Computer-Based Video Self-Modeling to Teach Receptive Understanding of Prepositions by Students with Intellectual Disabilities

Linda C. Mechling and Jenny R. Hunnicutt
University of North Carolina Wilmington

Abstract: This investigation examined the effects of computer-based video self-modeling on the receptive understanding of six prepositions by three students with a diagnosis of moderate intellectual disabilities. Using a multiple probe design across three sets of prepositions, video captions were paired with photographs on the computer in order to simulate and teach prepositional concepts. When students selected a target photograph on the computer screen, the corresponding self-modeling video segment was activated. Results indicate an increase in the number of photographs correctly selected with the computer-based program and that students were able to generalize receptive understanding of concepts to the activities “positioning self” and “positioning objects” measured during probe conditions. Implications are discussed with respect to teaching generalized use of specific language concepts using computer-based video instruction.

Teaching language and communication skills is an important component of most curriculums for students with disabilities (Bufkin & Altman, 1999; Stephenson & Dowrick, 2000) and considered essential for daily social and learning activities (Snell & Brown, 2006). Included in language skill instruction is the teaching of concepts such as object and picture labeling, vocabulary (word meanings), and action words. Additionally, language instruction includes teaching more abstract concepts such as prepositional relationships, pronouns, and adjectives. Functional use of each of these skills includes both the expressive and receptive understanding of concepts in everyday life. Traditionally, when teaching concepts such as prepositions, verbs, or object labels, students are presented with a verbal direction, “What is this?”, “What is he doing?” or “Where is the ____?” paired with the object or picture and a response prompting procedure (i.e. constant time delay, prompt and fade). Students have been taught in this manner to spontaneously label objects and pictures (Handleman, Powers, & Harris, 1984; Reagon, Higbee, & Endicott, 2006), label actions and verbs (Johnson, Knowlton, Adams, & Swall, 1992; Stephens, & Ludy, 1975), and expressively describe the prepositional location of objects (King, Moors, & Fabrizio, 2003; Konstantareas, 1984; McGee, Krantz, & McClannahan, 1985; Mitchell, Evans, & Bernard, 1978; Sailor & Taman, 1972). In addition to expressive labeling, measures of receptive understanding of concepts such as prepositions, has traditionally required the student to place objects in a particular position such as “in the box” (Alberto, Jobes, Sizemore, & Doran, 1980; Egel, Shafer, & Neef, 1984; Frisch & Schumaker, 1974; King et al.; Summers, Rincover, & Feldman, 1993). Receptive instruction of prepositions has also included “positioning self” whereby the student is instructed to place himself in a specific location in relation to an object (Egel et al.; King et al.) or requiring the student to point to pictures representing target stimuli (i.e., from an array of four, touch the picture “under the table”) (Coleman & Anderson, 1979).

Correspondence concerning this article should be addressed to Linda Mechling, University of North Carolina Wilmington, Department of Education of Young Children and Special Education, 601 S. College Road, Wilmington, NC 28404-5940.
dures for teaching language concepts such as prepositions. One form of technology-based instruction is the use of video technology. To date, video technology to teach language and communication skills, has primarily been used in the form of video models and video self-models. With video modeling the student observes another adult, sibling, and/or peer engaging in a skill and is later required to perform the skill. Communication skills taught with video modeling have included social initiations during play (Nikopoulos & Keenan, 2003; 2004) and conversational speech related to toys (Charlop & Milstein, 1989; Taylor, Levin, & Jasper, 1999). In an interesting comparison, Charlop-Christy, Le, and Freeman (2000) found that video modeling led to faster acquisition of tasks (including expressive labeling of emotions, spontaneous greetings, and conversational speech) than use of live (in vivo) models. When using video self-modeling the target child or adult serves as the model in the video. Videos are created by: a) editing out prompts provided by adults; c) editing out student errors made during taping; or c) only showing best case performances of a skill by the student on the video (Dowrick, 1999). Conversation skills (Sherer et al., 2001); spontaneous requesting (Wert, & Neisworth, 2003); verbal social interactions (Buggey, 2005; and verbal responses to questions (Buggey, Toombs, Gardener, & Cervetti, 1999) have all been successfully taught to students with autism using video self-modeling.

While shown to have positive results, the majority of the studies to date evaluating video technology to teach communication and language to students with disabilities have focused on social communication skills rather than specific language concepts (Ayres & Langone, 2005; Bellini & Akullian, 2007; Delano, 2007; Hitchcock, Dowrick, & Prater, 2003; McCoy & Hermansen, 2007; Meharg & Woltersdorf, 1990). Of those studies teaching a specific language concept through video technology, Reagon et al. (2007) taught object labeling to three preschoolers diagnosed with autism by presenting photographs, text, and verbal prompts on DVDs. Although DVDs were created and presented on a DVD player it does not appear that the study incorporated the features of animation and motion commonly used with video-based instruction. Like-wise, Moore and Calvert (2000) taught receptive recognition of noun labels using pictures presented on flash cards or still pictures presented on a computer software program. Animation and sound were used for reinforcement, but not for the actual representation of the concepts. Interestingly, the study found that the children with autism were more attentive, showed greater motivation to complete tasks, and acquired more vocabulary using the computer based program than teacher delivered instruction. In contrast to these two studies, Mechling and Langone (2000) used a computer-based program to present video captions paired with still photographs to teach photograph recognition to represent communication related concepts to two students with severe intellectual disabilities.

