J Autism Dev Disord (2015) 45:157–178
DOI 10.1007/s10803-014-2201-z

ORIGINAL PAPER

Evaluating Visual Activity Schedules as Evidence-Based Practice for Individuals with Autism Spectrum Disorders

Victoria Knight · Emily Sartini · Amy D. Spriggs

Published online: 1 August 2014

Abstract A comprehensive review of the literature was conducted for articles published between 1993 and 2013 to evaluate the quality of the Visual Activity Schedules (VAS) literature using current evidence-based criteria developed by Horner et al. (Except Child 71:165–179, 2005). Authors sought to determine whether VAS can be considered an evidence-based practice by expanding on the findings from previous reviews. A total of 31 studies met inclusion criteria for the use of VAS to various behaviors to students with autism spectrum disorder (ASD). Of these studies, 16 met criteria for acceptable quality. Results suggest that VAS can be considered an EBP for individuals with ASD, especially when used in combination with systematic instructional procedures. VAS can be used to increase, maintain, and generalize a range of skills of individuals from preschool through adulthood in a variety of settings (e.g., general education, community). Implications for practitioners using VAS, limitations, and recommendations for future research are discussed.

Keywords Visual activity schedules · Evidence-based practices · Autism spectrum disorder

V. Knight (✉)
Department of Special Education, Vanderbilt University, GPC 228, 230 Appleton Place, Nashville, TN 37203-5721, USA
e-mail: victoria.f.knight@vanderbilt.edu

E. Sartini
Fayette County Public Schools, Lexington, KY, USA

A. D. Spriggs
University of Kentucky, Lexington, KY, USA

Introduction

Visual Activity Schedules (VAS) are a commonly prescribed method for teaching a variety of skills, including transition behaviors (Dettmer et al. 2000) and on-task behaviors (Bryan and Gast 2000), to individuals with autism spectrum disorder (ASD). VAS have been used to reduce problem behaviors (Lequia et al. 2012; Massey and Wheeler 2000) decrease latency to begin a new activity (Dettmer et al. 2000), and to decrease tantrums during transitions (Schmit et al. 2000). VAS may also be used to increase, maintain, and generalize a variety of social skills. For example, VAS have been used to teach socio-dramatic play (Dauphin et al. 2004), social initiation (Krantz et al. 1993), participation in social exchanges (Krantz and McClannahan 1998), and independent play skills (Morrison et al. 2002).

VAS are a series of images, pictures, photographs, or line drawings used to depict a sequence of events. The purpose of VAS is to visually prepare the individual with ASD for the next activity or next step within an activity or chain of activities. The mode of presentation varies from more traditional approaches like a three-ring binder with a picture of one activity or step on each separate page to innovative approaches like a power point presentation or video of the schedule (e.g., Waters et al. 2009; Van Laarhoven et al. 2010). Systematic instructional approaches are often combined with VAS, and may include graduated guidance and variable interval schedules of reinforcement, in which individuals are rewarded after an average number of intervals rather then a set number each time.

Originating from the Treatment and Education of Autistic and Communications-Handicapped Children (TEACCH) model, VAS are part of a overarching category known as visual supports (Mesibov et al. 2006). Visual

supports include visually-enhanced physical environments, organization of materials (e.g., shoe box tasks), instructions (e.g., picture instructions, graphic organizers, structured worksheets) and instructional techniques (e.g., color highlighting, Comic strip conversations; Gray 1994), as well as visual cues to support receptive and expressive communication (e.g., TEACCH and PECS; Kroupa 2013). Research has shown that visual supports (e.g., visual scripts, rule reminder cards) can aide expressive and receptive communication skills for individuals with ASD (Quill 1995). Visual supports can also assist students with ASD in their transition behaviors, on-task behaviors, and engagement (Bryan and Gast 2000; Dettmer et al. 2000; MacDuff et al. 1993; Massey and Wheeler 2000; Morrison et al. 2002).

Experts, practitioners, and individuals with ASD themselves (e.g., Temple Grandin) believe that the reason visual supports are beneficial is because children and adults with ASD process visual information better than auditory information. Results of recent studies show support for atypical visual and auditory perception in individuals with ASD. Roth et al. (2012) conducted a study to compare the auditory brainstem responses (ABR) of young children suspected of having ASD to both children who are typically developing and children who have a language delay. Findings indicate those suspected of having ASD had more abnormalities than either of the other two groups. According to the authors, the "results provide first time evidence for a neurodevelopmental [auditory] brainstem abnormality that is already apparent in young children with suspected ASD and children with a language delay. The overlap in the ABR findings supports the assertion that an auditory processing deficit may be at the core of these two disorders" (p. 23). Several recent studies in neuropsychology indicate individuals with ASD also show superior processing of simple visual tasks, but diminished processing of complex visual stimuli (e.g., Neumann et al. 2011).

Students who have deficits in auditory processing, including students with ASD, are at a disadvantage in the classroom since the majority of information is communicated verbally. Students who are typically developing will follow a teacher's verbal instructions in order to transition effectively from one activity to the next; however, students with ASD often have problems with transitions leading to aberrant behaviors such as verbal and physical aggression, and noncompliance (Schreibman et al. 2000). Visual cues can increase activity engagement (Bryan and Gast 2000; MacDuff et al. 1993; Massey and Wheeler 2000; Morrison et al. 2002), and decrease aberrant behaviors (Dettmer et al. 2000; Schmit et al. 2000). Visual supports, like VAS, are non-intrusive prompts that can be used to assist students with ASD in transitioning from one activity to the next (e.g., math to reading), or within an activity (e.g., calendar to singing songs as part of circle time). The use of visual supports can reduce student dependence on caregivers if the student learns to use the visual support independently to stay on-task and on-schedule.

Since VAS are a common practice in classrooms for and other settings with ASD, practitioners should know whether they are effective. The Individuals with Disabilities Education Improvement Act (2004) and the No Child Left Behind Act (2001) have mandated teachers use evidence-based practices (EBP) to teach skills to students with ASD. Practices are considered evidence-based when they are implemented consistently and reliably with positive results across multiple research studies. The rigor of the research design, the methodological quality, magnitude of effect, and the overall number of quality studies is essential when evaluating research effectiveness in special education (Cook et al. 2009). Although no universal method is currently used for determining research quality, most methods focus their guidelines on research design. Several evaluative methodologies exist in special education research using the framework of research quality indicators (e.g., group experimental and quasi-experimental, Gersten et al. 2005; single-subject, Horner et al. 2005). "Single-subject research designs are… closely aligned with special education's core principles of individualized instructional decisions and frequent monitoring of student progress… make[ing] single-subject research methods critical considerations for special educators" (Tankersley et al. 2008, p. 84). Guidelines set forth by Horner et al. have often been used when evaluating research using single-subject research designs to determine EBP (e.g., Browder et al. 2009; Chard et al. 2009; Test et al. 2010).

Banda and Grimmett (2008; NPDCASD 2010) examined the literature on VAS from 1993 to 2004 to determine the efficacy of VAS for persons with ASD. In addition, they evaluated whether the effects could be generalized to other activities, and whether VAS were perceived as socially valid. Based on the 13 studies reviewed, the authors suggested that the use of VAS was an effective intervention for increasing social, functional, on-task, and transition behaviors in individuals with ASD; however, the studies were not evaluated using the Horner et al. (2005) criteria for EBP. Even though the authors recommend VAS as an effective practice, they suggest additional research to determine efficacy of VAS, especially for persons with Asperger's syndrome, and to establish the most effective components (e.g., pictures, mode of presentation). Limitations of the studies they reviewed include a lack of generalization and social validity.

In addition to Banda and Grimmett (2008), the National Autism Center (2009) determined *schedules* to be an "effective" intervention as part of their National Standards Project report. The National Professional Development

Center on Autism Spectrum Disorder (NPDCASD) verified "visual supports" as an EBP, but did not differentiate visual schedules from other visual supports (e.g., maps, labels, organization systems, timelines). In a recent systematic review, Lequia et al. (2012) examined the effects of activity schedules on problem behaviors of students with ASD in relation to different variables, including: setting, schedule type and purpose, and participant characteristics. Although authors were unable to detect a trend based on these variables, efficacy findings based on their analysis of Non-overlap of All Pairs (NAP) reveal that activity schedules are "fairly" effective in reducing problem behaviors (p. 489). Since the Lequia et al. (2012) did not evaluate the research quality of the articles based on set criteria, and authors of the current review consider the methodological rigor of studies important for determining evidence of effectiveness, the Horner et al. (2005) criteria was used in the current procedures for evaluating VAS. Further, the current review is broader in scope than the Lequia et al. (2012), since authors of this review sought to examine the effects of VAS on various behaviors (v. evaluating challenging behaviors only). In order to update and expand the findings from these recent reviews, the purpose of this comprehensive literature review was to (a) evaluate the quality of the VAS literature using evidence-based criteria developed by Horner et al. (2005), (b) calculate the magnitude of effect using Percent of Non-overlapping Data (PND), and (c) determine if VAS can be called an EBP.

