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Behavioral Sciences

Teaching Skills Via Video Modeling for Children with ASD: Effect of Monitoring

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ABSTRACT – The acquisition of daily life skills using video modeling (VM) has been investigated in children diagnosed with ASD. However, such studies show divergences regarding the effectiveness of this teaching modality. This research is to investigate the effects of monitoring training on the learning using VM of children with ASD. A multiple probe design between participants was used. Two children diagnosed with ASD were exposed to monitoring training. Before and after this training, skill learning probes were performed via VM. There were also maintenance and generalization tests for skills learned via VM. Participants acquired the monitoring repertoire, and the data suggest that such performance contributed to further learning via VM, in addition to demonstrating retention and generalization to other skills.

KEYWORDS: daily living skills, observational learning, videomodeling, monitoring, Autism Spectrum Disorder

Ensino de Habilidades Via Videomodelação para Crianças com TEA: Efeito do Monitoramento

RESUMO – Tem-se investigado o aprendizado de habilidades da vida diária utilizando a videomodelação (VM) para crianças diagnosticadas com TEA, no entanto, tais estudos apresentam divergências quanto à efetividade desta modalidade de ensino. Objetivou-se investigar os efeitos do treino de monitoramento na aprendizagem via VM de crianças com TEA. Utilizou-se um delineamento de sondas múltiplas entre participantes. Duas crianças com TEA foram expostas a um treino de monitoramento. Antes e após este treino, foram realizadas sondas de aprendizagem de habilidades via VM. Houve, ainda, testes de manutenção e de generalização das habilidades aprendidas via VM. Os participantes adquiriram o repertório de monitoramento e parece que este aprendizado contribuiu para a aprendizagem via VM, além de demonstrarem retenção e generalização para outras habilidades.

PALAVRAS-CHAVE: Habilidades da vida diária; aprendizagem observacional; videomodelação; monitoramento; Transtorno do Espetro Autista.

Autism Spectrum Disorder (ASD), according to the *Diagnostic and Statistical Manual of Mental Disorders V* (DSM-V - *American Psychiatric Association*, 2014), is characterized by deficits in social interactions and communication, in addition to restricted interest and patterns of repetitive and stereotyped behaviors. ASD is one of the most serious developmental disorders and its incidence has been growing over the last decade. In 2016, the incidence in the United States, estimated by the *National Health Center for Health Statistics*, was one case for every 40 children (Zablotsky *et al.*, 2019). The worldwide incidence is one case for every 132 individuals (Baxter *et al.*, 2015), with a higher incidence in boys (Volkmar & McPartland, 2014). The estimated incidence in Brazil is one case for every 370 inhabitants (Paula *et al.*, 2011).

The characteristic deficits of ASD substantially influence observational learning (Greer *et al.*, 2006; Taylor & DeQuinzio, 2012) and daily living skills (DLS) (Gillham *et al.*, 2000; Jacobson & Ackerman, 1990; Kraijer, 2000). Observational learning is defined as learning results from observing the response of others and their consequences (Catania, 2007). This learning occurs when the observer learns the relationship between a person's response, called a model, and its consequence, which may be reinforcing or punitive (Fryling *et al.*, 2011; Greer *et al.*, 2006; Plavnick & Hume, 2014).

This type of learning has great social importance, as several social rules are learned through observing the behavior of others and their consequences. Furthermore, in order to learn via observation, it is not necessary for the observer to have direct contact with the contingencies to reproduce the model's behavior (Greer *et al.*, 2006; MacDonald & Ahearn, 2015; Taylor & DeQuinzio, 2012). Previous research shows that children with disabilities, including children diagnosed with ASD, are less likely to learn through observing others while they are receiving instructions (MacDonald & Ahearn, 2015).

Another limitation of people with ASD, often cited in literature, is the difficulty in independently performing DLS (Gillham *et al.*, 2000; Jacobson & Ackerman, 1990; Kraijer, 2000; Liss *et al.*, 2001; MacDuff *et al.*, 1993), which can be defined as self-care activities, appropriate for a given age, necessary for functioning at home and in the community, and including behaviors such as bathing, dressing, completing household chores, among others (Domire & Wolfe, 2014; Green & Carter, 2014). Independence to perform such skills can contribute to the individual's significant participation in society and to their quality of life (Carter *et al.*, 1998) as well as the life quality of those who take care of them (Pierce & Schreibman, 1994). According to Cannella-Malone *et al.* (2011), adults with ASD who have difficulties in performing DLS tend to have lower employability rate and less possibility of living independently.

Although people with ASD have difficulty learning through observation, they have benefited from using video as a teaching technique (Bellini & Akullian, 2007; Charlop-Christy *et al.*, 2000; Charlop-Christy & Daneshvar, 2003; Shipley -Benamou *et al.*, 2002) concerning several skills, including those of daily living.

