J Dev Phys Disabil (2013) 25:493–503
DOI 10.1007/s10882-012-9325-x

A Video-Based Package to Teach a Child with Autism Spectrum Disorder to Write Her Name

Dennis W. Moore · Angelika Anderson · Francesca Treccase · Joanne Deppeler · Brett Furlonger · Robert Didden

Published online: 9 January 2013

Abstract The purpose of this study was to trial a procedure involving point-of-view video modeling, backward chaining and reinforcement to teach a child with ASD to write her name. Video modeling and reinforcement were used to teach letter writing, and backward chaining to produce the complete name. A multiple baseline across behaviors design treating each letter as a different behavior established the effectiveness of the procedure for teaching letter writing and generalization data suggest the efficacy of backward chaining in teaching production of her name. Treatment integrity was satisfactory and a post-intervention questionnaire indicated the intervention was acceptable to the participant's mother. These findings suggest that point-of-view video modeling in combination with backward chaining and reinforcement may be an effective tool for teaching new academic skills.

Keywords Autism · Backward chaining · Point-of-view video modeling · Reinforcement · Writing

Video modelling, a process of recording a model engaging in target behaviors for a viewer to imitate, is now recognized as an evidence-based practice for teaching children with Autism Spectrum Disorder (ASD) (Bellini and Akullian 2007). It has been shown to be effective for teaching skills such as social initiations (Litras et al.

Video scripts, DV scoring details, and the procedural checklist available on request.

D. W. Moore (✉) · A. Anderson · F. Treccase · J. Deppeler · B. Furlonger
Faculty of Education, Monash University, Melbourne, Victoria 3800, Australia
e-mail: dennis.moore@monash.edu

R. Didden
Radboud University, Nijmegen, The Netherlands

F. Treccase
Faculty of Health, Medicine, Nursing and Behavioural Sciences, Deakin University, Geelong, Victoria, Australia

2010; Nikopoulos and Keenan 2004), pretend play (Reagon et al. 2006), communication (Baharav and Darling 2008), perspective taking (Charlop-Christy and Daneshvar 2003), academic performance (Kinney et al. 2003) and functional skills (Rayner 2010). However video modeling alone is not always effective. The majority of reported studies to date include additional elements such as prompting and reinforcement.

Leblanc (2003) for example in assessing the use of a video self modeling procedure to teach perspective taking skills to children with ASD concluded that the target skills were acquired through the use of both VM and reinforcement. Kagohara et al. (2012) also successfully used VM to teach correct use of the spell-check function while word processing to two students with ASD. Positive reinforcement was given to participants in the form of verbal praise for their efforts. The authors concluded that the praise provided may have been a necessary component of the intervention. Shukla-Mehta et al. (2010) concluded that prompts and reinforcement should be incorporated in video modeling interventions.

Video modeling is thought to improve stimulus control, as it is able to selectively direct the child's attention to a particular element within a scene or image (McCoy and Hermansen 2007; Sturmey 2003). This increases the likelihood of accurate imitation, with less confusion as to which element of a scene is the focus of attention. Well-constructed videos that capture the child's attention, portray the task clearly with sufficient detail and provide multiple exemplars of the modeled behavior, and which include elements that aid retention are likely to be more effective that those videos that do not.

There are several types of video modeling including scene view video modeling (e.g., Nikopoulos and Keenan 2004; Kleeberger and Mirenda 2010), video self-modeling (e.g., Buggey 2005), and point-of-view video modeling (e.g., Hine and Wolery 2006). All have shown promise as an intervention for children with ASD. Point-of-view video modeling (POVM) involves filming from the perspective of the person who is the target of the intervention (Hine and Wolery 2006). It is a relatively novel approach, with little research available concerning its effectiveness. It possibly improves stimulus control through selectively directing the viewer's attention to specific elements within the image.

Backward chaining is the process of breaking a complex task into smaller steps, then teaching the last step in the chain first. It has proven successful in past research, including in teaching adults with intellectual disabilities to access age-appropriate websites (Jerome et al. 2007), and teaching self-help skills to individuals with autism (Matson et al. 1990; Sadlier et al. 1992).