While it is recognized that use of real materials in real-life situations is an effective means for teaching language concepts (i.e., prepositions) to students with disabilities, creating video-based instruction may provide an interesting medium for delivering instruction to students in a controlled environment with repeated practice and limited distractions. For example, placing a block “in” or “under” a box (traditional method) may hold less motivational appeal when compared to a video segment of a dog barking while sitting “in” a dog house or a familiar peer crawling “under” a table while being chased by another peer. The alternative method of “positioning self” may also pose distracting difficulties when trying to manage students going “under” tables and returning to their seats in a timely manner. In contrast, students may interact repeatedly with a video based program by selecting photographs on the screen and watching the related action or concept being modeled in real-life fashion. Such programs may further remove irrelevant stimuli that may be distracting to the student (Charlop-Christy et al., 2000) and can zoom in on salient features (i.e., dog in a dog house) thus reducing attention to stimuli irrelevant to the task (Charlop-Christy et al.; Shipley-Benamou, Lutzker, & Taubman, 2002).

Video-based instruction may further provide multiple teaching examples that may not be available in the classroom. While research supports the use of multiple exemplars to promote stimulus and response generalization...
across untaught environments, materials, and persons (Chadsey-Rusch & Halle, 1992; Hughes, 1992; Hupp, 1986), teachers may find themselves limited to a table and chair when teaching the concept “under” or jumping on a trampoline when teaching the concept “up.” Video technology provides a near endless supply of teaching examples taken from real-life examples (i.e., local fireman “up” on a ladder).

The purpose of the current study was to evaluate computer-based video self-modeling and constant time delay as an instructional procedure for teaching prepositional concepts to students with a diagnosis of moderate intellectual disabilities. The investigation addressed two research questions: (1) Would computer-based video self-modeling be effective in teaching students to receptively identify pictures corresponding to prepositional concepts?; and (2) Would students generalize receptive use of prepositions to untaught materials, settings, and response topographies as measured by: (a) positioning self and; (b) positioning objects?

Method

Participants

Three students, one boy and two girls ages 7 to 8 years with a diagnosis of moderate intellectual disability, participated in the study. The students were selected based on their ages; identified Individualized Educational Program (IEP) objectives in the area of language development; diagnosis; and entry level skills. Entry level skills included: (a) visual ability to see photographs and video captions on the computer screen; (b) fine motor ability to touch the computer screen and to place small objects in various locations on a table; (c) gross motor ability to position self in relation to objects in the classroom; (d) ability to imitate a video model; and (e) attention to task for 10 minutes. All students attended a self-contained elementary classroom for students with moderate intellectual disabilities. Each had received computer assisted instruction and it was reported that each enjoyed working on the computer, an interactive whiteboard, and watching videos.

Andrea was an 8 year, 11 month old female diagnosed with a moderate intellectual disability (IQ 50 Wechsler Intelligence Scale for Children – Third edition: Wechsler, 1991) and cerebral palsy. Her composite score on the Vineland Adaptive Behavior Scale (Sparrow, Balla, & Cicchetti, 1984) was 60. She was delivered by C-section at birth, had breathing problems, and experienced a decline in skills at the age of 6-months. Her vision and hearing were within normal limits and she received speech, occupational, and physical therapies. Her gait was unsteady, however, she could walk, run, and swing with good leg pumping. Her fine motor skills were significantly impaired making it difficult for her to complete tasks such as writing letters or copying shapes. She demonstrated a right hand preference, but occasionally switched hands if not monitored. She was able to cut across paper, but needed assistance for rotating paper. She was also able to isolate her index finger for keyboarding.

Andrea demonstrated significant difficulties with speech production with weaknesses in oral motor skills. She had severe verbal apraxia characterized by Voicing Errors (i.e., /b/ for /p/), Final Consonant Deletion (i.e., /do/ for /dog/), Cluster Reduction (i.e., /soon/ for /spoon/) and Fronting (i.e., /tey/ for /key/) which most often appeared when producing words within phrases. She could identify 11 letter sounds and 7 sight words and followed along with a story being read while needing visual picture prompts to answer comprehension questions. She could rote count to 20 with verbal prompts for the teens and recognized numerals to 10. She counted objects with assistance with pointing to objects as she counted. Behaviorally, she was described as cooperative and enjoyed attention of both adults and peers. She greeted others, offered high-five’s and expressed wants and needs by saying such things as “my turn.” She struggled with personal space issues and demonstrated some aggression towards certain peers. Her teachers reported her as sometimes being stubborn and she used visual cues such as photographs to assist with compliance and understanding of tasks. She also demonstrated anxiety and possible panic attacks (facial expressions of panic, heart racing, and trembling) and unusual responses to sounds and places she once liked (i.e., favorite restau-
rant she later tried to escape from) and environments such as public and busy places (i.e., grocery store, shopping center). At school she refused to enter the cafeteria at times and was observed covering her ears even when no noticeably unusual sound was present. Her watch was identified as a treasured possession and used for behavior reinforcement. She wore pull-ups and went to the restroom on a regular schedule. She undressed herself, but needed assistance with zipping and buttoning her pants. She also needed prompts to wash and dry her hands. She was semi-independent with lunchroom skills and could open her milk carton and utensil package.