Among the possibilities of using video as a teaching tool, the use of video modeling (VM) stands out. VM is an instruction technique in which the person (the learner) watches a short video in which a model (child, adult, or her/himself) performs a sequence of steps of a given skill and, subsequently, the learner must reproduce the observed steps (Cannella-Malone *et al.*, 2011; Charlop-Christy, Dennis *et al.*, 2010; Charlop-Christy et al ., 2000; Gardner & Wolfe, 2015).

In recent years, studies have investigated DLS learning, using VM as a teaching procedure, in children diagnosed with ASD (Cannella-Malone *et al.*, 2011; Charlop-Christy *et al.*, 2000; Keen *et al.*, 2007 ; Lee *et al.*, 2014; Shipley-Benamou *et al.*, 2002). However, it is noted that the literature on teaching DLS through MV reports effectiveness (Charlop-Christy *et al.*, 2000; Keen *et al.*, 2007; Lee *et al.*, 2014; Shipley-Benamou *et al.*, 2002) but also cases of failure involving people diagnosed with ASD (Cannella-Malone *et al.* 2006; Cannella-Malone *et al.*, 2011).

In view of such inconsistence regarding the effectiveness of VM as a DLS teaching procedure for people with ASD, it is reiterated the need of studies to be conducted in order to increase the effectiveness of such teaching modality, especially in cases involving special needs to teach several repertoires. An important limitation on this topic is that few studies address observational learning via VM as a dependent variable (*e.g.*, Brasiliense *et al.*, 2018; Pereira–Delgado & Greer, 2009; Taylor *et al.*, 2012).

Pereira-Delgado and Greer (2009) tested the effects of directly training a monitoring repertoire, with the model performing correct and incorrect responses and the presentation of the consequences of such responses, on the emergence of observational learning in two experiments with children diagnosed with ASD. In the first experiment, in which two children participated, pre-experimental tests were conducted. The results showed that the children did not have the observational learning repertoire for verbal operants such as textual and tact. After this initial phase, the children were trained to evaluate the model answers, distinguishing the occurrences of model's correct and incorrect responses. Monitoring training consisted of reinforcing participants' correct discrimination of model responses. When the participant made errors, a correction procedure was implemented. Monitoring training was conducted in three stages: 1) installation of monitoring repertoire; 2) developing control of the child's response by the model's response; 3) developing control of the participant's response by the consequence provided to the model on the video. After each stage, a new evaluation of the observational learning was conducted. After completion of monitoring training, both children demonstrated observational learning for textual and tactile learning.

A second experiment replicated the previous one, with differences: three children with ASD participated, the trained repertoire was spelling dictated words, and probe tests were no longer performed after each stage of monitoring training. The results suggested that children began to learn through observation by monitoring the model's response and the consequences of that response (Pereira-Delgado & Greer, 2009).

Brasiliense *et al.* (2018) also investigated the possibility of establishing monitoring repertoires via VM and evaluated the impact of acquiring such repertoire on observational learning of verbal behaviors such as tactile (saying the name of objects or properties) and textual (saying the name in front of a written word). A systematic replication of Pereira-Delgado and Greer's Experiment 2 was conducted. Monitoring training was implemented with videos of a model learning tacts responses. Pre- and post-experimental tests of observational learning of tacts and textual responses were conducted. Both children who participated in the study acquired the monitoring repertoire in four sessions. One of the participants acquired tactile and textual skills through observational learning.

Considering (a) the importance of DLS training for children diagnosed with ASD, (b) the need for studies that increase the effectiveness of VM as an instructional technique, and (c) monitoring training as a strategy to increase the probability of learning by observation, the present study aimed to investigate the effects of monitoring training on DLS learning in children diagnosed with ASD via VM. To this end, an adaptation of the procedure implemented in Experiment 2 by Pereira-Delgado and Greer (2009) was proposed, replicated by Brasiliense *et al.* (2018), for monitoring training with the purpose of teaching DLS via VM. Based on the literature, the hypothesis was that monitoring training would increase the success rate in learning DLS skills via VM in children with ASD.

METHOD

Participants

Two boys diagnosed with ASD participated in the study: Igor (6 years and 4 months) and Victor (4 years and 10 months). They both attended the APRENDE project (Service and Research on Learning and Development – Barros *et al.*, 2012) from the Federal University of Pará (Brazil) at the time of research. The names used here are fictitious in order to maintain the confidentiality of the children's identities.