Handwriting is a skill which is vital to school performance being a primary means for students to demonstrate their knowledge (Mercer and Mercer 1998). Consequently students with poor writing skills may be disadvantaged in classes that use written tasks as the main method of assessment. Handwriting has also been shown to be a pre-skill for reading and written composition, both of which are essential academic skills (Graham 2010). Church et al. (2000), and Myles et al. (2003) have shown that children with ASD may struggle with handwriting. Fuentes et al. (2009) found that, overall, the handwriting of children with ASD was worse than typically developing children due particularly to the quality of

their letter formation. Traditional remedial approaches such as tracing and in vivo modeling have demonstrated some success (Caletti et al. 2012) but clearly further research trialing alternative intervention procedures to improve the handwriting of children with ASD is warranted. To date there are no documented studies exploring the effectiveness of POVM on teaching handwriting to individuals with ASD.

The purpose of this study was to trial a procedure involving POVM, reinforcement and backward chaining to teach a child with ASD to write her name. POVM and reinforcement were used to teach each letter and backward chaining to produce the complete name.

Method

Participant and Setting

Kiera was 5 years and 5 months old on commencement of the study. Kiera was diagnosed with ASD (CARS=37; Schopler et al. 1988), and ADHD at age three years four months. Prior to this study an Occupational Therapist had spent six month trying to teach Kiera to write her name by requesting that she trace dotted-line letters. Kiera had learned the correct pencil grip, and could label each letter, but was unable to independently form any letter in *Kiera*. All sessions were conducted in the family living room. Prior to data collection approval for the study was obtained from the university ethical review committee and Kiera's parents signed a consent form. Due to the nature of the research, Kiera's parents consented to her first name being used in reporting the study.

Materials

Video content Each video began with an orienting voiceover, then showing two hands opening a book, picking up a pencil and writing the target letter, with vocal descriptions of the movement of the hand. In the first video, the first four letters were already completed, and the video only showed how to produce the letter *a*. In the second video, the first three letters were completed, and the video showed how to write *r* (new skill) and *a* (revision). This pattern continued until the final video depicted production of all letters.

Each video had the same structure: an introduction to the activity, three demonstrations of writing the letters, praise of the model after each demonstration together with a popular cartoon figure (with permission), upbeat audio excerpts, and applause. The voiceover then informed Kiera that it was her turn to write. The videos ranged from one to four minutes in length, depending on the number of letters demonstrated.

Five shorter versions, approximately 10 seconds long, were also produced to use as visual prompts if required. Each of these showed the target letter production once, with vocal descriptions.

A laminated chart, 10 Velcro-backed flower stickers, markers, and a range of mother-nominated preferred items and activities were used in the token economy.

Dependent Measures and Data Collection

The dependent measures were (i) production of each letter, and (ii) performance of the generalization probe task of writing her name. Each attempt at writing a letter was marked out of five, one mark each for: (a) recognizable letters, (b) correct execution, (c) correct components, (d) all components in the correct place, and (e) correct size. Kiera was asked to write the letter five times in each session yielding a maximum possible score of 25 for each letter. Letters produced under generalization conditions were scored out of four, correct execution being unmeasurable from inspection of the permanent product. The marking criteria for each letter are shown in Table 1.

The sessions were conducted by either the third author or Kiera's mother, using a procedural checklist to ensure treatment fidelity. Each session was video recorded. Kiera's mother was trained through an initial discussion of the procedural checklist and modeling the first five sessions.

POVM instruction occurred twice a day, typically four times a week. Sessions were initially 15 min long increasing to 20–25 min once the token economy was introduced (see below).

Inter-observer Agreement

Inter-observer agreement on both letter production and performance of the generalization probe task was assessed. The recording of each session meant that all sessions could be coded and scored by two observers noncontiguously. The third author was the primary observer, and an individual blind to experimental conditions served as the second observer. Inter-observer agreement was calculated for all sessions. A trial-by-trial inter-observer agreement figure was calculated for each letter Kiera attempted by dividing the number of items (or marks) that were agreed upon by the total number of items (or marks), and multiplying that number by 100 (Cooper et al. 2007). Inter-observer agreement was calculated for 100 % of the data, and 98.5 % agreement was found.

