VIDEO MODELING AS AN INTERVENTION FOR PLAY SKILL ACQUISITION IN INDIVIDUALS WITH DISABILITIES: A REVIEW OF THE LITERATURE

by

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ABSTRACT

Children with intellectual and developmental disabilities such as autism spectrum disorder (ASD) tend to need more direct instruction to support play skills than typically developing children of the same age (Lee et al., 2017). Video modeling is an evidence-based practice that is used to teach various skills (e.g. play) to children with ASD (Sani-Bozkurt & Ozen, 2015). Fragale (2014) conducted a systematic review of studies that assessed the effectiveness of video modeling on play skills in children with ASD. The purpose of this literature review sought to replicate and extend upon the findings of Fragale 2014 by identifying the effectiveness of video modeling as the sole intervention on the acquisition of play skills by including relevant articles from 2014 on, as well as broadening the targeted population's diagnosis and age. Twenty-one studies (n=75 participants) met inclusion criteria and were included in this review.

INDEX WORDS: Autism Spectrum Disorder. Intellectual Disabilities. Developmental Disabilities. Video Modeling. Play Skills. Literature Review.

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B.S., Georgia College and State University, 2019

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE

ATHENS, GEORGIA

2020

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December 2020

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CHAPTER 1

INTRODUCTION

Play is an activity to promote the development of important social, emotional, and cognitive skills (Fragale, 2014). Engagement in play activities fosters symbolic thinking, social development, and friendship formation. It also serves as an important context for learning new vocabulary and rules of conversation (Laubscher et al., 2019). Play is defined as active engagement with objects, toys, and activities either individually or with others for the purpose of recreation for nonacademic purposes. It is an activity that is done for its own sake that leads to a positive effect on the individual engaging in the activity (Smith & Pellegrini, 2008).

Children diagnosed with autism spectrum disorder (ASD), or other intellectual or developmental disabilities (IDD), often engage in inappropriate play. This can be portrayed as engagement with toys in a more restrictive or rigid manner with poorer quality play skills, than those of typically developing children of the same age (Lee et al., 2017). This limits the child's opportunities to engage with other children in interactive activities (Lee et al., 2020). Because of this, appropriate play instruction is a common goal of curricula and educational programming for young children (MacManus et al., 2015).

ASD, ID, and DD

Autism spectrum disorder is a neuro-developmental disorder that is characterized by repetitive patterns of behavior and difficulties with social interaction and communication (National Institute of Neurological Disorders and Stroke, 2015). These repetitive behaviors and limited interests manifest as restrictive play.

Intellectual and developmental disabilities typically present themselves at birth and affect an individual's physical, intellectual, and/or emotional development (National Institute of Child Health and Human Development, 2016). Intellectual disability can impact the ability to learn, reason, and problem solve. The current review includes participants with various diagnoses including severe cognitive disability, down syndrome, Pervasive Developmental Disorder-Not Otherwise Specified, and microcephaly.

Types of Play

There are several different categories of play that are defined by who the individual plays with and how they play. The forms of play included solitary (independent) and social play (involving two or more individuals) which were then further broken down into functional, pretend (or symbolic), and leisure activities.

Functional play refers to engaging, or playing, with an object or toy based on its typical function (Lee et al., 2020). This type of play is important because it promotes critical cognitive development and social interactions with others (Lee et al., 2017). For the purpose of this study, functional play included engagement with objects such as blocks, puzzles, and Legos. Symbolic, or pretend play, is defined as play in which the individual acts in a manner that is representational. Symbolic play includes object substitutions, attribution of absent or false properties, creating imaginary objects, and role playing (Laubscher et al., 2019). Pretend play can also involve narrating actions and commenting on the actions of others (Dueñas et al., 2019). This ability to demonstrate symbolic play is considered an important milestone in development due to its relationship to the development of language (Lee et al., 2020). Though engagement in leisure activities often includes functional play, they were differentiated for the purpose of this

study. Unlike functional or symbolic play, leisure activities included the active participation for the purpose of competition such as social games, video games, board games, and kickball. Leisure in this case also referred to engagement with objects other than toys like blocks and Legos such as arts and crafts.