Methods

Search Procedures

The authors reviewed the literature to determine the evidence-base for using VAS to increase, maintain, and generalize a variety of skills to students with ASD. The authors used a list of search terms similar to those used by Banda and Grimmett (2008) in their literature review. A list of six terms (visual schedule, picture activity schedules, schedule, picture prompts, visual cues, work system) was used in combination with descriptors of the student population (autis*, PDD, Aspergers, ASD). Studies published between 1993 and 2013 were examined. To find articles published prior to 2004, the authors searched the reference list for articles included by Banda and Grimmett (2008) in their literature review. In order to update and expand the articles published after the Banda and Grimmett (2008) review, the authors conducted an electronic search of relevant articles published after 2004 using the following search engines: PsycINFO, ERIC, Academic File Premier, and Master File Premier. In addition, the authors completed a hand search of the following journals: *Journal of Autism and Developmental Disorders*, *Education and Training in Developmental Disabilities*, *Exceptional Children*, *Journal of Applied Behavior Analysis, Research in Autism Spectrum Disorders,* and the *Journal of Special Education*. Finally, the authors compiled all studies and completed an ancestral search of the reference lists.

Inclusion Criteria

All studies met the following inclusion criteria: (a) used a single case research or group design; (b) included at least one participant with ASD diagnosed using either DSM-IV-TR or DSM-V criteria (e.g., autism, PDD, PDD-NOS, Asperger's syndrome); (c) investigated the effects of VAS on a specific dependent variable (e.g., on-task, on-schedule, transition behavior) by students with autism; and (d) published in a peer-reviewed journal in English prior to October of 2013. For the purposes of this review, the authors considered "visual activity schedules" to be any sequence of visual cues (e.g., pictures, written words, objects) used with a student, including work systems with visual prompts for instruction of chained tasks. No articles were found that used a group design. Studies that did not use an appropriate design to demonstrate sufficient experimental control were not included.

A comprehensive list of 31 articles met inclusion criteria, and were retained for analysis. In the reference list, one asterisk was used to delineate studies examined in the review and two were used to show acceptable studies retained for further analysis. The comprehensive list included 12 of the 13 of the Banda and Grimmett (2008) articles (i.e., Dauphin et al. 2004 did not use a design to demonstrate sufficient experimental control and was excluded). After determining which articles met inclusion criteria, the researchers evaluated the quality of the studies against the criteria established by Horner et al. (2005; see Table 1). Horner et al. 2005 stated that acceptable studies must include five characteristics: (a) an operational definition of the intervention, (b) an operational description of outcome, (c) fidelity, (d) functional relationship between intervention and outcome, and (e) demonstration of experimental control. The researchers used these criteria to determine whether studies qualified as acceptable.

After the researchers coded the articles for QIs according to the Horner et al. (2005) criteria, the researchers then recorded descriptive information from the "acceptable" studies. Descriptive information (see Table 2) included information about the following study components: (a) reference, (b) information about participants (e.g., age, disability category), (c) setting, (d) the targeted skill/response, (e) dependent variable, (f) type of schedule (e.g., picture, written) and mode of presentation (e.g., video,

Table 1 Quality indicators from acceptable quality studies identified in visual activity schedule literature

Indicator	Betz et al. (2008)	Blum-Dimaya et al. (2010)	Bryan and Gast (2000)	Carlile et al. (2013)	Cihak (2011)	Cuhadar and Diken (2011)	Dettmer et al. (2000)	Duttlinger et al. (2013)
Participants								
1. Described sufficiently	Y	Y	Y	Y	Y	Y	Y	Y
2. Selection described sufficiently	N	N	Y	Y	Y	Y	Y	Y
3. Setting described sufficiently	Y	Y	Y	Y	Y	Y	Y	Y
Dependent variable (DV)								
4. Described with replicable precision	Y	Y	Y	Y	Y	Y	Y	Y
5. Quantifiable	Y	Y	Y	Y	Y	Y	Y	Y
6. Measurement described to replicable precision	Y	Y	Y	Y	Y	Y	Y	Y
7. Measurement occurred repeatedly	Y	Y	Y	Y	Y	Y	Y	Y
8. Interobserver agreement data reported	Y	Y	Y	Y	Y	Y	Y	Y
Independent variable (IV)								
9. Described with replicable precision	Y	Y	Y	Y	Y	Y	Y	Y
10. Systematically manipulated	Y	Y	Y	Y	Y	Y	Y	Y
11. Procedural fidelity described	N	Y	Y	Y	Y	Y	N	Y
Baseline								
12. Phase provided evidence of pattern, prior to intervention	Y	Y	Y	Y	Y	Y	Y	Y
13. Described with replicable precision	Y	Y	Y	Y	Y	Y	Y	Y
Validity								
14. Three demonstrations of experimental effect	Y	Y	Y	Y	Y	Y	Y	Y
15. Design controlled threats to internal validity	Y	Y	Y	Y	Y	Y	Y	Y
16. Effects replicated, indicate external validity	Y	Y	Y	Y	Y	Y	Y	N
17. DV socially important	Y	Y	Y	Y	Y	Y	Y	Y
18. Magnitude of change in DV due to intervention socially important	N	Y	Y	Y	N	Y	N	Y
19. IV is cost effective/practical	N	N	Y	Y	N	Y	Y	Y
20. IV is implemented over time, typical contexts/typical agents	N	Y	Y	Y	N	Y	N	Y
Indicators met/total indicators	16/20	18/20	20/20	20/20	17/20	20/20	17/20	19/20

Indicator	Hume and Odom (2007)	MacDuff et al. (1993)	Mechling et al. (2009)	Mechling and Gustafson (2008)	Morrison et al. (2002)	Pierce et al. (2013)	Van Laarhoven et al. (2010)	Waters et al. (2009)
Participants								
1. Described sufficiently	Y	Y	Y	Y	Y	Y	Y	Y
2. Selection described sufficiently	Y	Y	Y	Y	Y	N	Y	N
3. Setting described sufficiently	Y	Y	Y	Y	Y	Y	Y	Y

Table 1 continued

Indicator	Betz et al. (2008)	Blum-Dimaya et al. (2010)	Bryan and Gast (2000)	Carlile et al. (2013)	Cihak (2011)	Cuhadar and Diken (2011)	Dettmer et al. (2000)	Duttlinger et al. (2013)
Dependent variable (DV)								
4. Described with replicable precision	Y	Y	Y	Y	Y	Y	Y	Y
5. Quantifiable	Y	Y	Y	Y	Y	Y	Y	Y
6. Measurement described to replicable precision	Y	Y	Y	Y	Y	Y	Y	Y
7. Measurement occurred repeatedly	Y	Y	Y	Y	Y	Y	Y	Y
8. Interobserver agreement data reported	Y	Y	Y	Y	Y	Y	Y	Y
Independent variable (IV)								
9. Described with replicable precision	Y	Y	Y	Y	Y	Y	Y	Y
10. Systematically manipulated	Y	Y	Y	Y	Y	Y	Y	Y
11. Procedural fidelity described	Y	Y	Y	Y	Y	Y	Y	N
Baseline								
12. Phase provided evidence of pattern, prior to intervention	Y	Y	Y	Y	Y	Y	Y	Y
13. Described with replicable precision	Y	Y	Y	Y	Y	Y	Y	Y
Validity								
14. Three demonstrations of experimental effect	Y	Y	Y	Y	Y	Y	Y	Y
15. Design controlled threats to internal validity	Y	Y	Y	Y	Y	Y	Y	Y
16. Effects replicated, indicate external validity	Y	Y	Y	Y	Y	Y	Y	Y
17. DV socially important	Y	Y	Y	Y	Y	Y	Y	Y
18. Magnitude of change in DV due to intervention socially important	Y	N	N	N	Y	Y	Y	N
19. IV is cost effective/practical	Y	N	N	N	Y	N	N	N
20. IV is implemented over time, typical contexts/typical agents	Y	N	N	N	Y	Y	Y	N
Indicators met/total indicators	20/20	17/20	17/20	17/20	20/20	18/20	19/20	15/20

Y Yes, *N* No

paper), (g) training aspects (e.g., systematic instructional procedures used to teach schedule use), (h) research design, (i) results/outcome, and (j) PND calculation. A doctoral student in her third year of a doctoral program in special education coded experiments. The doctoral student was the primary coder for each of the studies, and two researchers from the local university were the second and third coders to determine reliability. After the studies were hand coded, the doctoral student and researchers created Tables 1 and 2 to determine the evidence-base for using VAS to teach a variety of skills to individuals with ASD.

Quality Analysis Using Horner et al. (2005) Indicators

To evaluate the quality of each study, the authors used standards for single-subject research outlined by Horner et al. (2005). Authors determined the presence or absence of each indicator using a data sheet developed by the researchers. The data sheet included an operationalized definition for each of the 20 quality indicators [(QIs) see Table 1 for a complete list of QIs] within five broad categories (i.e., participants, dependent variable, independent variable, baseline, and validity). Examples and non-examples of each indicator were discussed between reviewers before coding began. For example, a study that did not discuss individual students, but rather summarized information about the group of students in a table would not have met the QI for "participants described sufficiently" for this review. The authors then used Horner et al.'s guidelines to determine whether a study qualified as "acceptable."

Determination of an Evidence Base for Using Visual Activity Schedules

After acceptable studies were identified, they were collectively reviewed to determine if they met the criteria for an EBP according to Horner et al. (2005) including: (a) the number of quality studies was at least five, (b) the number of research teams in this set of experiments was at least three, (c) the number of participants across this set of studies was at least 20, and (d) the number of geographical locations represented was at least three. Although the reviewers of the current analysis decided to use the Horner et al. (2005) criteria, it should be noted that other criteria exist (e.g., National Autism Center 2009; Reichow et al. 2007; Reichow 2011).