Design and Procedure

A multiple baseline across letters design established the effectiveness of POVM plus reinforcement in teaching letter formation. In addition videos were presented within a backward chaining procedure to teach the sequence of the letters to spell *Kiera.*

A writing book was designed to prompt the desired behaviors in each phase. In baseline each page had *Kiera* written five times, each with a blank (underscored) space or spaces in place of the letter being taught and those in revision. In the first intervention phase the book presented *Kiera* five times with the first four letters already completed and an underscored space where the letter *a* could be inserted. In the second intervention phase five copies of *Kiera* were presented with the first three letters completed and two underscored spaces at the end. By the fifth intervention phase the book presented five sets of underscored spaces in which to write the letters of her name.

Table 1 Marking criteria used for coding letter attempts

Criteria	K	i	e	r	a
Recognisable	Was given a mark if it could be recognised as a 'K', even if taken out of context. Recognisable also meant that it could not be mistaken for any other letter.	Was given a mark if it could be recognised as an 'i', even if taken out of context. Recognisable also meant that it could not be mistaken for any other letter.	Was given a mark if it could be recognised as an 'e', even if taken out of context. Recognisable also meant that it could not be mistaken for any other letter.	Was given a mark if it could be recognised as an 'r', even if taken out of context. Recognisable also meant that it could not be mistaken for any other letter.	Was given a mark if it could be recognised as an 'a', even if taken out of context. Recognisable also meant that it could not be mistaken for any other letter.
Executed correctly					
Consisted of the correct components (with no additional components)	Three straight lines.	One straight line and one dot.	One closed semi-circle and one curved line.	One straight line and one curved line (also accepted if line was only slightly curved).	One circle and one straight line.
Components positioned in the right place	One vertical straight line on the LHS, two other straight lines angled opposite ways on the RHS, both joined at the middle of the vertical line, one pointing up, one pointing down.	One vertical line with a dot above it.	One closed semi-circle at the top, with the curved line joined at the bottom LHS of the semi-circle, and finishing at the bottom RHS of the letter	One vertical straight line with a curved line (concave down) attached on the RHS and towards the top of the vertical line	One circle with a vertical straight line attached on the RHS.
Correct size	Within 7mm of the presented letters (or within 7mm of the average of the other written letters when no letters presented).	Within 4mm of the presented letters (or within 4mm of the average of the other written letters when no letters presented).	Within 4mm of the presented letters (or within 4mm of the average of the other written letters when no letters presented).	Within 4mm of the presented letters (or within 4mm of the average of the other written letters when no letters presented).	Within 4mm of the presented letters (or within 4mm of the average of the other written letters when no letters presented).

Note: *RHS*=Right hand side, *LHS*=Left hand side

Baseline Baseline measures for all letters were obtained by presenting Kiera with her name written five times each minus one letter. For example, baseline measurements for *r* involved presenting her with a page with *Kie_a* written five times. She was then asked which letter was missing, instructed to write it, and prompted verbally if she responded incorrectly or forgot which letter was missing. All attempts at letter formation were praised.

Intervention Kiera sat at her table and watched the appropriate video before being presented with her writing book opened to the correct page. Following unsuccessful attempts to construct the letter she was told "that was a good try, but let's watch again to see how we write that letter" and the prompt-video was shown. Initially, Kiera was

praised for all attempts at writing and allowed to choose a preferred sticker (previously identified by her mother as a reinforcer).

Token economy When task motivation was observed to be diminishing a token economy was introduced. Each session began with Kiera choosing one of three items to work towards. Together Kiera and the instructor drew the reinforcing item in a space on the laminated chart. Below this were 10 Velcro-lined boxes. Kiera received flowers for watching the video (2 per viewing), for writing the target letters correctly (1 each) and, on an increasingly intermittent basis, for production of previously mastered letters. When a chart was filled, she could access her chosen reinforcer. Earned flowers accumulated across sessions and if she filled the boxes before completing the five attempts in a session she could stop immediately. Her session score was then prorated (total score/number of attempts, x 25). The token economy was also incorporated into the concurrent baseline sessions from this point.

Follow-up Follow-up data were gathered one week after conclusion of the intervention. Kiera was given a blank page with five underscored spaces and asked to write her name. She was not shown the video during this session.

Generalization probes Before introduction of each new letter, Kiera was asked to write her full name on a blank page without underscoring prompts and no vocal prompting was provided. On completion she was praised for effort, regardless of quality.