Based on the *Verbal Behavior Milestones Assessment and Placement Program* (VB-MAPP – Sundberg, 2014), it was found that both children presented session collaboration behaviors (sitting and waiting, for example), followed simple instructions and could perform imitation tasks. Victor communicated vocally. Igor communicated via picture exchange. Furthermore, they needed substantial support to perform at least five DLSs, according to an assessment conducted with the mothers. They also had difficulties in learning DLS via VM, as assessed during the baseline sessions of the present study. Igor and Victor had not participated in any previous study or intervention concerning DLS or received training with VM as a teaching tool.

Their participation was authorized by their parents, by signing the Free and Informed Consent Form. This work was approved by the Research Ethics Committee of the UFPA Institute of Health Sciences, according to review n 175.303.

Environment and instruments

The experimental sessions were conducted in a 2x2-meter room, equipped with air-conditioning and with artificial lighting, except for the toothbrushing skill training sessions, which were conducted in a bathroom. In all sessions, there was a table and two chairs (one for the researcher and one for the child); a box with toys (*tablet* , puzzle, cars, dolls, soap bubble maker, etc.) and a box with edibles (candies, corn flake, cake, biscuits, fruits, etc.), which were used as consequence for the participant's correct responding. There was also a video camera recording the sessions for later evaluation of the inter-observer agreement and procedural integrity.

For Igor, who used picture exchange as way of communication, a red and a green card (10 x 10 cm) were used to teach monitoring responses. Participants' performance were recorded on specific recording sheets.

Tasks and materials

The acquisition of four specific DLSs was tested via VM: a) preparing a sandwich, b) brushing teeth, c) preparing yogurt with cereal, and d) preparing chocolate milk. The skills used for monitoring training were a) drinking water, b) putting toys away, c) washing hands, d) washing one's face, e) preparing yogurt with cereal and f) preparing chocolate milk. Such skills were chosen because they are performed independently by most children at the age of the participants, also because they are considered functional and relevant for children at that age (Mancini, 2005). The task analysis of the skills tested via VM is presented in Table 1.

Table 1. Task analysis of the skills tested in the initial, final probes and baselines, via video modeling .

Skills tested via video modeling			
Sandwich preparation	Tooth brushing	Preparation of yogurt with cereal	Chocolate milk preparation
Get the cheese	Pick up the toothbrush	Get the cereal	Put the milk in the glass
Put cheese on bread	Get the folder	Put the cereal in the yogurt	Pick up the spoon
Get the ham	Put toothpaste on the brush	Pick up the spoon	Pick up chocolate with a spoon
Put the ham on the bread	Bring the toothbrush to your mouth	Place the spoon in the cup with yogurt	Put the chocolate in the milk
Close the bread	To brush your teeth	Stir (mix)	Stir (mix)
	Open the tap		
	Wash your mouth		
	Wash the brush		
	Close the tap		

All the objects and materials necessary to conduct the DLS were provided such as: bread; ham and cheese; toothbrush and toothpaste; cup; yogurt; cereal and spoon and glass; milk and chocolate.

Videos. For the VM and video monitoring sessions, three examples of videos were recorded for each skill, with the model performing all the steps of each skill, from the beginning to the end. For each DSL, the videos showed a variety of exemplars of materials, as well as variations of the instructor, model, and reinforcers. The videos were recorded in a third person perspective, that is, the participant, when watching the video, observed the scene as a spectator watching a person (the model) performing a task (Cannella-Malone *et al.*, 2006). Editing effects were used to highlight model's behavior. For example, when the model was acting, a circle was inserted so that model's behavior was highlighted, and the rest of the screen was darkened. There were no instructions added to the videos. The only vocalizations were from the instructors, when giving instructions to the model and presenting social reinforcers.

Video modeling. The videos for the VM sessions were created based on a sequence of steps. For better understanding, the skill of preparing a sandwich will be used as an example: the video began with an introductory vignette, comprising music and animated drawings (a boy or a girl). Then, footage of the instructor sitting in front of the model, separated by a table, was presented. The necessary materials were already available on the table. The instructor provided the instruction "prepare the sandwich." The model then performed all the steps of the DSL. After completing the last step, the instructor reinforced the model's behavior, with social and tangible reinforcers, which were placed next to the instructor. Furthermore, audio-visual editing effects, such as applause and celebration, were added at this point in the video. The videos for the 8 VM sessions lasted 34 to 54 seconds on average.

Monitoring. The videos for the monitoring sessions differed from the videos presented on VM sessions, because they could be either exemplars of a correct execution (the model's behavior was reinforced by the instructor on the video) or incorrect execution (in which the instructor implemented the correction procedure) of the skills. Audiovisual editing effects were added at this point in the video (applause for successful videos, vocal interjection suggesting deception, plus a red X on the screen, for videos showing incorrect execution, for example). The videos for monitoring sessions lasted an average of 34 to 50 seconds.