Interrater Reliability on Quality Indicators and Study Characteristics

After one of the authors coded each article for the QIs, descriptive study characteristics, and PND, two other authors independently conducted interrater reliability on 10 of the 31 articles (32.3 %). Articles were selected at random and authors were unaware of each other's scores. A point-by-point reliability method was used. The number of agreements was divided by the total number of indicators and multiplied by 100 %. For the QIs, Interrater reliability was acceptable at an average of 97 %, with a range of 90–100 %. Interrater reliability was collected on four of the 16 (25 %) studies retained for further review and was also acceptable for the descriptive study characteristics (86 %). Most disagreements were inconsistencies within the participants heading (e.g., one rater stating high school and age level while the other only stated age level) or the results section (e.g., one rater stated results only, while the other rater stated discussion points). The table was adjusted to account for the disagreements based on the inconsistencies. PNDs were calculated on 33 % of studies with an agreement of 94 % (i.e., authors only disagreed regarding one data point for one dependent variable on the Cuhadar and Diken 2011 study).

Results

Quality of the Single Subject Studies

A total of 31 studies met inclusion criteria for the review. Of these studies, 16 met the criteria for "acceptable" (see Table 1). Five studies met 100 % of the Horner et al. (2005) criteria (Bryan and Gast 2000; Carlile et al. 2013; Cuhadar and Diken 2011; Hume and Odom 2007; Morrison et al. 2002). Eleven other studies also met the five criteria necessary to be determined "acceptable" (Betz et al. 2008; Blum-Dimaya et al. 2010; Cihak 2011; Dettmer et al. 2000; Duttlinger et al. 2013; MacDuff et al. 1993; Mechling et al. 2009; Mechling and Gustafson 2008; Pierce et al. 2013; Van Laarhoven et al. 2010; Waters et al. 2009).

Fifteen studies did not meet "acceptable" standards. Studies that did not qualify were excluded on the basis of lack of experimental effect, lack of replication, failure to report inter-observer agreement (IOA), and/or failure to address social validity. Studies that did not demonstrate a pattern of data at baseline prior to intervention were excluded, as were studies that did not describe setting or procedures with enough clarity to allow for replication. A common reason for not meeting "acceptable" standards was the lack of sufficient replication of study effects (i.e., Bevill et al. 2001; Bennet et al. 2011; Dooley et al. 2001; Hall et al. 1995; Krantz et al. 1993; Machalicek et al. 2009; Massey and Wheeler, 2000; Mechling and Savidge 2011; Miguel et al. 2009; Newman et al. 1995; Pierce and Schreibman 1994; Riffel et al. 2005; Schneider and Goldstein 2010; Van Laarhoven and Van Laarhoven-Myers 2006; Watanabe and Sturmey 2003).

Table 2 Descriptive information from acceptable quality studies

Participants	Setting	Targeted skills	Dependent variable/measures	Schedule type and mode of presentation	Training aspects	Research design	Results/outcomes	PND
Betz et al. (2008)								
N: 6 (3 dyads)	Preschools (public, 1 university-based)	Play skills (in pairs)	% of engaged, prompted, unengaged intervals during play periods	Photographs in a 3 ring binder with student picture (the student "responsible" for initiating play) and the picture of one game per page	Graduated guidance	Non-concurrent multiple baseline design across dyads	All three dyads increased engagement and decreased need for prompting	97.3 % (highly effective)
Age: 4–5 years	Did not specify who implemented intervention					1 reversal phase for 1 dyad	IOA 91, 88, 92 %	
5 male, 1 female							PR (no measure)	
Diagnoses: Autism (6)							SV (no measure)	
Level of intellectual functioning not specified								
Blum-Dimaya et al. (2010)								
N: 4	Self-contained room (private self-contained school)	Playing video games	% of correctly completed schedule components	Photographs in a book with one picture per page	Graduated time delay with activity schedule to teach TA for playing game	Multiple baseline design across participants	All students increased % of correctly completed schedule components and on-task intervals	Schedule components: 95.8 % (highly effective) on-task-intervals: 91.6 % (highly effective)
Age: 9–12 years	Classroom teacher (graduate student) implemented intervention		% of on-task intervals		Edible rewards		Ability to play songs maintained after picture activity schedule removed	
3 male, 1 female							IOA 98–100 %	
Diagnoses: Autism (4)							PR 100 %	
Level of intellectual functioning not specified							SV: videos of student performance, Likert scale rated student behaviors pre/post intervention; high scores (strongly agreeing) yielded during post-test for engaging, attending, and age-appropriateness	
Bryan and Gast (2000)								

Table 2 continued

Participants	Setting	Targeted skills	Dependent variable/measures	Schedule type and mode of presentation	Training aspects	Research design	Results/outcomes	PND
N: 4	Resource room in a public school	Independent academic skills (e.g., file folder literacy games, books on tape)	% intervals on-task	Line drawings in a 4″ × 6″ photo album with one picture per page	Graduated guidance	ABAB withdrawal design	All students met criteria with graduated guidance and schedule; maintained when GG dropped out, dropped when book schedule removed	On-task with scheduled: 100 % (highly effective); on-schedule: 100 % (highly effective)
Age: 7–8 years	Teacher/ experimenter and paraprofessionals implemented intervention		% intervals on-schedule		VI-3 reinforcement for on-task and on-schedule behaviors		Skills generalized to new activities	
3 male, 1 female							IOA 100 %	
Diagnoses: Autism (4)							PR 100 %	
Level of intellectual functioning not specified							SV: Likert scale- teachers thought the intervention was effective and practical	
Carlile et al. (2013)								
N: 4	Self-contained classroom	Schedule following for leisure activities	% of correct schedule components	iPod touch	Physical prompts	Multiple probe across participants	All students improved on-task behaviors and learned to follow the schedule without assistance	Correct schedule: 75 % (fairly effective); on-task: 100 % (highly effective)
Age: 8–12 years	Special education teacher and assistants implemented the intervention		% of on-task intervals		Progressive time delay		Students maintained at 3 months and generalized the skills across settings	
4 male					Reinforcement		IOA 98 %	
Diagnoses: Autism (4)							PR 100 %	
Level of intellectual functioning not specified							SV: Videotapes rated by observers using Likert scales and peer/staff questionnaires suggested schedule use was preferred and socially appropriate	
Cihak (2011)								
N: 4	Two middle schools in classrooms for students with severe disabilities	Transitioning between typical classroom activities	% of independent transitions	Photographs of self displayed on a horizontal schedule	System of Least Prompts	Alternating treatments design	Both picture and video schedules showed improvements for all participants	89.8 % (fairly effective)

Table 2 continued

Participants	Setting	Targeted skills	Dependent variable/measures	Schedule type and mode of presentation	Training aspects	Research design	Results/outcomes	PND
Age: 11–13 years	Two special education teachers implemented intervention			Videos of self shown on classroom computer with touchscreen	Contingent praise		Two students were more independent transitions with video; 1 student more independent transitions with static pictures; 1 student performed similarly with both videos and pictures	
3 male, 1 female					Verbal prompt to attend to schedule if student did not transition		IOA 97 %	
Diagnoses: Autism (4)							PR 99 %	
Level of intellectual functioning not specified							SV (no measure)	
Cuhadar and Diken (2011)								
N: 3	Private school, therapy room	Play activities	% of correct schedule following	Photographs on 23″ × 20″ photo activity schedule (with picture of leisure skill and social interaction)	Physical assistance/ blocking of incorrect answers, fading of assistance	Multiple probe design across participants	All 3 participants met criteria	Schedule: 100 % (highly effective); engagement: 97.3 % (highly effective); play skills: 90.4 % (highly effective)
Age: 4–6 years	Researcher implemented intervention		% task engagement	Photographs in a 23″ × 20″ activity book (photo description of each task; one picture per page)	Reinforcement with preferred reinforcers		IOA 97 %	
Male							PR 98 %	
Diagnoses: Autism (3)							SV: mother and teacher interviews revealed a positive view on using activity schedules, reporting students becoming more independent; reported decrease in self-stimulatory and problem behaviors	
Level of intellectual functioning not specified								
Dettmer et al. (2000)								

Table 2 continued

Participants	Setting	Targeted skills	Dependent variable/measures	Schedule type and mode of presentation	Training aspects	Research design	Results/outcomes	PND
N: 2	Community and home	Leisure activities in community; homework and leisure activities at home	Amount of time between direction and student attempt to begin activity	Line drawings on Velcro strips, in 5.5″ × 6.5″ photo albums, and on	Verbal and gestural prompts	ABAB withdrawal design	Decreased latency times for attempting activities for both participants	100 % (highly effective)
Age: 5–7 years	Caregivers implemented intervention			3″ × 5″ notecards			IOA 95 %	
Male							PF (no measure)	
Diagnoses: Autism (2)							SV (no measure)	
Level of intellectual functioning not specified								
Duttlinger et al. (2013)								
N: 1	Self-contained middle school classroom	Independent schedule formation	% of tasks completed independently following initial teacher directions	Velcroed pictures on a piece of cardstock	System of least prompts	A–BC–B–A–B withdrawal design	Met criteria and generalized to community setting	100 % (highly effective)
Age: 13–14	School hallway and bathroom						IOA 96 %	
Female	Generalization at food court in the community						PR 99 %	
Diagnoses: Autism (1)	Teacher implemented intervention						SV: staff and student surveys on a Likert scale indicated that staff found the intervention helpful and feasible	
Mild to moderate intellectual functioning deficits								
Hume and Odom (2007)								
N: 3	Student classroom for 2 students	Independent work	% of time on task	Work system with schedule pictures	Verbal and visual prompts	ABAB withdrawal design	All students met criteria	On-task: 66.7 % (questionable) tasks completed: 66.7 % (questionable)
Age: 6–20 years	Work site for 1 participant	Play skills	% of tasks completed				All participants increased on all DVs, maintained at 1 month	
Male							IOA 91–100 %	