Social Validity

Social validity was assessed through an interview with Kiera's mother, using a purpose-made brief questionnaire with six open-ended statements (e.g., 'in your opinion, were the procedures used acceptable and/or ethical?' and space for unsolicited comments. The questionnaire addressed the three aspects of social validity identified by Wolf (1978): the social significance of the goals, the social appropriateness of the procedures, and the importance of the outcomes.

Results and Discussion

Figure 1 shows Kiera's performance of each letter over time and condition, expressed as a score out of 25 (left axis) together with the generalization probe data on a four point scale (right axis).

Baselines for the letters *a, r,* and *e*, were low and stable. Attempts on these letters were never recognizable, executed correctly, or with components in the right place. The letter *i* received relatively high baseline scores, being recognizable, containing the correct components in the right place but incorrect in size and execution. Baseline scores for *K* were also relatively high but variable.

Introduction of the intervention led to an immediate improvement of writing performance in each case. A performance decrement from Sessions 12 to 20 (letters

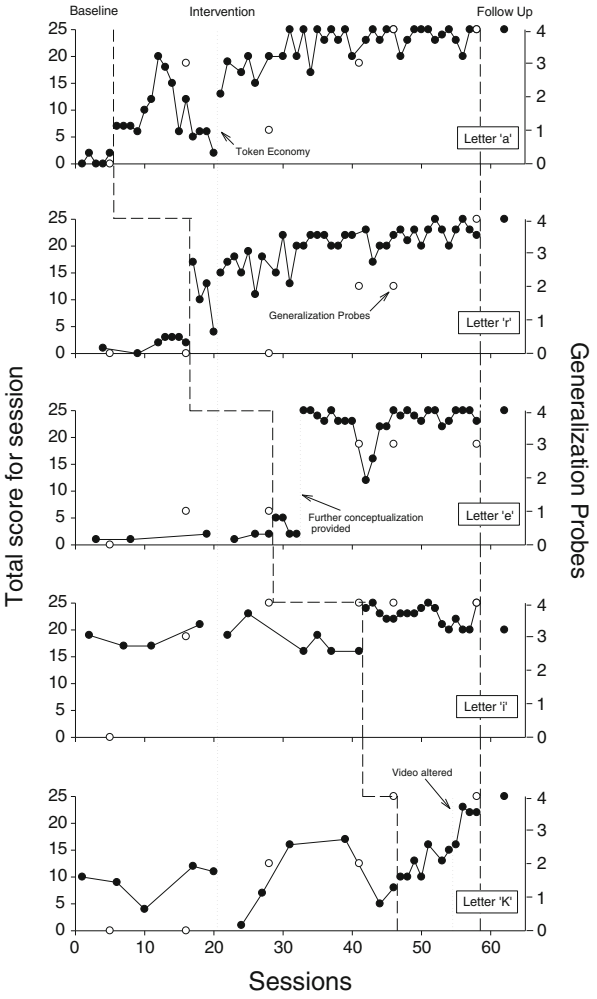

Fig. 1 Total letter scores and generalization probe scores over time

'a' and 'r') led to the introduction of a token economy in Session 21. This was associated with a steady increase in performance of letters already in intervention while no change in the baseline levels of performance in the other letters was observed.

Introduction of the intervention to the letter 'e' saw an initial small improvement before returning to baseline levels. To this point Kiera's attempts were rewarded. At the start of Session 33, the instructor told Kiera that from now on only '*e'* as seen on the video would be rewarded. Following this, Kiera produced a much improved *e*.

The change in letter formation in each successive intervention had no apparent effect on those letters still in baseline. One exception was the introduction of the *r* intervention was associated with a single high baseline score for *i* (23) followed by a decrease in baseline scores. Kiera imitated both the initial downward movement modelled in the *r* video and the next step of the *r* execution to *i*; she started at the

top, drew down, and then *back up* before dotting the *i*. The introduction of the *i* intervention video remedied this error.

Upon the introduction of the *K* intervention, Kiera's performance showed only gradual improvement. After seven intervention sessions the video was modified to further elaborate upon the production of *K*. A section was inserted that explained the *K* in terms of "a big straight line, and two big crocodile jaws". Kiera's performance increased in the following session, and remained high over subsequent sessions.

