ID would be advantageous for researchers, practitioners, and more importantly, the students who are in need of developing critical independent living skill to enable them to lead successful productive lives.

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