Andrea’s needs included identifying numerals above 10, rote counting to 30, counting up to 10 objects, understanding one-to-one correspondence, and increasing letter sound and sight word recognition. She was working on describing words, pairing adjectives and nouns in her speech, and use of descriptive words to describe items. Her communication needs also included combining words into phrases and short sentences, imitation of speech sounds and syllables, and imitation of familiar one and two syllable words. Her needs also included cutting within 1.5” line, writing letters of her first name, jumping down from a 15” height, remaining in assigned areas within the classroom, and following verbal directions with no more than two verbal prompts.

Vanessa was an 8 year, 2 month old female diagnosed with a moderate intellectual disability [IQ 49 Leiter International Performance Scale-Revised (Leiter-R): Roid & Miller, 1997] and her composite score on the Adaptive Behavior Evaluation Scale - Second Edition (ABES-R2; McCarney & Arthaud, 2006) was 42. At the time of birth she experienced persistent pulmonary hypotension that resulted in brain damage on the left side. She was diagnosed with hydrocephaly at 15 months, and was currently equipped with her fourth shunt. She had mild hypotonicity globally. Her vision and hearing were within normal limits and she received speech, occupational, and physical therapies. Gross motor skills indicated no delays and she was able to trace all letters independently, write the first letter of her name independently, and cut with children’s scissors. She demonstrated a nasal voice, spoke combining words into simple phrases, used some plurals, and named verbs, but did not use correct grammar or complete sentences. She was able to read and match sight words, knew 13 letter sounds, could follow words in text by pointing as the story was read, and rote count to 15. Behaviorally, Vanessa was characterized as attention-seeking, defiant, easily distracted and off-task. She occasionally used profanity against peers and teachers, but was described as being very social and expressed a desire to talk with others by saying “Me?” or “Play with me?” She also exhibited a short attention span which caused her to quickly ask to do something different. She was able to use the restroom independently, but needed assistance buttoning her pants.

Vanessa’s needs included improvement on functional reading skills (including reading sight words upon request), saying letter sounds, answering literal questions about a story, writing her first name, and completing a sentence by filling in the blank with a sight word. Her functional academic needs further included rote counting to 30, counting up to 10 objects using 1:1 correspondence, and identifying numerals in random order up to fifteen. She needed to continue to work on understanding the concept of categories, positional words, and the appropriate use of “ing” endings to describe actions. Her needs also included demonstration of appropriate school/classroom behaviors including remaining seated for up to fifteen minutes and independently following directions upon the first request.

Jeremy was a 7 year, 11 month old male diagnosed with a moderate intellectual disability (IQ 46 Wechsler Intelligence Scale for Children – Third edition: Wechsler, 2001) and his composite score on the Vineland Adaptive Behavior Scale (Sparrow et al., 1984) was 48. He was born prematurely at 22 weeks gestation and he had a shunt, history of seizures, and hydrocephaly. His vision and hearing were within normal limits and he received speech, occupational, and physical therapies. He had low muscle tone throughout his trunk and exhibited a weaker right side with hypertonia in his right upper extremity. When walking he reduced the amount of stance on his weaker right side. He ascended stairs with a
railing and was working on ascending stairs using a mature step-over-step pattern while holding the left railing. He required verbal encouragement for all playground activities and those which occurred on uneven terrain. He preferred to have his left hand held when walking. His right elbow and wrist remained in a flexed and abducted posture. His right hand was generally fisted with an indwelling thumb. He wore a left ankle foot orthotic and a thumb abductor with a wrist support brace which assisted with his thumb to digit grasp. He was unable to consistently grasp and release objects, but could open his hand in order to try to grossly grasp an item such as the edge of the table. He wrote his first name using his left hand and required minimal cues to stay within boundaries.

Jeremy was verbal and his speech was intelligible although he omitted verbs, prepositions and articles in his sentences and did not use regular plurals or past tense. He initiated conversations with others and formulated multiple word sentences, but sentences were often incomplete. He also exhibited some letter sound substitutions. Academically, he knew 14 letter sounds, was able to sound out three letter words, could recognize 9 sight words, and could answer comprehension questions after a passage was read to him. He identified numerals to 30, rote counted to 30, counted up to 12 objects, and could complete an AB pattern. Behaviorally he was described as inattentive, had difficulty following directions, and was easily distracted. He also perseverated on some topics of conversation and would repeatedly ask questions such as, “why?” and “then what?” He was also described as being a joy to have in class, sweet, kind and respectful. He also remembered names of everyone he met and was highly interested in knowing what everyone was doing. He used the restroom independently, but needed reminders to pull up his pants in the back. He also needed assistance with snapping, buttoning, and zipping. He washed his hands independently, but was learning to dry them. His other needs included: categorization, learning basic concepts and prepositions, answering “when” questions, articulating appropriate sounds in single words and short phrases, and using pronouns in speech. He was also working on ascending three steps while holding a railing with his left hand and using a step-over-step pattern. His academic needs included rote counting to 50, identification of numerals to 50, counting objects to 20, reading sentences containing sight words, filling in the blanks of sentences with sight words and sounding out words using phonemic awareness.