Table 2 continued

Participants	Setting	Targeted skills	Dependent variable/measures	Schedule type and mode of presentation	Training aspects	Research design	Results/outcomes	PND
Diagnoses: Autism (3)							PR 100 %	
Mild/moderate intellectual functioning deficits							SV: staff questionnaire reflected that student independence and task completion improved	
MacDuff et al. (1993)								
N: 4	Group home	After-school activities/ leisure and homework	% of intervals on-task	Photographs in a 3 ring binder with one picture per page	Graduated guidance, fading of verbal, gestural, physical prompts	Multiple baseline design across participants	All participants met criteria	On-task: 73.3 % (fairly effective); on-schedule: 100 % (highly effective)
Age: 9–14 years	"Primary data collector" implemented intervention		% of intervals on-schedule				IOA 96, 99 %	
Male							PR 99 %	
Diagnoses: Autism (4)							SV (no measure)	
Level of intellectual functioning not specified								
Mechling et al. (2009)								
N: 3	High school cooking room "Primary data collector" implemented intervention	Cooking skills	% of correctly completed recipe steps	Photographs shown via a Personal Digital Assistant	Self-prompting- no instructor prompts (auditory, video, picture)	Multiple probe design across tasks, replicated across three participants	All students met criteria after PDA introduced	100 % (highly effective)
Age: 19–22 years			% of steps at each prompt level	Videos shown via a personal digital assistant			All students faded their use of self-prompts	
Male							IOA 99.3, 98.3 %	
Diagnoses: Autism (1)							PR 98.9 %	
Mild/moderate intellectual functioning							SV: students asked about preference- all chose DVD or video	
Mechling and Gustafson (2008)								

Table 2 continued

Participants	Setting	Targeted skills	Dependent variable/measures	Schedule type and mode of presentation	Training aspects	Research design	Results/outcomes	PND
N: 6	Home living room in high school "instructor" implemented intervention	Cooking activities	% of correctly completed cooking tasks	Photographs or line drawings shown one picture at a time	Self-prompting- no instructor prompts (auditory, video, picture)	Adapted alternating treatments design	Both methods increased % of completed cooking tasks, but video resulted in higher percentages for all participants	Videos: 100 % (highly effective); static pictures: 100 % (highly effective)
Age: 15–21 years				Videos shown via portable DVD player	Static picture compared to video prompts		IOA 99.2 %	
Male							PR 99.7 %	
Diagnoses: Autism (6)							SV (no measure)	
Moderate intellectual functioning deficits								
Morrison et al. (2002)								
N: 4 with ASD; 8 typical peers	Inclusive preschool "Experimenter" implemented intervention	Cooking tasks	% of on-task behavior	Photograph placed with Velcro to a clipboard; pictures sequenced left to right	Verbal prompt then "prompt" until complete (prompting strategy not specified)	Multiple baseline design across participants	On-task behavior and play correspondence increased for all participants in the schedule ad play correspondence training	On-task: 92.3 % (highly effective); play: 91.9 % (highly effective)
Age:	42–70 months			# of play correspondence occurrences				IOA 92–100 %
2 male, 2 female							PR 100 %	
Diagnoses: Autism (4)							SV: stakeholders questioned- all agreed activity schedules were effective in increasing play and socially valid for classroom use	
Significant	developmental deficits (measured by Batelle)							
Pierce et al. (2013)								
N: 4	Self-contained classroom	Transition behaviors	% of independent transition steps	Schedule books with pictures	System of least prompts	ABAB withdrawal	All students increased % of independent transition steps	71.3 % (fairly effective)
Age: 9–11 years	Teacher and paraprofessionals implemented intervention			Pictures on centers within the classroom			Students generalized to new pictures and stimuli	
Male							IOA 99 %	

Table 2 continued

Participants	Setting	Targeted skills	Dependent variable/measures	Schedule type and mode of presentation	Training aspects	Research design	Results/outcomes	PND
Diagnoses: Moderate AD (4)							PR 99 %	
Level of intellectual functioning not specified							SV: Likert scale ratings by staff indicated schedules were effective and social appropriate	
Van Laarhoven et al. (2010)								
N: 2	Middle school faculty lounge	Daily living skills (laundry, cooking)	% of independent correct responses	Photographs in a PowerPoint slideshow, with one picture per slide; printed one slide per page and held together with a notebook ring	Model-Lead- Test with tasks unrelated to instructional tasks targeted in study	Adapted alternating treatments design	Both video and picture prompting effectively increased independent responses, and reduced prompts, but video prompting was more effective	Video: 100 % (highly effective); picture: 100 % (highly effective)
Age: 13–14 years	Researcher and teacher implemented intervention		% of error correction prompts	Video with voiceover narration shown via laptop			IOA 99; 96 %	
Male			% of prompts to use technology				PR 100 %	
Autism and Mild/ moderate disabilities (2)			Number of sessions to reach criterion				SV: interviews; staff thought videos were slightly more effective, but preferred pictures; students reported liking both, but preferred videos	
Mild and moderate intellectual functioning deficits								
Waters et al. (2009)								
N: 2	General education classrooms	Academic tasks	% of transitions with problem behaviors	Photographs with text in schedule binder	Verbal + physical prompting	Alternating treatments design	Picture schedules alone insufficient	65.6 % (questionable)
Age: 6 years	Did not specify who implemented intervention				3-Step prompting	Functional analysis	DRO, extinction, and activity schedule greatest reduction in problem behaviors	
Male							Extinction the likely component most responsible for behavior change	
Diagnoses: Autism (2)							IOA 100, 99 %	
Level of intellectual functioning not specified							PR (no measure)	

The 16 "acceptable" articles were retained for subsequent analysis of the study characteristics. Researchers examined "acceptable" studies for descriptive information, including: (a) participants, (b) setting, (c) targeted skills, (d) dependent variables, (e) schedule type and mode of presentation, (f) training aspects, (g) research design, (h) results/outcomes, and (i) PND calculations. The researchers also examined methodological limitations of the "acceptable" studies.

Participants

A total of 56 children and adolescents with ASD participated in the 16 studies. Forty-nine participants were male and seven were female. The studies included a range of ages (3–21 years) and a range of grade levels. For example, two studies examined the behavior of preschool students (Betz et al. 2008; Morrison et al. 2002). Eight studies examined VAS with elementary school aged students (Blum-Dimaya et al. 2010; Bryan and Gast 2000; Carlile et al. 2013; Cuhadar and Diken 2011; Dettmer et al. 2000; Hume and Odom 2007; Pierce et al. 2013; Waters et al. 2009). Four studies evaluated VAS for students at the middle school level (Cihak 2011; Duttlinger et al. 2013; MacDuff et al. 1993; Van Laarhoven et al. 2010). Three studies investigated VAS with students in the high school age range (Hume and Odom 2007; Mechling et al. 2009; Mechling and Gustafson 2008).

The 16 studies addressed students with diagnoses ranging in severity. Severity was determined in the studies using rating scales such as the Gilliam Autism Rating Scale (GARS) and educational eligibilities. Two studies examined VAS with students with ASD in the severe range (Cihak 2011; Hume and Odom 2007). Four studies included participants diagnosed with ASD in the moderate range (Mechling et al. 2009; Mechling and Gustafson 2008; Morrison et al. 2002; Pierce et al. 2013). Two studies included participants with ASD in the mild range (Mechling et al. 2009; Mechling and Gustafson 2008). Twelve of the studies did not specify the severity level for at least 1 of the participants (Betz et al. 2008; Blum-Dimaya et al. 2010; Bryan and Gast 2000; Carlile et al. 2013; Cuhadar and Diken 2011; Dettmer et al. 2000; Duttlinger et al. 2013; Hume and Odom 2007; MacDuff et al. 1993; Morrison et al. 2002; Van Laarhoven et al. 2010; Waters et al. 2009).

Ten of the studies did not specify the intelligence scores of the participants (Betz et al. 2008; Blum-Dimaya et al. 2010; Bryan and Gast 2000; Carlile et al. 2013; Cihak 2011; Cuhadar and Diken 2011; Dettmer et al. 2000; MacDuff et al. 1993; Pierce et al. 2013; Waters et al. 2009). Four studies reported that their participants had mild to moderate intellectual deficits (Duttlinger et al. 2013; Hume and Odom 2007; Mechling et al. 2009; Van Laarhoven et al. 2010) and one reported moderate deficits (Mechling and Gustafson 2008). One author described the participants' intellectual functioning as "significant" (Morrison et al. 2002). Table 2 shows the number of total participants (i.e., N: 2) for each study as well as number of participants within each study with a particular diagnosis. This number is designated in parenthesis after the diagnosis (i.e., autism [2]).

Settings

The studies included in this review examined VAS in a range of contexts. The general education setting and the self-contained setting were used most frequently. Six studies were implemented in the general education setting (Betz et al. 2008; Cihak 2011; Hume and Odom 2007; Morrison et al. 2002; Van Laarhoven et al. 2010; Waters et al. 2009). Of these six, one study used both a public school and a university-based preschool setting (Betz et al. 2008). This study did not specified whether the university-based preschool was a self-contained program. Five studies were conducted in special education settings such as resource and self-contained classrooms (Blum-Dimaya et al. 2010; Bryan and Gast 2000; Carlile et al. 2013; Duttlinger et al. 2013; Pierce et al. 2013). Separate rooms within schools such as cooking rooms and therapy rooms were used in four studies (Cuhadar and Diken 2011; Mechling et al. 2009; Mechling and Gustafson 2008). One study was conducted in a residential group home (MacDuff et al. 1993) and one study was conducted in both home and community settings (Dettmer et al. 2000). One study included a generalization component in the community setting (Duttlinger et al. 2013), and one study examined the use of VAS in a worksite (Hume and Odom 2007).