Dependent variable and independent variable

The dependent variable (DV) was the level of observational learning, measured by the difference in accuracy of performing DLS before and after VM. To measure VD, the percentage of skill steps performed correctly [(number of steps executed correctly/total number of steps] x 100) was considered, based on the task analysis presented in Table 1. The independent variable (IV) was the implementation of video monitoring training. In other words, IV was teaching the skill of monitoring videos and its effect was measured on the acquisition of DLSs shown on new video samples.

Experimental Design

Pre- and post-treatment assessments between participants were embedded in a variation of the multiple baseline experimental design, called multiple probes (Horner & Bayer, 1978) to increase the internal validity of verifying the functional relation between direct training of monitoring videos and observational learning of daily living skills *via* VM. The multiple probe design was chosen so that participants would not be exposed to too many baseline sessions.

Procedure

Phase 1. Initial probe. Participants underwent probe sessions performing the acquisition of two DLSs (tooth brushing and sandwich preparation) *via* MV. Such DLSs were known to be absent in the child's repertoire. Each VM session consisted of first the experimenter obtaining child's attention and then showing a video. After watching the video, the researcher provided verbal instructions for the child to perform the skill taught and the child had up to 15 seconds to initiate the response. There were no programmed consequences for the child's responses. Each probe consisted of three observation/test sequences. There were intervals of approximately 3 minutes between the observation/test sequences, during which the researcher interacted with the child. This procedure was also implemented to probe tooth brushing DLS.

Each step of the skills performed was considered correct when they corresponded to what was displayed in the video (see Table 1). Partially correct responses, responses lasting longer than two minutes beyond the time of the observed video and the absence of responses were considered errors. Failure to show the DLS was considered when the participant performance was below 30% correct ([number of correct steps/total number of steps] x 100) for both skills.

Phase 2. Baseline. Baseline sessions were identical to the initial probe, except that successive evaluations were made in order to check for tendence. The criteria for evaluating participants' responses were identical to those of the initial probe.

Phase 3. Monitoring training. The monitoring training, divided into three stages, was conducted using videos and consisted of the child observing the video, and monitoring the response (correct or incorrect) of the model and the consequence (reinforcement or punishment) provided by the instructor. The monitoring response required was to identify whether the model had it right or wrong. In all stages, the criterion to move on was two consecutive probes with independent correct monitoring responses.

Each trial began with the experimenter obtaining the child's attention. Then the experimenter presented the video and asked, "What happened?." For the non-vocal child, the required monitoring response was to choose the green card when observing model's correct responses or the red card for incorrect responses. For the vocal child, the vocal response "correct", or "error" were required.

The monitoring repertoire was trained through gradual steps, from the highest to the lowest level of help (vocal help for Victor and physical help for Igor). The last probe trial was given without prompts and without programmed consequences.

Correct monitoring responses with prompt were reinforced with praise; independent correct responses were followed by highly preferred tangible items and praise. Incorrect responses were followed by the correction procedure, which consisted of withdrawing attention for three seconds, re-presenting the video, and providing a prompt for the correct answer, followed by social reinforcement and presentation of the next trial.

Step 1 . This step aimed at installing the monitoring repertoire. It was done with two DLSs that were already part of the participant's repertoire (drinking water and washing hands). At this stage, the child observed the whole video, so that he could see the consequence given by the instructor for the model's response in the video. Reinforcing consequences were correlated to correct implementation of the DLS and well as errors were indicated by the instructor. Possibly, at this stage, such differential consequences worked as discriminative stimuli of correct and incorrect implementations.

Step 2 . This stage aimed to develop control over the participant's response over the model's response. To this end, other videos of skills that were already part of the participant's repertoire (putting toys away and washing one's face) were used. This stage differed from *Stage 1* by the opportunity for the participant to identify whether the model's answer was correct or wrong before the consequence was presented in the video. The researcher presented part of the video but paused it before the feedback of the instructor on the model's response. Then, a monitoring response was demanded from the participant (presentation of the red or green card, or the vocal responses). Right after the monitoring response, the researcher presented the corresponding consequence by releasing the video so that the participant could see the end of the scene. Then, the experimenter would say "See, you got it right!" (for correct answers) or "no, that's not the correct answer, let's see it again?" (for incorrect answers). For independent correct responses, highly preferred tangible reinforcers were also presented. At this stage, the model's response in the video worked as a discriminative stimulus for the participant's response.

Step 2 remediation training. It was necessary to implement remedial training for Victor since, over 10 sessions of the second stage, his monitoring responses were always declarations of correct implementation whether the video showed a correct or an incorrect exemplar. Remediation training consisted of unbalancing the exemplars, so that more exemplars of incorrect executions were presented throughout the session. The contingencies established in this training were identical to the other stages.