Setting and Instructional Arrangement

All computer-based video self-modeling sessions were conducted in the classroom at a small table sectioned off behind a series of dividers and screens. The student sat directly in front of the laptop and the instructor sat to the right of the student. The reliability data collector sat behind and to the left of the student when present. Video recordings were also made for reliability data collection purposes and the camera was positioned on a tripod behind the student when used.

During “positioning of objects” generalization probe sessions the materials were placed on the same table within the classroom area used during intervention and the student, instructor, and reliability data collector were positioned identically to that of the intervention. Generalization “positioning of self” probe sessions were held in the sectioned off area of the classroom used during intervention, the hallway outside of the classroom, and outdoors in a paved courtyard area.

Prepositions, Materials, and Equipment

Three pairs of prepositions (6 total) were taught to each student using computer-based video self-modeling and three different exemplars were used to teach each preposition (Hupp, 1986). Students had not shown mastery or understanding of the prepositions during screenings prior to the study. The three pairs of prepositions were: (a) on/under, (b) in/next to, and (c) in front of/behind (McGee et al., 1985). Table 1 shows each preposition and photograph exemplars used during placement of objects and self during generalization sessions. Three different photographs of the target student demonstrating the preposition and three different video self-modeling recordings were made for
each of the six target prepositions for use during photograph probe sessions and computer-based video self-modeling (Table 1). Photographs and video recordings were made using a Sony 800x digital video camera. Photographs were downloaded onto a Dell Latitude 300 laptop computer from the camera’s MemoryStick using the USB port. Video self-models were created by editing out teacher prompts for placing or directing students to the correct position representing each preposition. While the student was engaged in the correct position, a still photograph was also taken. Video streaming features of the camera allowed downloading of video to the computer using the same USB port. Video recordings were then edited using Windows Movie Maker and saved onto the laptop computer. The instructional programs were created using the software program PowerPoint (Microsoft). Three 3in x 3in color photographs (one target and two distractors) were placed in a horizontal row across the bottom of a slide. Students selected photographs on the computer screen by touching a Magic Touch touch screen (Keytec, Inc). The PowerPoint program was programmed to advance to the next slide “on a click” when a student touched a target (correct) photograph. The target photograph was hyperlinked to a slide which automatically played the corresponding digital video recording. The program remained on the photograph slide until the student touched the correct photograph. Video recordings corresponding to the target photograph played approximately 5 seconds and then stopped and the program automatically advanced to the next slide containing three photographs.

Response Definitions and Data Collection

During generalization probe sessions students were asked to place an object or themselves in one of 6 positions (on, under, in, next to, in front of, and behind) when presented with a task direction such as, “Put the cake on the table.” Student responses were recorded as: (a) correct – student initiated the behavior within 3s of the task direction and placed object or self in correct position within 5s; (b) incorrect – student failed to initiate the behavior within 3s of presentation of the task direction (latency error); (c) incorrect - student failed to place object or self in the correct position within 5s of the task direction (duration error); or (d) incorrect – student placed object or self in an incorrect position (topography error). Correct placement of objects and self was defined as placing the item within .5in. of the target position for objects and 4in. for self.

### TABLE 1

Exemplars used for teaching prepositions during CBVI and for measuring generalization of skills.

<table>
<thead>
<tr>
<th>CBVI</th>
<th>Generalization Positioning Self</th>
<th>Generalization Positioning Objects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On/under</strong></td>
<td>Beach towel</td>
<td>Beach towel</td>
</tr>
<tr>
<td></td>
<td>Table</td>
<td>Table</td>
</tr>
<tr>
<td></td>
<td>Bean bag chair</td>
<td>Bean bag chair</td>
</tr>
<tr>
<td><strong>In/next to</strong></td>
<td>Laundry basket</td>
<td>Laundry basket</td>
</tr>
<tr>
<td></td>
<td>Tunnel</td>
<td>Tunnel</td>
</tr>
<tr>
<td></td>
<td>Wagon</td>
<td>Wagon</td>
</tr>
<tr>
<td><strong>In front of/ Behind</strong></td>
<td>Rocking chair</td>
<td>Rocking chair</td>
</tr>
<tr>
<td></td>
<td>Three sided screen</td>
<td>Three sided screen</td>
</tr>
<tr>
<td></td>
<td>Crate</td>
<td>Crate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Novel example: Large box</td>
</tr>
</tbody>
</table>

Novel example: Beach mat, Table, Bean bag chair, Laundry basket, Tunnel, Wagon, Rocking chair, Three sided screen, Crate, Miniature doll and chair, Table, Bean bag chair, Laundry basket, Tunnel, Wagon, Rocking chair, Three sided screen, Three sided screen, Round storage tub.
During computer-based video self-modeling and CTD instruction student responses for touching the correct photograph were recorded as: (a) unprompted correct (initiating and correctly touching the photograph within 3s of the task direction); (b) prompted correct (touching the correct photograph within 3s after delivery of the controlling prompt (gesture) by the instructor); (c) unprompted incorrect (touching an incorrect photograph within 3s of the instructor delivering the task direction); (d) prompted incorrect (touching an incorrect photograph within 3s after the instructor’s gesture prompt); or (e) no response (failure to initiate touching a photograph within 3s after the instructor’s gesture prompt).

Experimental Design

A multiple probe design (Gast & Ledford, 2010) across three pairs of prepositions and replicated across three students, was used to evaluate the effectiveness of computer-based video self-modeling and constant time delay on the acquisition and generalization of receptive comprehension of prepositions.