Various people were responsible for instruction across studies. Typical intervention agents were responsible for the instruction in the majority of studies. For example, in 8 of the 16 studies, classroom teachers or special education teachers were responsible implementing the intervention (Blum-Dimaya et al. 2010; Bryan and Gast 2000; Carlile et al. 2013; Cihak 2011; Duttlinger et al. 2013; Mechling and Gustafson 2008; Pierce et al. 2013; Van Laarhoven et al. 2010). In three of the five studies, the classroom teacher and staff delivered the instruction (Bryan and Gast, 2000; Carlile et al. 2013; Hume and Odom 2007). In another one of the eight studies, the classroom teacher and the researcher were responsible for the instruction (Van Laarhoven et al. 2010). In one of the eight studies, the special education teachers conducted the intervention (Cihak 2011). In one of the eight studies the classroom teacher was used (Blum-Dimaya et al.) and in one study the "instructor" (i.e., not specified) was used (Mechling and

Gustafson 2008). Caregivers were responsible for delivering the treatment in one study (Dettmer et al. 2000). Researchers or primary data collectors were responsible for conducting the intervention in four of the studies (Cuhadar and Diken 2011; MacDuff et al. 1993; Mechling et al. 2009; Morrison et al. 2002). Two studies did not specify who implemented the intervention (Betz et al. 2008; Waters et al. 2009).

Targeted Skills

The studies examined in this review investigated the use of VAS with a wide range of skills. Of the 16 studies, seven employed schedule use during play activities such as video games (Blum-Dimaya et al. 2010) and typical school play choices (Betz et al. 2008; Carlile et al. 2013; Cuhadar and Diken 2011; Dettmer et al. 2000; Hume and Odom 2007; Morrison et al. 2002). Five studies examined the effects of visual schedules in the context of academic activities (Bryan and Gast 2000; Cihak 2011; Duttlinger et al. 2013; Pierce et al. 2013; Waters et al. 2009). Three of the studies used VAS with daily living tasks such as laundry (Van Laarhoven et al. 2010) and cooking (Mechling et al. 2009; Mechling and Gustafson 2008; Van Laarhoven et al.). One study used picture schedules to assist in the completion of homework and after-school leisure activities (MacDuff et al. 1993). In one study, VAS were used with work skills in a job site (Hume and Odom 2007).

Dependent Variables

Of the 16 studies examined for descriptive information, seven recorded the percentages of on-task intervals (Betz et al. 2008; Blum-Dimaya et al. 2010; Carlile et al. 2013; Cuhadar and Diken 2011; Hume and Odom 2007; MacDuff et al. 1993; Morrison et al. 2002). Six studies examined the percentages of on-schedule components (Blum-Dimaya et al. 2010; Bryan and Gast 2000; Carlile et al. 2013; Cuhadar and Diken 2011; MacDuff et al. 1993; Morrison et al. 2002). Two studies examined the number of appropriate and independent transitions (Cihak 2011; Waters et al. 2009). One of the studies measured latency between direction and task commencement (Dettmer et al. 2000). Six studies investigated the percentage of correctly completed responses, task, or task analysis steps (Duttlinger et al. 2013; Hume and Odom 2007; Mechling et al. 2009; Mechling and Gustafson 2008; Pierce et al. 2013; Van Laarhoven et al. 2010). Level of prompt necessary for task completion was examined in three studies (Hume and Odom 2007; Mechling et al. 2009; Van Laarhoven et al. 2010).

Independent Variables

Type of Schedule

Of the 16 studies retained for further descriptive analysis, 13 investigated interventions that included basic pictures or photographs in the VAS (Betz et al. 2008; Blum-Dimaya et al. 2010; Cihak 2011; Cuhadar and Diken 2011; Duttlinger et al. 2013; Hume and Odom 2007; MacDuff et al. 1993; Mechling et al. 2009; Mechling and Gustafson 2008; Morrison et al. 2002; Pierce et al. 2013; Van Laarhoven et al. 2010; Waters et al. 2009). Two studies used line drawings in the VAS (Bryan and Gast 2000; Dettmer et al. 2000). Four studies involved video schedule interventions (Blum-Dimaya et al. 2010; Cihak 2011; Mechling and Gustafson 2008; Van Laarhoven et al. 2010). Two studies used a visual schedule on a personal digital assistant, which is a handheld device that shows both videos and pictures (Carlile et al. 2013; Mechling et al. 2009).

Mode of Presentation

Ten studies used a presentation format that presented one picture at a time (Betz et al. 2008; Blum-Dimaya et al. 2010; Bryan and Gast 2000; Cuhadar and Diken 2011; Dettmer et al. 2000; MacDuff et al. 1993; Mechling et al. 2009; Mechling and Gustafson 2008; Van Laarhoven et al. 2010; Waters et al. 2009). These examples included the use of a binder (e.g., Betz et al. 2008), book (e.g., Blum-Dimaya et al. 2010), or photo album (Bryan and Gast 2000). Seven studies used a format that presented all of the pictures at one time (Cihak 2011; Cuhadar and Diken 2011; Dettmer et al. 2000; Duttlinger et al. 2013; Hume and Odom 2007; Morrison et al. 2002; Pierce et al. 2013). These examples included a notecard (Dettmer et al. 2000), horizontal schedules (Cihak 2011; Pierce et al. 2013), Velcro strips (Dettmer et al. 2000), or Velcro on a clipboard or cardstock (Duttlinger et al. 2013; Hume and Odom 2007; Morrison et al. 2002). Four studies presented the VAS using a video format (Cihak 2011; Mechling et al. 2009; Mechling and Gustafson 2008; Van Laarhoven et al. 2010); one showed the video on a portable DVD player (Mechling and Gustafson 2008), one was shown via a personal data assistant (Mechling et al. 2009), one was viewed on a computer with a touchscreen (Cihak 2011), and one was watched on a laptop (Van Laarhoven et al. 2010). One study used a picture schedule on an iPod touch (Carlile et al. 2013).

Training Components

Fourteen of the sixteen studies used systematic instruction to teach students to use the VAS. In contrast, no instruction

or prompting was used in only two of the studies. For example, nine of the studies used verbal, gestural, and/or physical prompting (Carlile et al. 2013; Cihak 2011; Cuhadar and Diken 2011; Dettmer et al. 2000; Duttlinger et al. 2013; Hume and Odom 2007; Morrison et al. 2002; Pierce et al. 2013; Waters et al. 2009). Three of the studies employed the use of graduated guidance (Betz et al. 2008; Bryan and Gast 2000; MacDuff et al. 1993). Three studies used the system of least prompts (Cihak 2011; Duttlinger et al. 2013; Pierce et al. 2013). Two studies used time delay (Blum-Dimaya et al. 2010; Carlile et al. 2013). One study employed the model/lead/test procedure (Van Laarhoven et al. 2010). Two studies used fading (Cuhadar and Diken 2011; MacDuff et al. 1993). Four of the 12 studies used some type of reinforcement as part of the VAS training (Blum-Dimaya et al. 2010; Bryan and Gast 2000; Cihak 2011; Cuhadar and Diken 2011).

Single Subject Research Designs

The authors recorded the types of designs used in the literature. Four studies used a multiple baseline across participants design (Betz et al. 2008; Blum-Dimaya et al. 2010; MacDuff et al. 1993; Morrison et al. 2002); of these, only one was non-concurrent (Betz et al. 2008). Five studies used withdrawal designs (Bryan and Gast 2000; Dettmer et al. 2000; Duttlinger et al. 2013; Hume and Odom 2007; Pierce et al. 2013). Two studies used an alternating treatments design (Cihak 2011; Waters et al. 2009) and two studies used an adapted alternating treatments design (Mechling and Gustafson 2008; Van Laarhoven et al. 2010). Three studies used multiple probe designs across participants (Carlile et al. 2013; Cuhadar and Diken 2011) or across tasks and participants (Mechling et al. 2009).

Study Results and Outcomes: Effectiveness of Visual Activity Schedules

Efficacy of VAS

The effect of VAS on student outcomes was determined using PND statistic calculations. Table 2 summarizes the PNDs calculated across the 16 studies included in this review. Effects of VAS interventions were measured using intervention phases only, since generalization and maintenance were not included in all studies. Of the 26 dependent variables measured across studies, results from these analyses suggest VAS are highly effective for 19, fairly effective for four, and questionable for three (range 65.6–100 %; Scruggs and Mastropieri 1998). No studies suggest VAS are ineffective for the dependent variables measured. Considering this yield, it can be concluded that VAS are fairly to highly effective for the majority of dependent variables evaluated across studies.

Student Outcomes

All of the 16 studies revealed that VAS produced positive effects. Eight studies, for example, noted that on-task behavior increased as a result of VAS implementation (Betz et al. 2008; Blum-Dimaya et al. 2010; Bryan and Gast 2000; Carlile et al. 2013; Cuhadar and Diken 2011; Hume and Odom 2007; MacDuff et al. 1993; Morrison et al. 2002). Four studies demonstrated that the use of VAS resulted in decreased need for prompting (Betz et al. 2008; Hume and Odom 2007; Mechling et al. 2009; Van Laarhoven et al. 2010). Nine studies also indicated that correct task and schedule completion steps improved as a result of visual schedule implementation (Blum-Dimaya et al. 2010; Carlile et al. 2013; Cuhadar and Diken 2011; Duttlinger et al. 2013; Hume and Odom 2007; Mechling et al. 2009; Mechling and Gustafson 2008; Pierce et al. 2013; Van Laarhoven et al. 2010). Transitional behavior improved in three studies (Cihak 2011; Pierce et al. 2013; Waters et al. 2009). In addition, Dettmer et al. (2000) demonstrated improved latency time after students were directed to complete an activity.