Video Modeling

Video modeling is an evidence-based practice that is used in teaching various skills to children with ASD (Sani-Bozkurt & Ozen, 2015). This practice involves observing an individual(s), oneself, or a point-of-view video of a model engaging in the targeted behavior. The model is often portrayed engaging in a series of scripted actions and verbalizations (MacDonald et al., 2015). After watching the video, the participant is expected to engage in the behavior themselves. One important reason that video modeling is preferred is that it allows for the demonstration of the target behavior multiple times with minimal effort (Besler & Kurt, 2016).

Prerequisite Skills

For video modeling to be effective, participants must have a repertoire of certain prerequisite skills. The participant set to be included in the video model intervention must first demonstrate the ability to attend to a screen in order to effectively watch the video. Because learning from video modeling requires imitation, findings also suggest that the skills of delay imitation and matching aid in better performance following a video modeling intervention (MacDonald et al., 2015). Studies included in this review reported many prerequisite skills such as previous video model exposure, ability to follow directions, ability to attend to a video, and imitation skills.

Purpose

Fragale (2014) published a review that evaluated the effects of video modeling on the acquisition of play skills by children with ASD. Results indicated that video modeling was an effective intervention in teaching various play-related skills across the studies included. One limitation of this review was that it included studies that used various other prompting or components in combination with the video modeling. The current review shifts the focus to evaluating the effectiveness of video modeling without the of various other prompting or learning procedures. Fragale (2014) also required studies to include at least one participant with ASD, while this study broadened the population.

This purpose of this literature review is to identify, analyze, and summarize the effectiveness of video modeling as the sole intervention on the acquisition of play skills in individuals diagnosed with ASD, ID, or DD. This paper sought to extend upon the findings of Fragale 2014 by including articles published from 2014 on and identifying the common characteristics of video modeling interventions.

CHAPTER 2

METHOD

Search

An electronic database search was conducted using ERIC, PsycINFO, and MedLine. Multiple search terms were used to find articles that may be relevant to the review. The primary search terms of video model* (or video based or video instruction or video) were entered into the first search field, autism (or intellectual dis* or developmental dis* or dis*) into the second field and play (or pretend or leisure or recreation) into the third. Secondary search terms included video model* in the first search field and Applied Behavior Analysis (or Special Education) into the second field.

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was used to aid in the process of identification, screening, eligibility, and inclusion of studies for this literature review. A total of 2,383 articles were screened for this review. After assessing for eligibility and removing duplicates 21 articles fit inclusion criteria and were included in this review. Figure 1 shows this process.

Inclusion Criteria

To be included in the review, the study had to meet several inclusion criteria. First, the study must have been published no earlier than the year 2014. This is due the fact that the review by Fragale (2014) already includes the previous years. Second, at least one participant had to have a diagnosis of ASD, ID, or DD. The age of the participant ranged from preschool aged to 22 years of old (the age in which individuals no longer qualify for special education services). Third, the study included video modeling as the sole intervention. Articles that included video modeling in conjunction with another intervention, such as a prompt fading strategy or error correction strategy, were excluded from this review. However, studies including programmed reinforcement during the delivery of the video model intervention were included. Similar to Fragale 2014, video modeling was defined as a process in which the participant observed a video of a model (e.g., self or another person) engaging in a target behavior and then was expected to imitate the behavior. Fourth, studies must have reported a play behavior as the dependent variable. Play behavior was defined as functional, symbolic engagement, or leisure and could have occurred with or without materials and a partner. Unlike Fragale, this review also included social initiations (ex: “will you play with me?”) as a play behavior. Lastly, only articles that were peer-reviewed were included. Table 1 includes a summary of each included study.

Coding

After screening for inclusion criteria, the articles included in this review were analyzed and coded for using a narrative coding spreadsheet specifically designed for this review. Participant characteristics (number, gender, age, diagnosis), setting, model used in video, dependent variables, type of play (leisure, symbolic, functional), whether play was solitary or social, results (functional relationship, generalization, maintenance), and experimental design (experimental control, fidelity, social validity, and design type) were all coded for. The format of the video model used was also coded for in order to note any profound differences in effectiveness.