The order of experimental conditions was: (a) Positioning Objects Generalization Probe condition; (b) Positioning Self Generalization Probe condition; (c) Computer-based Video Self-Modeling and Constant Time Delay Discrimination Instruction with the first pair of prepositions. Criterion for mastery of each pair was defined as 80% correct responding across three sessions using 3s delay trials. Criterion was set at this level to allow for distractibility of the students and due to their young age. The generalization probe conditions served to evaluate students’ abilities to demonstrate receptive comprehension of prepositions across untaught settings, requests, and materials. Following computer-based video self-modeling with the first pair of prepositions, generalization probe conditions with objects and self were repeated across all three pairs followed by computer-based video self-modeling with the second pair of prepositions. This sequence continued until all three pairs reached mastery level. Subsequent generalization probe sessions of mastered pairs of prepositions served as maintenance checks.

General Procedure

Probes were conducted to measure receptive responding to prepositions prior to computer-based video self-modeling and generalization across untrained stimuli and response topographies following computer-based video self-modeling. All probe and computer-based video self-modeling sessions were conducted in a one-to-one arrangement and procedures were similar to those by Egel et al. (1984) for evaluating positioning of objects and positioning self generalization conditions. Each probe condition was conducted for a minimum of three sessions or until responding stabilized. One to two sessions were implemented per day in the morning and/or afternoon for probe and computer-based video self-modeling conditions. Sessions were conducted 4-5 days a week and lasted approximately 15 minutes for probe sessions and 5 minutes for computer-based video self-modeling. Probe sessions with objects consisted of 18 trials, 3 trials for each of the 6 prepositions and positioning self probe sessions consisted of 24 trials due to the inclusion of 1 trial per novel exemplar for each preposition. Computer-based video self-modeling sessions consisted of 5 intermixed trials for each of the 2 prepositions in the pair (10 total trials). During computer-based video self-modeling sessions, trial sequences varied and prepositions were presented so that no more than two consecutive trials for one preposition were presented at once.

Positioning Objects Generalization Probe Procedure

At the beginning of the investigation and following mastering of a pair of prepositions using computer-based video self-modeling, a minimum of three probe sessions were conducted to evaluate a student’s ability to generalize receptive understanding of prepositions using novel objects not depicted in computer-based video self-modeling. Sessions consisted of 18 intermixed trials, 3 trials for each preposition. One object was placed on the table in front of the student and the student was given a second object (Table 1). Each pair of objects was used for more than one prepositional request to ensure that students were attending to the preposition and not receiving cues from objects. Three multiple exemplars were used.
for each prepositional pair (Table 1). By placing only one object on the table and handing the student only one object, student’s focus was directed to the preposition rather than differences among object labels and multi-component directions. A general attentional cue was provided and after an attentional response was obtained, the instructor presented the task direction, “Put ___ (behind) the ___.” and waited 3s for the student to initiate a response and 5s for the student to complete the behavior. The instructor delivered verbal praise on a variable ratio schedule (VR-3) for attending, correct positioning, and attempting to position objects. Incorrect or no responses were ignored and the instructor presented the next trial.

**Positioning Self Generalization Probe Procedure**

Following evaluation of positioning objects, a minimum of three probe sessions were conducted whereby the student was directed to position him/herself in relationship to stimuli in the video self-models and a novel stimulus not depicted in computer-based video self-modeling. Furniture and equipment exemplars were used for more than one prepositional request to ensure that students were attending to the preposition and not receiving positional cues from stimuli. Three different multiple exemplars were used for each pair of prepositions plus one novel exemplar (Table 1). By placing only one piece of furniture or equipment in front of the student, focus was directed to the preposition rather than differences among names of stimuli and requests with multiple components. During these sessions the student was seated on a chair facing the front of the object (i.e., rocking chair) and a general attentional cue was provided. After an attentional response was obtained, the task direction, “Go_____(under) the ____” was given by the instructor. The student was given 3s to initiate a response and 5s to complete the behavior. The instructor delivered verbal praise on a variable ratio schedule (VR-3) for attending and attempting to position self. Incorrect or no response was ignored and the instructor presented the next trial. Sessions consisted of 24 trials, 3 trials per preposition using target stimuli and 1 trial per novel stimuli for each preposition.

**Computer-Based Video Self-Modeling and CTD Procedure**

Individual instruction with computer-based video self-modeling and CTD began on the first pair of prepositions after a student’s data stabilized across the two probe conditions (positioning objects and self). During instructional trials, three photographs appeared on the computer monitor (PowerPoint slide). Students were directed to look at the photographs followed by the task direction, “Touch ____ (in).” During 0s trials the instructor immediately gestured to the correct photograph. Touching the photograph resulted in the PowerPoint program advancing to the next slide which showed a brief video of the student modeling the preposition corresponding to the photograph. Sessions continued at 0s until the student reached 100% prompted correct responses for touching the two target prepositions across one session of 10 trials (5 trials per preposition). Thereafter, a 3s prompt delay interval was inserted between the presentation of the task direction and delivery of the controlling prompt (gesture). Unprompted correct and prompted correct responses (student touching correct photograph) resulted in playing of the video segment and verbal praise. Unprompted incorrect, prompted correct, and no responses resulted in the instructor pointing to the correct photograph. On the next trial the student was presented with the task direction for a second preposition within the pair while viewing a new slide with three photographs. Sessions consisted of 10 intermixed trials, 5 trials for each preposition. Three different photograph exemplars and video segments were used for each prepositional pair (Table 1). Exemplars presented the prepositions within the pair and one other preposition using the same stimuli (e.g., photographs of the student under, on, and beside the bean bag chair). Criterion for mastery on each pair was 80% unprompted correct responding across three sessions. As criterion was reached for each pair, generalization probe sessions were again conducted.