Two studies suggested that the presence of VAS alone were not sufficient to improve problem-free transitions and on-task behavior (Morrison et al. 2002; Waters et al. 2009). Morrison et al. (2002) demonstrated that preschool students with ASD required training to correctly complete the schedules. After correspondence training was implemented, the students demonstrated improved on-task behavior and play correspondence. Waters et al. (2009) demonstrated that a combination of differential reinforcement of other behaviors (DRO), extinction, and VAS effectively reduced transition difficulties for 6-year-old students. In this study, visual schedules alone did not lead to improved behavior. The use of DRO and extinction resulted in decreased aggressive and disruptive behaviors during transitions, with the addition of VAS causing a modest improvement.

Three of the studies compared the effectiveness of photographic activity schedules to video picture schedules (Cihak 2011; Mechling and Gustafson 2008; Van Laarhoven et al. 2010). All three studies demonstrated that both types of schedules were effective. Cihak (2011) demonstrated that picture schedules were more efficient for one student while video schedules were more efficient for two students. A fourth student responded to both types equally. Cihak (2011) concluded that different types of schedules may be effective for different students and called for teacher flexibility in determining which type to implement. In contrast, Mechling and Gustafson (2008) and Van

Laarhoven et al. (2010) demonstrated that video schedules were most effective for all participants.

Reliability and Social Validity

All of the 16 studies that met the QIs measured interrater reliability data with ranges from 88 to 100 %. Thirteen of the sixteen studies measured procedural reliability with ranges from 98 to 100 % (Blum-Dimaya et al. 2010; Bryan and Gast 2000; Carlile et al. 2013; Cihak 2011; Cuhadar and Diken 2011; Duttlinger et al. 2013; Hume and Odom 2007; MacDuff et al. 1993; Mechling et al. 2009; Mechling and Gustafson, 2008; Morrison et al. 2002; Pierce et al. 2013; Van Laarhoven et al. 2010).

Ten studies included a formal social validity measure (Blum-Dimaya et al. 2010; Bryan and Gast 2000; Carlile et al. 2013; Cuhadar and Diken 2011; Duttlinger et al. 2013; Hume and Odom 2007; Mechling et al. 2009; Morrison et al. 2002; Pierce et al. 2013; Van Laarhoven et al. 2010). Eight of these studies included adults' perspectives (Blum-Dimaya et al. 2010; Bryan and Gast 2000; Carlile et al. 2013; Cuhadar and Diken 2011; Duttlinger et al. 2013, Hume and Odom 2007; Morrison et al. 2002; Pierce et al. 2013; Van Laarhoven et al. 2010), while three studies included student perspectives (Duttlinger et al. 2013; Mechling et al. 2009; Van Laarhoven et al. 2010). One study examined peer perspectives (Carlile et al. 2013). All studies reported positive responses to the social validity measures, reporting improved behavior as a result of schedule use. Two studies reported that students preferred videos to pictures (Mechling et al. 2009; Van Laarhoven et al. 2010), and one reported that teachers preferred pictures, although they felt the videos were more effective (Van Laarhoven et al. 2010). In all studies, teachers use of VAS was feasible in the classroom.

Methodological Limitations of Studies Reviewed

The 16 studies included in this review had some limitations. One limitation was failure to conduct procedural reliability. Three studies did not meet this indicator (Betz et al. 2008; Dettmer et al. 2000; Waters et al. 2009). Two studies did not describe participant selection criteria sufficiently (Blum-Dimaya et al. 2010; Waters et al. 2009). The most common limitation was the failure to meet social validity indicators. Of the 16 studies, 6 did not include a formal social validity assessment component.

Discussion

The purpose of this comprehensive literature review was to update and expand the findings from previous reviews by determining whether VASs could be considered an EBP for increasing, maintaining, and generalizing a range of skills of individuals with ASD. According to Horner et al. (2005), acceptable studies must include the following five key features (a) the practice is operationally defined, (b) the context and outcomes are clearly defined, (c) the practice is implemented with fidelity, (d) the practice is functionally related to change in valued outcomes, and (e) experimental control is demonstrated across a sufficient range of studies. A practice is considered evidence-based when there are five studies meeting acceptable quality, across three research teams in three different geographical locations, and with a total of 20 participants. The What Works Clearinghouse (Kratochwill et al. 2013) has applied these same standards, and has gained substantial legitimacy in the field. In the current analysis, 15 acceptable studies meeting the five key features were found, across more than 3 research teams and geographical locations, and included a total of 53 participants. Complimenting previous findings from (a) Banda and Grimmett (2008) recommending VAS as an effective practice, (b) Lequia et al. (2012) suggesting that VAS are fairly effective in reducing challenging behaviors, and (c) NAC (2009) promoting "schedules" as an effective practice, the current analysis of the literature shows that VAS should be recommended as an EBP for increasing a variety of behaviors. Specifically, VAS can be used: (a) to teach on-task, on-schedule, and appropriate and independent transitions; (b) to improve latency to task from task direction, percentage of correctly completed responses, task, or task analysis steps; and (c) decrease level of prompts necessary for transitions.

Implications for Practice

Teachers are mandated by current legislation to use EBP as the driving force behind educational decisions. With the limited number of identified EBP for individuals with ASD, teachers are required to use interventions that have a high probability of desired outcomes, avoiding potentially harmful practices (e.g., Facilitated Communication). Due to the strong level of evidence found in this review for using VAS to teach a variety of behaviors, there are a number of positive results that can impact practice. First, VAS have been used to teach, improve, maintain, and generalize a range of skills (e.g., on-task, on-schedule, transition, percentage of task completion) across environments. Increasingly, activity schedules are being used in general education settings as well as resource, community, and home settings.

Second, VAS are widely applicable; that is, children and youth from across the full spectrum of ASD (e.g., severe to mild ASD) and from preschool to high school seem to benefit from the use of VAS. Third, systematic instruction appears to

promote the success of VAS. In all but three of the studies, VAS were used in combination with systematic instruction. For example, many of the studies used graduated guidance, reinforcement (e.g., high fives, edible rewards, contingent praise, preferred reinforcers), and gestural, verbal, and physical prompts. Further, some of the research studies reviewed showed that VAS alone did not produce a change in the dependent variable, but when used in combination with systematic instruction, students made progress (e.g., Morrison et al. 2002). As suggested by Banda and Grimmett (2008) in their review, VAS may also be beneficial because task analytic instruction is "built in" to the VAS by breaking the skill into smaller steps. The current review contributes to understanding of how to teach VAS using systematic instruction, because, although Banda and Grimmett (2008) suggested that many studies used systematic instruction in their review, they did not examine the components of systematic instruction used across studies.

From the research reviewed, both picture and video activity schedules were effective for teaching a range of behaviors. Most studies used basic pictures or photographs in the VAS indicating that "low tech" schedules work well; however, in three of the comparison studies, (Cihak 2011; Mechling and Gustafson 2008; Van Laarhoven et al. 2010) video activity schedules were more effective for most students than picture activity schedules. In addition, students preferred video activity schedules in two other studies (Mechling et al. 2009; Van Laarhoven et al. 2010). These results suggest that techniques should be matched to individual and care provider characteristics and preferences. Hume and Odom (2007) also suggest that various types of visual supports can be combined to create an "intervention package."

Overall, results from the social validity measures were positive. Stakeholders reported that the VAS (a) were engaging and age-appropriate and that students attended to them, (b) were effective and practical, and (c) promoted student independence after using them. In addition, students reported a preference for video activity schedules over picture activity schedules in two studies. Interestingly, in the Van Laarhoven et al. (2010) study, staff agreed that the videos were more effective but still preferred the pictures because they were more familiar and easy to transport.

Therefore, there may be additional considerations for the implementation of VAS beyond the analysis of empirically-based findings. For example, teachers, clinicians, and other service providers may need to individualize activity schedules based on individual preference, needs of the child or adult, age, prior experience with VAS, as well as user-friendliness and accessibility for all stakeholders involved. Most studies used a presentation format that presented pictures one at a time, but several studies also presented all of the pictures at one time. Younger students, students with complex support needs, or students who have not used VAS previously may benefit from pictures presented one at a time, while older students may not need that level of support. Two studies found that the presence of VAS alone were not sufficient to improve behaviors, but these studies were both with young children; it may be that older students or students who have previously used VAS may not need explicit instruction.

One final caveat is that educators and clinicians should consider using EBPs before applying less verified (and sometimes controversial) techniques; however not all EBPs work for all participants with ASD. Criticisms of evaluating and using EBPs center around the importance of conducting research that will translate to practice in applied settings (e.g., Mesibov and Shea 2011; Rogers and Vismara 2008). In practice, reliance upon clinical expertise, use of individualized interventions, and consideration of generalizable skills are often cornerstones to effective interventions; yet, they are often overlooked in both research studies and reviews. As Rogers and Vismara (2008) point out, "Decisions about appropriate interventions for a specific child must involve the intervention that can actually be delivered to an individual child rather than practices that were carried out by authors of a research article." (p. 32). In most of the articles reviewed, typical intervention agents were responsible for implementing the intervention; however, it was not clear if the interventionists attempted to individualize the intervention components based on individual learner needs, characteristics, and preferences (e.g., mode of presentation). Although there is a clear call for strengthening the rigor of the research, additional studies should balance the justification for methodological rigor with the need to address unique student characteristics and promote "real-life" (and often difficult to measure or "messy") long-term outcomes (Rogers and Vismara 2008). Since this review focused on evaluating whether VAS could be considered an EBP, a more nuanced discussion of visual supports in general, taking into consideration the limitation of using only EBP in applied settings, and the importance of individualizing supports based on learner and care provider characteristics would be beneficial. In practice, all decisions regarding strategies for individuals with ASD should be made on a case-by-case basis. Individual student performance via visual inspection of graphed data will determine both the benefits and drawbacks of tested interventions. Student performance based on individualized goals should be used in decision making for all interventions, including those identified as EBP.