Step 3. This stage aimed to establish control by the consequence provided to the model on the video. This training followed the same procedure as described for *Stage 1*. The difference was that the DLSs (preparing chocolate milk and preparing cereal) were not part of the participant's repertoire. The researcher presented the whole scene on video and then provided the opportunity for the participant to monitor the model's response. The consequences provided were the same as described in the previous steps.

Phase 4. Final probe. Probes after monitoring training were identical to those implemented in the initial probe.

Phase 5. VM1 + *prompt*. After the final probe, the DLS steps that were not performed independently by the participant after watching the video were directly trained. The training sessions were identical to those of the initial probe. In each session, a block of five trials was performed, with the first and last being the probes (without prompting procedures or programmed consequences for the child's response). When incorrect responses (errors, partial responses, or no response) were observed on any step of the first probe, the previous mentioned prompting procedures were implemented in subsequent trials, and gradually decreasing, from immediate total help to delayed partial help, over the remaining three trials of the block. The consequences for correct and incorrect responses were the same described previously.

The measurement of the dependent variable was performed following the same procedure as described for the probes. The criterion established to consider that the participant had acquired the repertoire was 90% independent accuracy in two consecutive sessions or one session with 100% independent accuracy.

Phase 6. Maintenance probes 1. One week after the acquisition criterion had been reached, maintenance probes were conducted. Participants were exposed to an observation/test sequence. Dependent variable measurement was performed following the same procedures previously described. The criterion established to consider that the participant had maintained learning the skill was a performance accuracy above 90%.

Phase 7. Generalization test 1. It consisted of a probe of a DLS previously identified as absent from the participant repertoire, which they had monitored in the third stage of monitoring training (preparing the cereal). Participants were exposed to up to three observation/test sequences. The criterion established to consider that the participant had generalized the learned skill was a performance accuracy above 90%.

Phase 8. VM2 + *prompt*. This training phase, conducted only with Igor, was identical to Phase 5. However, the skill taught was the one tested in Generalization 1.

Phase 9. Maintenance probes 2. The second maintenance probe was similar to the first maintenance probe, that is, assess maintenance of the sandwich preparation DLS. It was conducted after the learner had reached criterion in the previous phase.

Phase 10. Generalization test 2. This phase, performed only by Igor, was identical to Phase 7. However, the skill tested in this phase was the one monitored in the third phase of monitoring training.

Interobserver Agreement and assessment of procedural integrity.

A second register of the participant's performance was made by a second trained researcher in 30% of the sessions throughout the experiment. This second assessment was used to calculate the agreement between observers and the integrity of the procedure. Interobserver agreement was obtained by dividing the number of agreements by the sum of agreements plus disagreements and multiplying this quotient by 100. Interobserver agreement in this study was 100%.

The procedure integrity assessment was made by checking whether the planned procedures were implemented correctly for all participants. For this end, a *checklist was used* that included all steps (items) of the implemented procedures. The integrity of the procedure was obtained by dividing the sum of items correctly implemented by the total number of items and multiplying the quotient by 100. The integrity assessment of this study was 91%

RESULTS

A peculiarity of the present study is that both dependent and independent variable imply teaching conditions. Our independent variable is teaching the ability of monitoring videos, and the dependent variable is the acquisition of DLS via videomodeling, measured by the percentage of correct implementation of DLS steps. Therefore, data on DLS learning gains (dependent variable) and the monitoring learning process (independent variable) are presented below. Figure 1 presents data from Victor (top of the figure) and Igor (bottom of the figure) in the initial and final probe sessions, as well as baseline, DLS training via VM (VM1 + *prompt* and VM2 + *prompt*), maintenance probes (1 and 2) and generalization tests (1 and 2). Data from the monitoring training are presented in Figure 2. All experimental phases visualized in this graph represent the performance accuracy (percentage of independent execution) of the participants when performing DLS steps after VM training.