Results from one-week follow-up indicated that the skills Kiera learned maintained over time with ceiling scores for four of five letters.

Letter formation generalization probes (sampled from her attempts at writing her name without prompts or other scaffolds) are summarized in Fig. 1 and also presented in Fig. 2. Clear improvements from baseline levels are evident with all letters. Probes 3 to 5 reveal increasingly recognizable approximations to her full name except for Probe 3 where, having just completed a series of sessions on how to write the letter *r*, *r* was omitted. Improvements in all letters are evident, including those not yet taught in the POVM sessions. Overall there were improvements in a number of dimensions of the task of writing the name *Kiera* including letter sequencing, alignment and letter size.

At the conclusion of all phases of the intervention (Probe 6) Kiera could write her name fluently, legibly and seemingly effortlessly when requested. She was observed to write it spontaneously on occasion, once on an art piece she produced while waiting for a session to begin.

During the social validity interview Kiera's mother indicated that she believed the procedures used were acceptable and ethical suggesting the social appropriateness of the procedures. She stated that the outcome of the study was important in that Kiera's ability to write her name had increased greatly, that this improvement was worth the time and effort involved, and she also supported the goals of the intervention as significant in that being able to write her name was likely to result in increased reinforcement in the future for Kiera.

This study contributes to the literature by showing for the first time how a procedure involving POVM, reinforcement and backward chaining can be used as an alternative to tracing-based procedures (Caletti et al. 2012) to teach a child with ASD to write her name. POVM and reinforcement were used to teach each letter and backward chaining to produce the complete name. The study also illustrates how the effectiveness of video modeling can be affected by additional factors, both within and external to the modeling video. POVM was partially successful in teaching Kiera how to form the letters of her name though only with the addition of effective reinforcement to maintain performance. Thus, for acquiring new academic/motor skills such as letter formation which require repeated practice to achieve mastery, explicit reinforcement may be required.

In two cases additional explanation (external to the video in the case of the letter *e*, and built into the revised video for *K*) was required to achieve mastery. The elaborations on the letter *e* and the crocodile analogy for the letter *K* appeared to aid discrimination and fine motor reproduction processes required for accurate performance. Further research on the critical elements of the video model is warranted.

Not only did Kiera learn how to write each of the letters of her name, she also learned how to write these in the correct sequence to produce her name. Backward chaining may have served to teach the correct sequencing of letters.

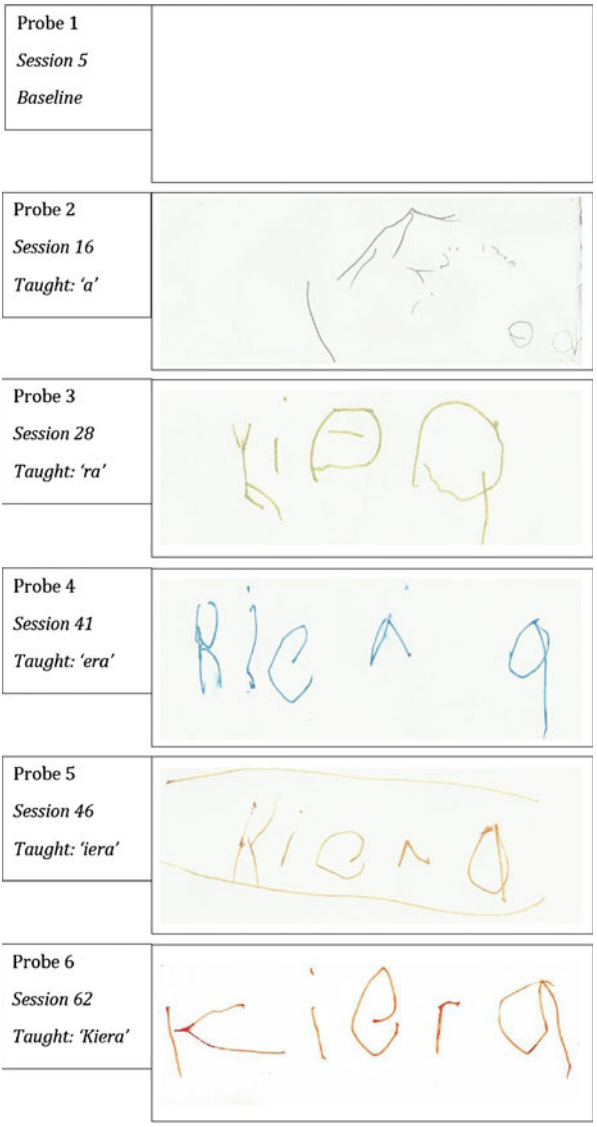

Fig. 2 Generalization probes; Kiera's attempts to write her name at six different points in time