Limitations

Although 15 studies were identified as acceptable, some limitations in the process for reviewing this literature exist.

First, quality indicators for each article were rated against criteria set forth by Horner et al. (2005). Some researchers suggest criteria set forth by Horner et al. (2005) is too stringent and often modified by authors reviewing literature for quality (Cook et al. 2009). Other criteria could have been used, possibly affecting the results (e.g., NAC 2009; Reichow et al. 2007; Reichow 2011). For example, NAC (2009) developed a rating system rubric, where QIs are scored (0–5) with higher scores indicating higher rigor. NAC guidelines for "established" practices include two group or four single-subject research articles with high ratings (3–5) and beneficial results. If the studies had been evaluated using NAC guidelines, as opposed to those set forth by Horner et al. (2005) results may have yielded additional studies. Similarly, if studies had been evaluated against the criteria developed by Reichow et al. (2007) or Reichow (2011), additional studies may have been considered acceptable (or unacceptable). Their criteria allow researchers to evaluate both single-subject and group research, and provides methods for determining research rigor, strength, and to calculate whether an intervention has the evidence needed to be considered an EBP using a formula. Although some researchers would argue that Horner et al. (2005) criteria are too stringent, use of these criteria still showed VAS to be evidence based practice.

Second, the interrater reliability was 86 % (range 56–100 % for each column heading; range 81–100 % for each article) for the descriptive study characteristics. Although a mean of 86 % agreement is acceptable, the floor (56 %) for column headings was not. In contrast, interrater reliability was considerably higher for QIs (average of 97 %, with a range of 90–100 %) and PNDs. This could be due to the fact that authors chose a study and coded it to 100 % agreement together prior to coding QIs independently; however, this was not completed for the descriptive study characteristics. Finally, while there is a range of proposed methods for determining "effect size" calculations for single case designs (e.g., Cohen's d), many authors would argue there is no suitable, agreed upon method (i.e., one that determines a magnitude of change, considers the replications of effect, and accounts for variability, trend, and level changes; e.g., Wolery et al. 2008). Given this, conclusions based solely on the PND calculations should be viewed with caution.

Recommendations for Future Research

There are a number of recommendations for future research based on the studies reviewed. Half of the original 30 studies included for analysis did not meet criteria for "acceptable" studies. The main reason was the lack of replication to establish external validity. According to Horner et al. (2005), external validity is demonstrated through three demonstrations of effect. Multiple probe designs across three participants, for example, could, at most, show three demonstrations of effect. To be included for consideration as "acceptable," multiple probe designs would need to show three replications of effect. Additional research is needed in which replication across participants, settings, and materials to establish external validity is addressed. In addition, some studies showed a lack of experimental effect, failure to report IOA, and failure to address social validity; future research should include these quality indicators.

In addition to addressing the methodological limitations to the studies reviewed, future studies should address the overall limitations to the participants and settings of the studies. For example, although there were a total of 56 participants and the ratio of males to females was close to the typical population (4:1), more studies should address VAS for female participants with ASD. Additionally, much of the research did not disclose the severity or specific diagnosis of the participant's ASD. From the studies that did report the severity level, it appears that additional research is needed for children and youth with more severe ASD as well as for individuals with Asperger's syndrome. Since most studies took place in elementary schools, additional research is needed in high school, preschool, community, and home settings.

Further, future research should examine the limitations of the dependent and independent variable. With respect to the dependent variable, additional research is needed that explores the use of VAS for academic and daily living activities, as most of the research in this review examined the use of VAS to increase, maintain, and generalize play and leisure behaviors. With respect to the independent variable, future studies should continue to compare the type of schedule, mode of presentation, and the of effect systematic instruction on learning the VAS for particular students. For example, although studies using video schedules are increasing in number, additional research is needed that examines this format in comparison to more traditional formats. Studies evaluating VAS often exists in conjunction with other interventions; therefore, future research could also clarify the extent to which VAS alone (e.g., without another intervention component such as choice or reinforcement) results in improved behaviors.

Only two studies examined the use of a portable device (i.e., PDA, iPod). With personal portable devices (e.g., tablet computers) becoming commonplace in schools for instructional use, this will likely take the place of more traditional approaches (e.g., binders with pictures or photographs). Mobile devices also have the added benefits of being novel and less stigmatizing than a binder with Velcro and pictures. Additional studies should examine the use of these portable devices for the delivery of the VAS. The

mode of presentation should also be addressed in future studies. For example, video modeling was shown to be more effective for some students (and preferred by students) in a few studies. Additional research is needed to explore this non-traditional approach to VAS. To increase independence, video models could be embedded into the VASs for children and youth who needed additional support for each individual activity in their schedule. Future research should compare the systematic instructional strategies used to teach VAS to see if individuals with ASD can learn more effectively or efficiently using one systematic instructional method over another.

Conclusion

Since many people tend to "cling to familiar routines so we don't have to experience the stress of change," (Hodgdon 1999; p. 105), why wouldn't this be true for individuals with ASD? VAS can provide structure and help to reduce problem behaviors (e.g., latency during transitions) for individuals with ASD, who often have difficulty understanding verbal directions. Not only does the current review indicate VAS are an EBP for increasing a range of skills, but they are a fairly easy way to provide students with consistent cues about their daily activities and are widely applicable to individuals across the lifespan. In the case of VAS for individuals with ASD, maybe a picture really is worth a thousand words.

References

*** Studies examined in the review; ** Acceptable studies retained for further analysis**

Banda, D. R., & Grimmett, E. (2008). Enhancing social and transition behaviors of persons with autism through activity schedules: A review. *Education and Training in Developmental Disabilities, 43*, 324–333.

*Bennet, K., Reichow, B., & Wolery (2011). Effects of structured teaching on the behavior of young children with disabilities. *Focus on Autism and Other Developmental Disabilities, 26*(3), 143–152.

**Betz, A., Higbee, T. S., & Reagon, K. A. (2008). Using joint activity schedules to promote peer engagement in preschoolers with autism. *Journal of Applied Behavior Analysis, 41*, 237–241.

*Bevill, A. R., Gast, D. L., Maguire, A. M., & Vail, C. O. (2001). Increasing engagement of preschoolers with disabilities through correspondence training and picture cues. *Journal of Early Intervention, 26*(2), 129–145.

**Blum-Dimaya, A., Reeve, S. A., & Reeve, K. F. (2010). Teaching children with autism to play a video game using activity schedules and game embedded simultaneous video modeling. *Education and Treatment of Children, 33*, 351–370.

Browder, D., Ahlgrim-Delzell, L., Spooner, F., Mims, P. J., & Baker, J. N. (2009). Using time delay to teach literacy to students with severe developmental disabilities. *Exceptional Children, 75*(3), 343–364.

**Bryan, L. C., & Gast, D. L. (2000). Teaching on-task and on-schedule behaviors to high-functioning children with autism via picture activity schedules. *Journal of Autism and Developmental Disorders, 30*, 553–567.

**Carlile, K. A., Reeve, S. A., Reeve, K. F., & DeBar, R. M. (2013). Using activity schedules on the iPod touch to teach leisure skills to children with autism. *Education and Treatment of Children, 36*(2), 33–57.

Chard, D. J., Ketterlin-Geller, L. R., Baker, S. K., Doabler, C., & Apichatabutra, C. (2009). Repeated reading interventions for students with learning disabilities: Status of the evidence. *Exceptional Children, 75*(3), 263–281.

**Cihak, D. F. (2011). Comparing pictorial and video modeling activity schedules during transitions for students with autism spectrum disorders. *Research in Autism Spectrum Disorders, 5*, 433–441.

Cook, B. G., Tankersley, M., & Landrum, T. J. (2009). Determining evidence-based practices in special education. *Exceptional Children, 75*, 365–383.

**Cuhadar, S., & Diken, I. H. (2011). Effectiveness of instruction performed through activity schedules on leisure skills of children with autism. *Education and Training in Autism and Developmental Disabilities, 46*(3), 386–398.

Dauphin, M., Kinney, E. M., & Stromer, R. (2004). Using video-enhanced activity schedules and matrix training to teach sociodramatic play to a child with autism. *Journal of Positive Behavior Interventions, 6*, 238–250.

**Dettmer, S., Simpson, R. L., Smith Myles, B., & Ganz, J. B. (2000). The use of visual supports to facilitate transitions of students with autism. *Focus on Autism and Other Developmental Disabilities, 15*(3), 163–169.

*Dooley, P., Wilczenski, F. L., Torem, C. (2001). Using an activity schedule to smooth school transitions. *Journal of Positive Behavior Interventions, 3*(1), 57–61.

**Duttlinger, C., Ayres, K. M., Bevill-Davis, A., & Douglas, K. H. (2013). The effects of a picture activity schedule for students with intellectual disability to complete a sequence of tasks following verbal directions. *Focus on Autism and Other Developmental Disabilities*, *28*(1), 32–43.