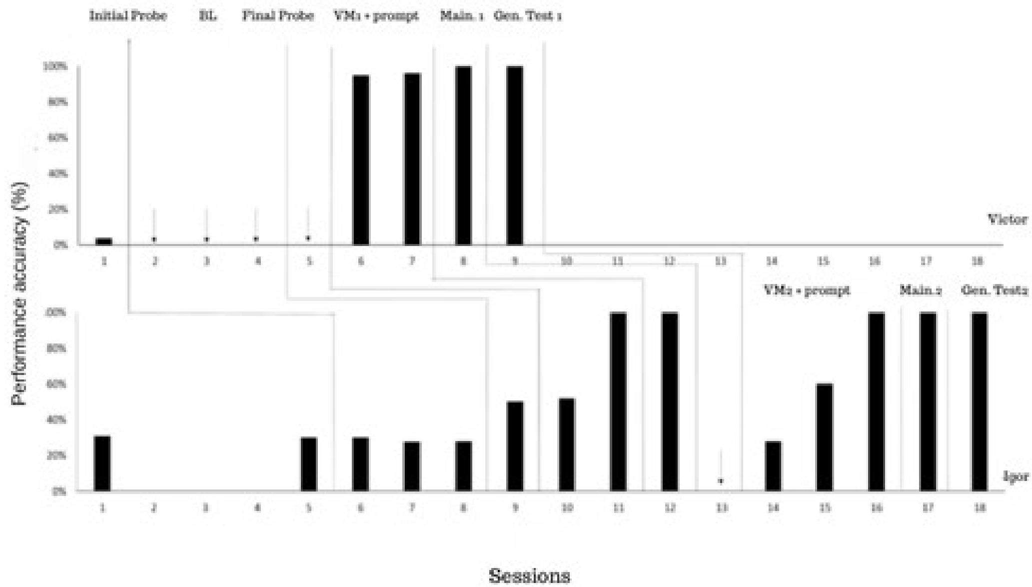

Figure 1. Performance accuracy, in percentage, of participants Victor (top) and Igor (bottom) in the initial and final probe sessions, baseline, DLS training via VM, maintenance probes and generalization tests.

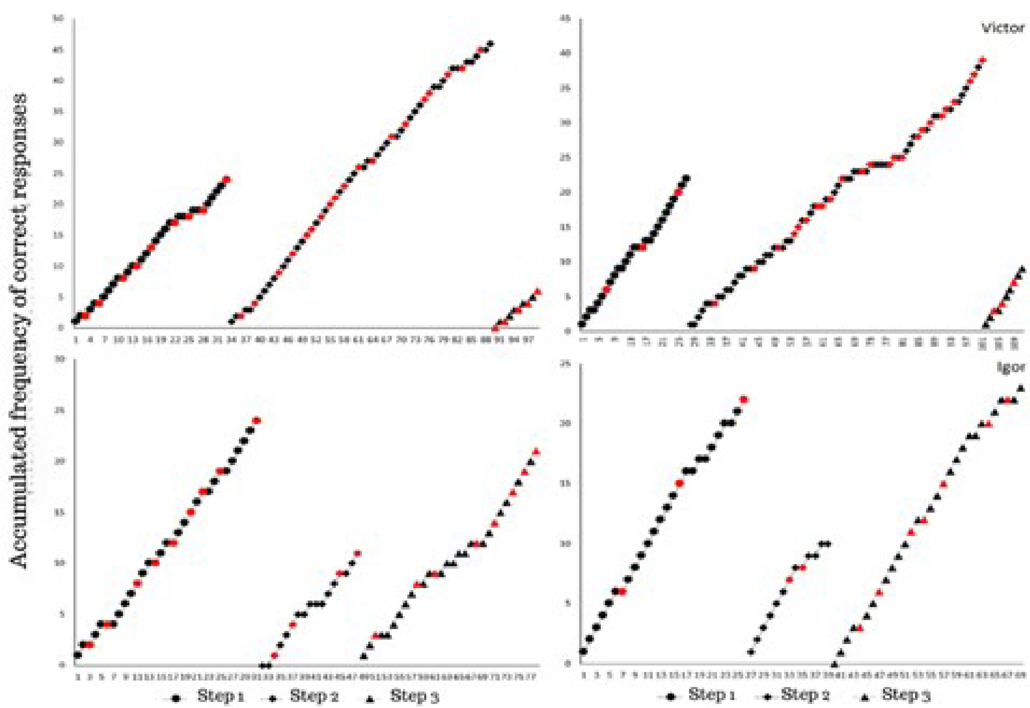

Figure 2. Accumulated frequency of correct responses (with help and without help) in each monitoring stage. The *x- axis* represents the number of attempts. Monitoring correct executions is on the left side. Monitoring for incorrect executions is on the right side. The top two graphs represent Victor's performance. The two graphs at the bottom represent Igor's performance. Red markers represent probe attempts.

In the initial and final probe and baseline sessions, for both participants, "tooth brushing" and "sandwich preparation" were the DLSs tested. In the VM1 + *prompt sessions*, those DLS were taught to Victor, as this participant did not demonstrate learning of any of the steps. For Igor, only "sandwich preparation" was taught, as this participant learned the "tooth brushing" DLS via VM. At session 1 of Generalization Test, the DLS tested was "cereal preparation", for both participants. Victor ended his participation after this phase. Igor moved on to VM2 + *prompt sessions*, in which the DLS previously tested for generalization (prepare the cereal) was now directly trained. In Generalization Test 2, conducted with Igor, the DLS tested was "preparing chocolate milk". For both participants, maintenance sessions were conducted with the DLS "sandwich preparation."