Though successful for Kiera, this study has a number of limitations. The effects of the chaining procedure were not examined experimentally. This, together with investigating possible differential effects of backward and forward chaining, or whole word training, on the acquisition of the complete name deserves further exploration. A further limitation was the need to change some of the procedures during the course of the study thereby reducing the number of clear replications of the experimental effect. Effortful tasks such as handwriting, which are unlikely to come into contact with immediate natural reinforcement, may require powerful reinforcers that are likely to stay effective over extended periods of time.

While it is clear that these findings provide some support for point-of-view modeling in conjunction with backward chaining as a viable and effective intervention, further research identifying the significant elements - both within the video and within the broader learning environment - is warranted. For example, are videos more effective if they include voice-overs, and is there a difference in effectiveness between backward and forward chaining methods?

For practitioners this study illustrates a potentially promising alternative or complimentary approach to teaching handwriting skills to this population capitalising on the many advantages that VM has over in vivo modelling. In this case Kiera failed to acquire the skill of writing her name via a conventional 'tracing dotted lines' approach to the extent that during the baseline generalisation probe Kiera did not even approach the task and made no mark on the paper. The video-modeling intervention however was entirely successful. Even after having been taught only the first letter Kiera attempted to write her name during the generalisation probe. This suggests that this approach might address motivational issues associated with this skill.

References

Baharav, E., & Darling, R. (2008). Case report: Using an auditory trainer with caregiver video modeling to enhance communication and socialization behaviors in autism. *Journal of Autism and Developmental Disorders, 38*, 771–775. doi:10.1007/s10803-007-0429-6.

Bellini, S., & Akullian, J. (2007). A meta-analysis of video modeling and video self-modeling interventions for children and adolescents with autism spectrum disorders. *Exceptional Children, 73*, 264–287. doi:10.1177/074193250702800304 01DOI:10.1177%2F074193250702800304 01.

Buggey, T. (2005). Video self-modeling applications with students with autism spectrum disorder in a small private school setting. *Focus on Autism and Other Developmental Disabilities, 20*, 52–63. doi:10.1177/10883576050200010501.

Caletti, E., McLaughlin, T. F., Derby, K. M., & Rinaldi, L. (2012). The effects of using visual prompts, tracing, and consequences to teach two young preschool students with disabilities to write their names. *Academic Research International, 2*(3), 265–270.

Charlop-Christy, M. H., & Daneshvar, S. (2003). Using video modeling to teach perspective taking to children with autism. *Journal of Positive Behavior Interventions, 5*, 12–21. doi:10.1177/10983007030050010101.

Church, C., Alisanki, S., & Amanullah, S. (2000). The social, behavioural, and academic experiences of children with Asperger syndrome. *Focus on Autism and Other Developmental Disabilities, 15*, 12–20. doi:10.1177/108835760001500102DOI:10.1177%2F108835760001500102.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied Behavior Analysis* (2nd ed.). New Jersey: Pearson.

Fuentes, C. J., Mostofsky, S. H., & Bastian, A. J. (2009). Children with autism show specific handwriting impairments. *Neurology, 73*(19), 1532–1537. doi:10.1212/WNL.0b013e3181c0d48c DOI:10.1212%2FWNL.0b013e3181c0d48c.

Graham, S. (2010). Want to improve children's writing? don't neglect their handwriting. *Education Digest: Essential Readings Condensed for Quick Review, 76*(1), 49–55.

Hine, J. F., & Wolery, M. (2006). Using point-of-view video modeling to teach play to preschoolers with autism. *Topics in Early Childhood Special Education, 26*, 83–93. doi:10.1177/02711214060260020301.

Jerome, J., Frantino, E. P., & Sturmey, P. (2007). The effects of errorless learning and backward chaining on the acquisition of internet skills in adults with developmental disabilities. *Journal of Applied Behavior Analysis, 40*, 185–189. doi:10.1901/jaba.2007.41-06.