Gersten, R., Fuchs, L. S., Compton, D., Coyne, M., Greenwood, C., & Innocenti, M. S. (2005). Quality indicators for group experimental and quasi-experimental research in special education. *Exceptional Children, 71*(2), 149–164.

Gray, C. (1994). *Comic strip conversations: Colorful, illustrated interactions with students with autism and related disorders*. Arlington, TX: Future Horizons Inc.

*Hall, L. J., McClannahan, L. E., & Krantz, P. J. (1995). Promoting independence in integrated classrooms by teaching aides to use activity schedules and decreased prompts. *Education and Training in Mental Retardation and Developmental Disabilities, 30*, 208–217.

Hodgdon, L. A. (1999). *Solving behavior problems in Autism: Improving communication with visual strategies*. Troy, MI: Quirk Roberts Publishing.

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children, 71*, 165–179.

**Hume, K., & Odom, S. (2007). Effects of an individual work system on the independent functioning of students with Autism.

Journal of Autism and Developmental Disorders, 37, 1166–1180.

Individuals With Disabilities Education Improvement Act of 2004. (2004). Retrieved July 10, 2010, from http://idea.ed.gov.

*Krantz, P. J., MacDuff, M. T., & McClannahan, L. E. (1993). Programming participation in family activities for children with autism: Parents' use of photographic activity schedules. *Journal of Applied Behavior Analysis, 26*, 137–138.

Krantz, P. J., & McClannahan, L. E. (1998). Social interaction skills for children with autism: A script-fading procedure for beginning readers. *Journal of Applied Behavior Analysis, 31*, 191–202.

Kratochwill, T. R., Hitchcock, J. H., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., et al. (2013). Single-case intervention research design standards. *Remedial and Special Education, 34*, 26–38.

Kroupa, S. E. (2013). The TEACCH approach to working with individuals on the autism spectrum: understanding, educating, empowering. In D. Riva, S. Bulgheroni, & M. Zappella (Eds.), *Neurobiology, diagnosis and treatment of autism: An update* (pp. 107–119). Montrouge: John Libbey Eurotoxtext.

Lequia, J., Machalicek, W., & Rispoli, M. J. (2012). Effects of activity schedules on challenging behavior exhibited in children with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders, 6*, 480–492.

**MacDuff, G. S., Krantz, P. J., & McClannahan, L. E. (1993). Teaching children with autism to use photographic activity schedules: Maintenance and generalization of complex response chains. *Journal of Applied Behavior Analysis, 26*, 89–97.

*Machalicek, W., Shogren, K., Lang, R., Rispoli, M., O'Reilly, M. F., Hetlinger Franco, J., et al. (2009). Increasing play and decreasing the challenging behavior of children with autism during recess with activity schedules and task correspondence training. *Research in Autism Spectrum Disorders, 3*, 547–555.

*Massey, G. N., & Wheeler, J. J. (2000). Acquisition and generalization of activity schedules and their effects on task engagement in a young child with autism in an inclusive pre-school classroom. *Education and Training in Mental Retardation and Developmental Disabilities, 35*, 326–335.

**Mechling, L. C., Gast, D. L., & Seid, N. H. (2009). Using a personal digital assistant to increase independent task completion by students with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 39*, 1420–1434.

**Mechling, L. C., & Gustafson, M. R. (2008). Comparison of static picture and video prompting on the performance of cooking-related tasks by students with autism. *Journal of Special Education Technology, 23*(3), 31–45.

*Mechling, L. C., & Savidge, E. J. (2011). Using a personal digital assistant to increase completion of novel tasks and independent transitioning by students with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 41*, 687–704.

Mesibov, G., & Shea, V. (2011). The TEACCH program in the era of evidence-based practice. *Journal of Autism and Developmental Disorders, 40*, 570–579.

Mesibov, G., Shea, V., & Schopler, E. (2006). Foundations of the TEACCH structured teaching approach. In *The TEACCH approach to autism spectrum disorders* (pp. 33–49). New York, NY: Springer.

*Miguel, C. F., Yang, H. G., Finn, H. E., & Ahearn, W. H. (2009). Establishing derived textual control in activity schedules with children with autism. *Journal of Applied Behavior Analysis, 42*, 703–709.

**Morrison, R. S., Sainato, D. M., Benchaaban, D., & Endo, S. (2002). Increasing play skills of children with autism using activity schedules and correspondence training. *Journal of Early Intervention, 25*(1), 58–72.

National Autism Center. (2009). *The National Autism Center's national standards report*. Randolph, MA: National Autism Center.

National Professional Development Center on Autism Spectrum Disorders (NPDCASD). (2010). *Visual Supports: Evidence Base.* Retrieved from http://autismpdc.fpg.unc.edu/content/visual-supports.

Neumann, N., et al. (2011). Electromagnetic evidence of altered visual processing in autism. *Neuropsychologia, 49*, 3011–3017.

*Newman, B., Buffington, D. M., O'Grady, M. A., McDonald, M. E., Poulson, C. L., Hemmes, N. S. (1995). Self-management of schedule following in three teenagers with autism. *Behavioral Disorders, 20*(2), 190–196.

No Child Left Behind Act of 2001, Pub. L. No. 107-110, 115 Stat.1425 (2002). Retrieved from: http://www2.ed.gov/nclb/landing.jhtml.

*Pierce, K. L., & Schreibman, L. (1994). Teaching daily living skills to children with autism in unsupervised settings through pictorial self-management. *Journal of Applied Behavior Analysis, 27*, 471–481.

**Pierce, J. M., Spriggs, A. D., Gast, D. L., & Luscre, D. (2013). Effects of visual activity schedules on independent classroom transitions for students with autism. *International Journal of Disability, Development and Education, 60*, 253–269.

Quill, K. A. (1995). Visually cued instruction for children with autism and pervasive developmental disorder. *Focus on Autism and Other Developmental Disabilities, 10*(3), 10–20.

Reichow, B. (2011). Chapter 2: Development, procedures, and application of the evaluative method for determining evidence-based practices in autism. In B. Reichow, Doehring, P., Cicchetti, D. V., and F. Volkmar, (Eds.) *Evidence-based practices and treatments for children with Autism*. doi:10.1007/978-1-4419-6975-0_2.

Reichow, B., Volkmar, F., & Cicchetti, D. V. (2007/2008). Development of the evaluative method for evaluating and determining evidence-based practices in autism. *Journal of Autism and Developmental Disorders, 38*(7), 1311–1319. Epub 2007 Dec 18.

*Riffel, L. A., Wehmeyer, M. L., Turnbull, A. P., Lattimore, J., Davies, D., & Stock, S. (2005). Promoting independent performance of transition-related tasks using a palmtop PC-based self-directed visual and auditory prompting system. *Journal of Special Education Technology, 20*(2), 5–14.

Rogers, S. J., & Vismara, L. A. (2008). Evidence-based comprehensive treatments for early autism. *Journal of Clinical Child & Adolenscent Psychology, 37*(1), 8–38.

Roth, D. A., Muchnik, C., Shabtai, E., Hildesheimer, M., & Henkin, Y. (2012). Evidence for atypical auditory brainstem responses in young children with suspected autism spectrum disorders. *Developmental Medicine & Child Neurology*. Advanced online publication. doi:10.1111/j.1469-8749.2011.04149.x.

Schmit, J., Alper, S., Raschke, D., & Ryndak, D. (2000). Effects of using a photographic cueing package during routine school transitions with a child who has autism. *Mental Retardation, 38*, 131–137.

*Schneider, N., & Goldstein, H. (2010). Using social stories and visual schedules to improve socially appropriate behaviors in children with autism. *Journal of Positive Behavior Interventions, 12*(3), 149–160.

Schreibman, L., Whalen, C., & Stahmer, A. C. (2000). The use of video priming to reduce disruptive transition behavior in children with autism. *Journal of Positive Behavior Interventions, 2*(1), 3–11.

Scruggs, T. E., & Mastropieri, M. A. (1998). Summarizing single-subject research issues and applications. *Behavior Modification, 22*(3), 221–242.

Tankersley, M., Harjusola-Webb, S., & Landrum, T. J. (2008). Using single-subject research to establish the evidence base of special education. *Intervention in School and Clinic, 44*, 83–90.

Test, D. W., Richter, S., Knight, V., & Spooner, F. (2010). A comprehensive review and meta analysis of the social stories literature. *Focus on Autism and Other Developmental Disabilities, 26*, 49–62.

**Van Laarhoven, T., Kraus, E., Karpman, K., Nizzi, R., & Valentino, J. (2010). A comparison of picture and video prompts to teach daily living skills to individuals with autism. *Focus on Autism and Other Developmental Disabilities, 25*(4), 195–208.

*Van Laarhoven, T. & Van Laarhoven-Myers, T. (2006). Comparison of three video-based instructional procedures for teaching daily living skills to persons with developmental disabilities. *Education and Training in Developmental Disabilities, 41*, 365–381.

*Watanabe, M., & Sturmey, P. (2003). The effect of choice-making opportunities during activity schedules on task engagement of adults with autism. *Journal of Autism and Developmental Disorders, 33,* 535–538.

**Waters, M. B., Lerman, D. C. & Hovanetz, A. N. (2009). Separate and combined effects of visual schedules and extinction plus differential reinforcement on problem behavior occasioned by transitions. *Journal of Applied Behavior Analysis*, *42*, 309–313.

Wolery, M., Busick, M., Reichow, B., & Barton, E. (2008). Comparison of overlap methods for quantitatively synthesizing single-subject data. *The Journal of Special Education, 44*(1), 18–28.