Single-Case Analysis and Review Framework (SCARF) was used to assess the quality and rigor of included studies. Quality refers to whether the study includes components that are considered to be important for generality or applicability (Ledford et al., 2016). It analyzes the design appropriateness, potential demonstrations of effect, reliability, and data sufficiency. Rigor refers to the extent in which researchers planned and conducted the study in a manner that produces convincing outcomes. It evaluates to what extent the study allows for confidence and in the results as well as determining areas of future research (Ledford et al., 2016). Figure 2 shows the graphs of the SCARF results.

CHAPTER 3

Results

The 21 studies included in this review all reported the use of video modeling to show positive outcomes in relation to play skills. Studies also demonstrated experimental control through the use of a single case design. The use of procedural fidelity and social validity measures was also reported across studies. The studies are discussed below in relation to whether they fell into the category solitary or social play. Within those categories the results are further broken down and presented based on the type of play the dependent variable targeted.

Participants

This literature review included a total of 75 participants. Of these participants 82.67% were male (n=62) and 21.33% were female (n=16). The most common diagnosis among the participants was ASD, making up a total of 94.67% (n=71) of the participants. There were 6.67% (n=5) of participants with intellectual disability, 1.33% (n=1) had a developmental disability other than ASD, and 1.33% (n=1) had no diagnosis (typically developing). The age of the participants ranged from age three to twenty-one years old with a median age of 6 years old.

Dependent Variables: Solitary Play

Ten out of 21 studies included play skills that targeted solitary play (Akmanoğlu & Pektaş-Karabekir, 2020; Besler & Kurt, 2016; Cardon et al., 2019; Kim, 2016; Kurnaz & Yanardag, 2018; Lee et al., 2017; Lee et al., 2020; MacManus et al. 2015; Sani-Bozkurt & Ozen, 2015; Sherrow et al., 2016; Ulke-Kurkcuoglu, 2015). One study included both solitary and social play, one per each participant (Miltenberger & Charlop, 2015). This article is not counted for in

the total percentage of solitary play articles but is included in the participant count. Twenty-nine participants engaged in a solitary play activity with an average age of 7.14 years. After articles were determined to be solitary play, they were further analyzed for what type of play the target skill served.

Symbolic

Of the 10 solitary play studies, three included engagement in symbolic, or pretend, play (Lee et al, 2020; Sani-Bozkurt, & Ozen, 2015; Ulke-Kurkcuoglu, 2015). The participant that engaged in solitary play in the study by Miltenberger & Charlop also included symbolic engagement (Miltenberger & Charlop, 2015). Two of the articles included an adapted alternating treatment design (Sani-Bozkurt, & Ozen, 2015; Ulke-Kurkcuoglu, 2015), one included a multiple baseline across participants in combination with an alternating treatment design (Miltenberger & Charlop, 2015), and one was a multiple probe across behaviors (Lee et al., 2020). All four of these studies measured for both generalization and maintenance.

In Lee et al. (2020), symbolic play included two stages. Stage one involved using the self as the agent (the child preforms the actions towards himself) and stage two involved performing the action towards a figure. The number of correct verbalizations and movements served as the dependent variable in this study. Results indicate that for all three children video modeling was effective in increasing the number of correct responses in playing with imaginary objects. These results were maintained at a relatively high level for 12 weeks following the intervention (Lee et al., 2020). In Miltenberger and Charlop (2015) the participant that engaged in solitary symbolic play was observed playing with batman and Star Wars toys (Miltenberger & Charlop, 2015). Each set of toys was paired with a video model either on an iPad or a television. The number of

pretend play verbalizations served as the dependent variable. Results indicate that video modeling led to the mastery of both target behaviors.

Sani-Bozkurt and Ozen (2015) and Ulke-Kurkcuoglu (2015) both looked at the number of correct steps completed in a task analysis. Results from both studies indicate that the video modeling intervention was effective in teaching chained pretend play tasks to children with ASD.