**Reliability**

Interobserver and procedural reliability data between the instructor and observer were col-
lected on 20% of all probe and instructional sessions with at least one session being conducted per condition. Interobserver reliability ratings on student responses were analyzed using the point-by-point method (total number of agreements divided by total number of agreements plus disagreements and multiplied by 100). Mean interobserver agreement when recording student responses was 98.5% across all participants during computer-based video self-modeling sessions (range = 90-100), 94.2% during positioning self generalization sessions (range = 83.3-100), and 95.3% during positioning object generalization sessions (range = 88.9-100). Disagreement occurred most frequently for placing the item within 4in. during positioning of self and placing an object or self in the correct position within 5s. Procedural reliability was derived by dividing the number of observed instructor behaviors by the number of opportunities to emit the behavior and multiplying by 100 (Billingsley, White, & Munson, 1980). The following instructor and computer behaviors were evaluated: (a) advancement of slides during computer-based video self-modeling; (b) delivery of the controlling prompt (computer-based video self-modeling); (c) delivery of reinforcement; (d) wait times; and (e) presenting correct materials during positioning self and object generalization sessions. Procedural reliability was 96.5% across all participants during computer-based video self-modeling sessions and 97.7% during generalization probe sessions and conditions. Errors during computer-based video self-modeling instruction were due to photograph slides being incorrectly linked to video slides during initial sessions and the instructor delivering the controlling prompt before 3 seconds. Errors during generalization sessions were due to placing incorrect materials on the table during positioning of objects.

Social Validity

After completion of the final generalization sessions, teaching staff were interviewed in order to determine their opinion of the computer-based video self-modeling program. They were also asked at that time to informally observe the three students throughout the school day in order to report back to the investigator two weeks later on any use of the six target prepositions by the students.

Results

Figures 1-3 show the data for each student’s acquisition of receptive understanding of prepositions. The graphic displays present the percentage of photographs selected correctly using the computer-based video self-modeling program along with generalization of the prepositions to self and objects. Results demonstrate that the three students were taught receptive identification of photographs associated with the six prepositions. Use of the computer-based program resulted in an increase in the level of performance (photograph selection) for each of the three participants although the number of sessions to criterion varied across pairs for each student and across students. Vanessa required the greatest number of sessions to criteria on her first pair of prepositions (21), but required successively fewer trials on each of her remaining pairs. This may have reflected a need for her to learn to respond to the computer-based program although the other two participants did not follow this pattern. Both Andrea and Jeremy required the least number of sessions to criteria when presented with the pair on/under, but it should be recognized that they were beginning to place themselves and objects in these two positions prior to computer-based video self-modeling instruction. No other patterns appear to exist between correct performance and prepositional pairs across the three students when using the computer program.

Although positive changes occurred in the generalization of concepts to self and objects (Figures 1-3, Table 2), in comparison to probe sessions prior to instruction, with the exception of Vanessa and her third pair of prepositions (in front of/behind), students were able to position themselves and objects with some accuracy across each pair prior to computer-based video self-modeling instruction. In addition, levels of generalization for positioning self and objects were below 100% for each student with the exception of Jeremy and Andrea who demonstrated 100% correct placement of themselves on their third pair of prep-
positions immediately following computer-based video self-modeling and Vanessa who was able to generalize positioning of her second pair (in/next to) 100% correctly when using a novel material.

Table 2 shows the mean number of correct responses for each student during generalization sessions. Probe sessions immediately following mastery of each pair of prepositions using computer-based video self-modeling indicated that all students performed best during generalization sessions of “self” compared to objects. Andrea’s mean performance across all pairs, immediately following computer-based video self-modeling, was the highest (87%) followed by Jeremy (85.2%), and Vanessa (74.1%) using the actual objects viewed in the videos. Vanessa was the only student who performed better (77.8% correct across all pairs) when positioning self with novel materials compared to using actual objects seen in the self-modeling videos (74.1% correct across all pairs). Andrea and Jeremy’s mean performances across all pairs immediately following instruction were also 77.8% correct with the novel materials. Performance during probe sessions immediately following mastery of each pair of prepositions was lowest for all students when positioning small objects. Andrea had the most difficulty in generalizing use of the dollhouse furniture with a mean number of 62.9% correct across all pairs. Jeremy correctly positioned 64.8% of the small objects immediately following instruction and Vanessa positioned a mean of 66.1% of the objects immediately following instruction.

Finally, as shown in Figures 1-3 and Table 2, students maintained or increased their levels of responding during maintenance probe sessions conducted for the first two pairs of prepositions (maintenance measures were not taken for the final pair of prepositions).