Kagohara, D. M., Sigafoos, J., Achmadi, D., O'Reilly, M., & Lancioni, G. (2012). Teaching children with autism spectrum disorders to check the spelling of words. *Research in Autism Spectrum Disorders, 33*, 1658–1669. doi:10.1016/j.rasd.2011.05.012DOI:10.1016%2Fj.rasd.2011.05.012.

Kinney, E. M., Vedora, J., & Stromer, R. (2003). Computer-presented video models to teach generative spelling to a child with an autism spectrum disorder. *Journal of Positive Behavior Interventions, 5*, 22–29. doi:10.1177/10983007030050010301.

Kleeberger, V., & Mirenda, P. (2010). Teaching generalized imitation skills to a preschooler with autism using video modeling. *Journal of Positive Behavior Interventions, 12*, 116–127. doi:10.1177/1098300708329279.

LeBlanc, L. A. (2003). Using video modeling and reinforcement to teach perspective-taking skills to children with autism. *Journal of Applied Behavior Analysis, 26*, 253–257. doi:10.1901/jaba.2003.36-253DOI:10.1901%2Fjaba.2003.36-253.

Litras, S., Moore, D. W., & Anderson, A. (2010). Using Video Self-Modelled Social Stories to teach social skills to a young child with autism. *Autism Research and Treatment,* Volume 2010, Article ID 834979, 9 pages. doi:10.1155/2010/834979

Matson, J. L., Taras, M. E., Sevin, J. A., Love, S. R., & Fridley, D. (1990). Teaching self-help skills to autistic and mentally retarded children. *Research in Developmental Disabilities*. doi:10.1016/0891-4222(90)90023-2DOI:10.1016/0891-4222%2890%2990023-2.

McCoy, K., & Hermansen, E. (2007). Video modeling for individuals with autism: a review of model types and effects. *Education and Treatment of Children, 30*, 183–213. doi:10.1353/etc.2007.0029.

Mercer, C. D., & Mercer, A. R. (1998). *Teaching students with learning problems*. Upper Saddle River, NJ: Prentice Hall.

Myles, B. S., Huggins, A., Rome-Lake, M., Hagiwara, T., Barnhill, G. P., & Griswold, D. E. (2003). Written profiles of children and youth with Asperger syndrome: From research to practice. *Education and Training in Developmental Disabilities, 38*, 362–369.

Nikopoulos, C. K., & Keenan, M. (2004). Effects of video modeling on social initiations by children with autism. *Journal of Applied Behavior Analysis, 37*, 93–96. doi:10.1901/jaba.2004.37-93.

Rayner, C. S. (2010). Video-modelling to improve task completion in a child with autism. *Developmental Neurorehabilitation, 13*, 225–230. doi:10.3109/17518421003801489.

Reagon, K. A., Higbee, T. S., & Endicott, K. (2006). Teaching pretend play skills to a student with autism using video modeling with a sibling as model and play partner. *Education and Treatment of Children, 29*, 517–528.

Sadlier, J., Dixon, R. S., & Moore, D. W. (1992). Use of a changing criterion procedure incorporating backward chaining to teach an autistic youth to tie shoe laces. *Australasian Journal of Special Education, 15*, 14–16. doi:10.1080/1030011920150103.

Schopler, E., Reichler, R. J., & Rochen Renner, B. (1988). *The childhood autism rating scale (CARS) for diagnostic screening and classification of autism*. Los Angeles: Western Psychological Services.

Shukla-Mehta, S., Miller, T., & Callahan, K. J. (2010). Evaluating the effectiveness of video instruction on social and communication skills training for children with autism spectrum disorders: A review of the literature. *Focus on Autism and Other Developmental Disabilities*. doi:10.1177/1088357609352901.

Sturmey, P. (2003). Video technology and persons with autism and other developmental disabilities: an emerging technology for PBS. *Journal of Positive Behavior Interventions, 5*, 3–4. doi:10.1177/10983007030050010401.

Wolf, M. M. (1978). Social validity: the case for subjective measurement or how applied behavior analysis is finding its heart. *Journal of Applied Behavior Analysis*. doi:10.1901/jaba.1978.11-203.