Victor did not perform correctly in any verification of learning skills via VM (initial probe, baseline, and final probe). During the training of those skills (VM1 + *prompt*), only two sessions (95% and 96%, respectively) were needed to reach the initially established learning criterion (90% in two consecutive sessions). It should also be noted that this participant only needed help for the first step of both trained skills. In the maintenance probe, Victor demonstrated maintenance of the "sandwich preparation" skill, which was learned via VM, performing 100% of the steps observed on the video model. In Generalization Test 1, the participant independently performed all the steps of "cereal preparation" as observed on the video. He ended his participation in the study at this stage.

In the probe sessions, Igor performed independently steps of the tested skills ("tooth brushing" and "preparing a sandwich"). On the initial probe, his performance was 11%, varying across baseline sessions (from 28% to 30%), and increased to 50% at the final probe. It is noteworthy that this increase in performance was restrict to the DLS "tooth brushing." Igor had already performed (after watching the video) the first five steps of such skill independently in the initial probe and baseline sessions. At the final probe, Igor performed all the steps presented in the video, except for washing the mouth. Regarding the skill of "preparing a sandwich," no correct responses were observed in the sessions, that is, no performance improvement was observed. The only step of this skill performed independently was "picking up the ham," which was a step already performed independently in the initial probes and baseline sessions. At the training sessions for the sandwich preparation (VM1 + *prompt*), Igor, as much as Victor, needed two training sessions to master it. However, Igor required physical assistance for all steps in the first attempt after the probe. In other hand, he showed the acquisition of all steps at the final probe of the first training session, reaching a total of 52% independent responding at the end of the trial block. In the second training session, all steps were performed independently, after watching the video (100%). When going through the generalization test, with "cereal preparation" skill, Igor did not show performance generalization, making it necessary to undergo training for such DLS (VM2 + *prompt*). His performance reached criterion after three training sessions via VM (28%, 60 % and 100%, respectively). Igor was given a second generalization test, in which he showed generalization. In both maintenance probes, Igor demonstrated maintenance of the "sandwich preparation" DLS which he learned via VM.

Figure 2 presents data from the implementation of the independent variable (DLS monitoring training) divided into three stages. The markers on the graph represent the cumulative frequency of participants' correct responses (with and without assistance) when monitoring a model performing DLS via video.

Regarding the video monitoring intervention, both participants went through all stages of the intervention, with an average of 15, 16, and 8 sessions, respectively at Stages 1, 2, and 3. Victor required 42 sessions to finish the whole intervention. The first stage comprised 12 sessions. Stage 2 was the one with greater number of sessions (26), compared to Igor in the same stage (6), or even compared with himself on the other stages (12 at the first and 4 at the third). Throughout the second stage sessions, after session 10, it was observed that Victor correctly monitored correct executions of the model. However, he emitted the same monitoring response for incorrect executions of the model. Based on this observation, it was decided to include remedial training for this participant, which consisted of unbalancing the trial blocks in order to produce greater exposure to monitoring model errors. This modification in the procedure was efficient for the participant to reach the criterion in this stage, after 16 sessions moving on to the last phase of monitoring. Then, the acquisition criterion was reached in the fourth intervention session.

For Igor, the first stage of monitoring was completed with 12 sessions. For the second stage, 6 sessions were required, and for the third stage, 4 sessions. Igor completed the training in a total of 22 sessions.

DISCUSSION

The present study was the first to (1) investigate the direct training of DLS video monitoring repertoire and (2) evaluate the impact of such repertoire on the acquisition of DLS via VM, as a dependent variable (Plavnick & Hume, 2014; Taylor *et al.*, 2012). To this end, adaptations of procedures reported in previous studies were made (see Pereira-Delgado & Greer, 2009, and Brasiliense *et al.*, 2018). The focus here was to verify if the acquisition of DLS via VM could be improved by teaching how to monitor DLS videos.

The data from this study show that the monitoring repertoire of models performing DLS was learned by both participants, however, in general, the acquisition of the monitoring repertoire, as an isolated variable, did not increase their performance in learning new DLS via VM. The only exception was the DLS "brushing teeth" learned by Igor. On the other hand, it can be concluded that the acquisition of the video monitoring repertoire was important for greater efficiency in the use of VM as a teaching tool, since the number of sessions needed to teach DLS via VM was exceedingly small, varying from two to three sessions. Another critical point to be mentioned is that both participants showed performance generalization, that is, the acquisition of new DLS, in at least one generalization test.

The data from this study corroborate the literature on the use of videos to teach several skills to children with disabilities (Bellini & Akullian, 2007), as well as on teaching DLS via VM (See Cannella-Malone *et al.*, 2011; Charlop-Christy *et al.*, 2000; Keen *et al.*, 2007; Lee *et al.*, 2014; Shipley-Benamou *et al.*, 2002, among others). Using videos as a tool was effective to teach how to monitor other's repertoire, as much as to directly teach DLS, which are so important for the independence and autonomy of people diagnosed with ASD.