Figure 1. Percentage of correct responses across three pairs of prepositions during computer-based video self-modeling, positioning objects, and positioning self generalization sessions by Andrea.
Social Validity

Teaching staff reported that use of computer-based video self-modeling would easily fit into students' scheduled times for computer-based instruction and that an adult who sat with students during this time could deliver prompts as needed. During informal observations two weeks following the last probe session, it was reported that Jeremy and Vanessa were observed responding receptively to walking on a line, Vanessa was observed positioning herself behind her teacher, and each student responded correctly to putting items in the trash, in a basket, and standing next to a peer.

Discussion

This study examined the effects of teaching receptive understanding of prepositions via computer-based video self-modeling instruction. In the early 1970s and 1980s researchers began to consider the importance of teaching comprehension of prepositional relationships due to their frequent use in the natural environment for locating items (e.g. the keys are on the table), specifying where an object should be placed (e.g. put the keys on the table), or to direct a student where to place him/herself in relation to a stimulus (e.g. stand beside the sink; Egel et al., 1984). As use and development of technology continues to increase, new technology-based programs for teaching language-based concepts, such as prepositions, may warrant further research attention. Results of the current study support those of previous studies which have found video self-modeling to be an effective means to teach concepts to young children with disabilities (Bellini & Akullian, 2007; Hitchcock et al., 2003; Meharg & Woltersdorf, 1990). In the current study, students were able to recep-
tively select photographs on the computer in response to the target direction, “Touch__” and to generalize use of the concepts by positioning themselves and objects. Generalization of concepts taught through the computer-based program was evaluated by measuring transfer of stimulus control from teaching examples on the computer to non-taught examples and across situations. Generalization of preposition use was evaluated across non-taught examples or stimuli (student positioning him/herself with novel objects and positioning small objects) and across settings and situations (positioning self in the school environment). Although the three students demonstrated an increase in their abilities to receptively place themselves and objects across untaught examples, during measures of generalization, students were unable to transfer stimulus control from the photograph, video teaching examples, to untaught examples with 100% accuracy. Results may have been influenced by the lower level of 80% criteria across three sessions. Criterion was set at this level to allow for the young age and distractibility of the students, however, this compromise may have affected students’ comprehension of the prepositions.

In order to promote generalization it is important that materials share common physical characteristics similar to those used during teaching. Results appear to support this recommendation whereby each student’s highest level of correct performance during generalization measures occurred when positioning themselves with objects seen in the video and similar novel materials compared to positioning small dollhouse figures. Researchers recommend that when designing software programs, instructors include multiple, natural examples that occur in the student’s environment (Higgins & Boone, 1996) and examples that closely match the attributes of the referents (Porter, Lahn, Behrmann, & Collins, 1996).

Figure 3. Percentage of correct responses across three pairs of prepositions during computer-based video self-modeling, positioning objects, and positioning self generalization sessions by Vanessa.
Although effort was made to select objects for positioning self from the students’ school and home environments (i.e., rocking chair, beach mat) use of positioning small dollhouse related objects may have included too many uncommon characteristics with those used during teaching.

While it appears that students learned prepositions through the computer-based video self-modeling program, data also indicate that students may have acquired skills through exposure to content in their classroom or natural environments. This appears evident by the levels of correct responding during probe sessions prior to introduction of the computer-based program. Although students were unable to identify the prepositions during screening and classroom teachers were in-

### TABLE 2
Mean number of correct responses for each student during generalization probe sessions.

<table>
<thead>
<tr>
<th></th>
<th>Andrea</th>
<th>Jeremy</th>
<th>Vanessa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Probe 1</td>
<td>Probe 2</td>
<td>Probe 3</td>
</tr>
<tr>
<td><strong>Pair 1: in/next to</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self</td>
<td>38.9</td>
<td>83.3</td>
<td>83.3</td>
</tr>
<tr>
<td>Novel</td>
<td>50</td>
<td>83.3</td>
<td>83.3</td>
</tr>
<tr>
<td>Object</td>
<td>5.6</td>
<td>66.7</td>
<td>61.1</td>
</tr>
<tr>
<td><strong>Pair 2: in front of/behind</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self</td>
<td>11.1</td>
<td>33.3</td>
<td>77.8</td>
</tr>
<tr>
<td>Novel</td>
<td>0</td>
<td>16.7</td>
<td>50</td>
</tr>
<tr>
<td>Object</td>
<td>5.6</td>
<td>11.1</td>
<td>22.2</td>
</tr>
<tr>
<td><strong>Pair 3: on/under</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self</td>
<td>88.9</td>
<td>83.3</td>
<td>88.9</td>
</tr>
<tr>
<td>Novel</td>
<td>33.3</td>
<td>100</td>
<td>66.7</td>
</tr>
<tr>
<td>Object</td>
<td>44.4</td>
<td>88.9</td>
<td>77.8</td>
</tr>
</tbody>
</table>
structed not to teach or reinforce use of the six prepositions, it was impossible for the students to receive daily instruction in a “vacume” and students were likely indirectly exposed to the prepositions in a variety of unidentified means. Levels of performance increased for Jeremy during maintenance sessions with his first pair of prepositions while Andrea showed increases across both her first and second pairs and Vanessa showed increased in her first pair and during positioning of self and objects with her second pair.

It should also be noted that some of the prepositions appeared to prompt a natural response topography from the students. For example, students tended to go “in” the tunnel and to sit “on” the rocking chair prior to computer-based video self-modeling instruction. It is also possible that students’ correct positioning of self during generalization sessions was due to imitation of the exact response topography seen in the video rather than receptively responding to the verbal directions (i.e., “go in the tunnel”). In other words, they may have seen the tunnel during generalization sessions and recalled that they went inside it on the video self-modeling recording. It was attempted to control this effect by providing two prepositional requests per object (i.e., “in” and “next to” the tunnel) and one distracting photograph (i.e., “behind” the tunnel) during computer-based instruction. The study also included the conditions for positioning self with novel objects and positioning objects in relation to other objects in order to control this effect and to measure students’ abilities to generalize responding to another response mode (Egel et al., 1985).

A further limitation to the study and its measures of generalization is that measures were in controlled environments with only one stimuli present rather than in natural environments where numerous materials and demands for receptive use of prepositions are required. Future research may also want to evaluate receptive use of prepositions when there is a greater distance between the student and the object to be used with the preposition. These scenarios may better represent the daily situations in which students are functionally required to use these concepts. Additionally, future research or applications of this procedure may wish to include a measure of expressive understanding of the concepts by including questions such as, “Where is the dog?” or “Where are you?” during teaching and generalization sessions.

While available research and results from the current study support use of video, including video self-modeling, for teaching concepts and skills to students with disabilities, limited research exists comparing different types of video. Of the comparative studies available, limited differences have been reported between video approaches. Two studies evaluating student preferences for types of video have had mixed results. Mechling and Moser (2010) found that collectively three students with autism showed no clear preference between watching themselves and others on video, however, individually one student indicated a preference for watching himself in videos and two students indicated a slight preference for watching themselves perform routine tasks. Mechling, Gast, and Cronin (2006) found that students with autism had a slight preference for watching video captions of themselves interacting with preferred stimuli compared to video captions of preferred activities or events in their study which evaluated the effects of presenting high preference items, paired with choice, via computer-based video programming. Cihak and Schrader (2008) also reported that four adolescents in their study comparing video modeling and video self-modeling reported that they preferred to watch themselves performing tasks over adult models in the videos. In addition to preferences, others have evaluated the effects on task performance between types of video. Ayres and Langone (2007) evaluated subjective point of view (perspective of the person watching the video) and third-person perspective (referred to as video modeling) with four elementary age students with autism and found no clear indication of superiority between the two approaches in terms of acquisition and generalization of skills with the fewest errors. In a study comparing video modeling to video self-modeling with five children with autism, no overall difference in rate of acquisition of answering conversation questions was found by Sherer and others (2001). Likewise, Cihak and Schrader found both video modeling and video self-modeling to be effective in teaching chained vocational tasks.
to four adolescents with autism spectrum disorder. However, individual differences did occur with one participant performing more effectively using video self-modeling and two additional participants acquiring skills more efficiently using video self-modeling (no differences were found for the fourth participant). A recent study further evaluated video modeling, self-modeling and subjective point of view with three students, ages 12-17 years, diagnosed with moderate intellectual disabilities (Van Laarhoven, Zurita, Johnson, Grider, & Grider, 2009). Findings suggest that two students performed best with video modeling while the third student completed more steps of the tasks correctly when watching video with a subjective point of view. However, they report significant differences in the time required to create the video materials. Creation of the self-modeling videos required almost twice the amount of time to create than the other two forms of video materials. Therefore it may be necessary to further evaluate the benefits of VSM in light of preparation time. For some students the benefit may justify the additional preparation time, however, as suggested by Van Laarhoven et al., self-modeling may be less cost effective in terms of outcomes and the amount of time required of teachers to prepare the materials. In the current study, the self-models were made by an instructor first pointing to where the child needed to stand and then the camera videotaped the student walking and standing in the target location. The adult prompter could be edited out of the self-modeling video using the Storyboard feature of Windows Movie Maker or by merely capturing a video clip after the student began to walk to the target location. This procedure appeared to require little additional time to that of making a video model of someone else demonstrating the target preposition.

Further evaluation, in terms of effectiveness and efficiency for teaching prepositions, should be made between traditional approaches (using real objects and pictures) to video technology. Early studies found personalized photographs of students engaging in activities to be an effective instructional procedure (Parnell, 1978). Due to their positive findings using personal photographs of students depicting the verbs in their language books, Johnson and others (1992) recommended use of video technology to provide an element of action that photographs could not provide. Such an early comparison by Stephens and Ludy (1975) found motion picture sequences to be more effective than still photographs and live demonstration for teaching verbs to 30 students with moderate intellectual disabilities. Issues that could be explored by future research include comparing photographs, live models, and video to teach concepts as well as further comparison of the different types of video perspectives.

For purposes of experimental control, instruction of prepositions in the current study only included the computer-based intervention. Practitioners will likely find it useful to teach such concepts with real-life, in-vivo instruction concurrently with computer-based instruction. In such a concurrent arrangement, teachers may rely on computer-based instruction to deliver repetitive, independent practice with multiple exemplars while providing opportunities for in-vivo instruction to support acquisition and generalization of skills (Ayres, Maguire, & McClimon, 2009).

Results of the current research produces evidence supporting video self-models to teach concepts such as prepositions. Now that instructors have the ability to create real life simulations through video technology, continued research is needed to evaluate which features of video technology are most effective and efficient for teaching different populations of students and whether the effects are influenced by the type of specific skills being taught.

References