Concerning the monitoring training, or more specifically the number of sessions necessary to reach the mastery criterion, we report here a greater number of required sessions, comparing to previous studies such as Pereira-Delgado and Greer (2009) (7 sessions on average) and Brasiliense *et al.* (2018) (4 sessions on average). This fact can be justified by the complexity of the skills monitored in the present study. The DLSs are actually chains of responses that, compared to the emission of tacts and textual ones, involve more steps to be conducted and, consequently, longer time spent monitoring the video, which makes the response of observing the video possibly a more costly response.

The participants in this study often looked away while watching the videos, which may be related to the slowness in reaching the learning criterion. Such data corroborate those reported by Cannella-Malone *et al.* (2006), who state that their participants seemed to be more engaged in watching videos lasting up to 30 seconds and looked away during VM sessions when videos were longer than a minute. Those findings are also consistent with studies that show children diagnosed with ASD having attention difficulties. It seems to be more related to social attention skills, which involve looking and being attentive to another person (Ames & Fletcher-Watson, 2010), one of the prerequisites required for monitoring and learning skills via video.

Future research can evaluate this hypothesis, reducing the length of the videos for both stages (monitoring and VM). The steps of each DLS obtained via task analysis could be targeted as a performance to be taught and the evaluation of monitoring training or VM could be made step by step. This could make the procedure close to what is defined as *video prompting* (Cannella-Malone *et al.*, 2006; Cannella-Malone *et al.*, 2011; Domire & Wolfe, 2014; Gardner & Wolfe, 2013; 2015).

Regarding the increase in accuracy of Igor's performance concerning the DLS of toothbrushing after watching the video, it is assumed that such improvement may be related to observational learning. For Catania (1998), observational learning involves two possible effects. One effect would be on performance, which consists of the child doing what they were capable of doing after observing the consequences for the model. Another effect would be learning, which consists of the child performing a new behavior, after observing the consequences received by the model. Previous studies show that, after changing reinforcement schedules, the researchers observed changes in behavior as result of observation (Deguchi *et al.*, 1988), suggesting changes in the performance of the participants. In the present study, Igor did not perform all DLS steps in the probe and baseline measurement, which shows that he did have such skills. Furthermore, with no manipulation of reinforcement schedules at the final probe, Igor performed the DLS. Such data suggests that monitoring skills may have contributed to learning DLS via VM.

Another important aspect of this study, compared to studies on VM, is that learning by observation via video was a variable studied in a more isolated way. Studies on VM used videos combined with oral instructions, for example (Cannella-Malone et al, 2006, 2011). In those cases, it is difficult to be sure that the effects on participants' performance are truly a function of what they observed on the videos, whether their performance is under the control of oral instruction.

It is possible that such mixed strategy contributed to the learning of the children who participated in these studies, since a systematic review of literature on the present topic (Wynkoop *et al.*, 2018) states that interventions carried out only with MV proved to be less effective than those that combine the use of video with help strategies and error correction procedures. In the present study, two differences were noted: a) the animated characters that made up the videos were only presented at the end, and b) only light levels of assistance were used (partial physical assistance with delay), which were infrequent (Victor, in four steps out of a total of 178; Igor, in 35 steps out of 105). Such data point to the possibility that the acquired monitoring repertoire contributed to learning via VM.

It is important to highlight the number of training sessions via VM that were necessary to reach the mastery criteria of DLS in the present study. Victor needed two training sessions to reach the learning criterion for two DLSs and showed generalization on the first test. Igor needed three training sessions to reach the learning criterion for "sandwich preparation." He did not show generalization in the first test. He was given another three sessions to reach criterion for a new DLS, then he showed generalization after one single exposure to a video of a third DLS. Comparing such data with the most recent data reported in literature on MV and DLS teaching (*e.g.* Wynkoop *et al.*, 2018), one can come to the conclusion that the procedure used in the present study was efficient, precisely because it enabled learning through observation in few sessions. It is assumed, therefore, that monitoring repertoire is required to learn via VM, or, at least, it seems to facilitate the acquisition of DLS via observation.

The data from the present study corroborate those reported by Pereira-Delgado and Greer (2009), Brasiliense *et al.* (2018) and Taylor *et al.* (2012) on the possibility of stablishing repertoires to monitoring correct and incorrect responses in children with ASD, and demonstrated that learning such skill, along with prompting procedures and differential reinforcement of correct responding, substantially influenced the learning of DLS via VM. However, this research presents only initial data, limiting its generalization to the population with ASD. Further research on learning via VM is needed in order to better investigate intervention possibilities with the population diagnosed with ASD. Making such teaching tool more efficient can considerably reduce the cost of the intervention and provide greater independence, autonomy, and life quality for those individuals.

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