Functional

Four of the 10 studies included engagement in functional play (Besler & Kurt, 2016; Kim, 2016; Lee et al., 2017; MacManus et al., 2015). Three of the studies included a multiple probe design (Besler & Kurt, 2016; Lee et al., 2017; MacManus et al., 2015) and one included a multiple baseline (Kim, 2016). MacManus et al. (2015) was the only study to not measure for maintenance. All other studies included both generalization and maintenance measures.

Besler and Kurt (2016) had a dependent variable of ratio of correct responding during play with Legos. Results indicate that video modeling was effective in helping children acquire the skill of building a Lego train, as well as maintain the skill post intervention and generalize to different settings and people (Besler & Kurt, 2016). Lee et al. (2017) also measured correct play actions. Results show that video modeling served as an effective intervention.

In the study conducted by MacManus et al. (2015) and Kim (2016), researchers observed verbalizations and play actions as the dependent variables. Results of both studies show that scripted verbalizations and play actions immediately increased following the video model intervention.

Leisure

Three of the 10 studies included engagement in leisure activities (Akmanoglu & Pektas-Karabekir, 2020; Kurnaz & Yanardag, 2018; Sherrow et al.2015). All three studies included a

multiple probe design. Akmanoglu and Pektas-Karabekir (2020) looked at the percentage of correct responding during the drawing of a six-part figure. Results demonstrate that all participants met mastery criterion with all the steps of drawing a six-part figure during the video modeling intervention (Akmanoglu & Pektas-Karabekir, 2020). Kurnaz and Yanardag (2018) and Sherrow et al. (2015) observed participant engagement in video games. Results show that video modeling was effective when teaching video game skills to the participants with ASD.

Dependent Variables: Social Play

Eleven out of 21 studies included play skills that targeted social play (Camella-Malone et al., 2016; Cardon et al., 2019; Dueñas et al., 2019; Ezzeddine et al., 2020; Grosberg & Charlop, 2014; Jung & Sainato, 2015; Kourassanis et al., 2015; Laubscher et al., 2019; Macpherson, Charlop, & Miltenberger, 2015; Miltenberger & Charlop, 2015; Plavnick et al., 2015). The study that included both solitary and social play is counted for in the total percentage of social play (Miltenberger & Charlop, 2015), as well as the participant count. Forty-six participants engaged in a social play activity with the average age being 8.41 years. After articles were determined to be social play, they were further analyzed for what type of play the target skill served.

Symbolic

Three out of the eleven studies that consisted of social interaction included engagement in symbolic play activities (Dueñas et al., 2019; Grosberg & Charlop, 2014; Laubscher et al., 2019). Two of these studies consisted of a multiple probe design (Dueñas et al., 2019; Laubscher et al., 2019) while one included a multiple baseline (Grosberg & Charlop, 2014). Grosberg and Charlop (2014) was the only study to measure for both generalization and maintenance. Dueñas et al. (2019) measured for generalization only while Laubscher et al. (2019) measured for neither.

In the study by Dueñas et al. (2019), frequency of unscripted verbalizations and play actions as we all the percentage of correct imitations served as dependent variables. Following the video modeling intervention, all participants demonstrated an increase in levels of scripted and unscripted verbalizations during pretend play. Laubscher et al. (2019) looked at the number of symbolic communicative turns taken. Results of this study provide evidence that video modeling interventions are associated with an increase in the number of symbolic communicative turns taken by individuals with ASD (Laubscher et al., 2019).

Grosberg and Charlop (2014) observed the dependent variable of percentage of persistence of play bids (example: “will you play with me?”). Results demonstrate that video modeling successfully taught the persistence in social initiation bids to all participants (Grosberg & Charlop, 2014).

Functional

Two of the eleven studies included functional play engagement as the primary play skill (Cannella-Malone et al., 2016; Cardon et al., 2019). Both studies measured for both generalization and maintenance. Both studies looked at the percentage of correct steps completed during functional play with puzzles and blocks. Results conclude that video modeling can be effective in teaching functional play skills. Video prompting alone was not always sufficient to teach each step of the skill and researchers reported the need for error correction for some participants (Cannella-Malone et al., 2016).

Leisure

Six of the eleven studies included social play engagement during leisure activities (Ezzeddine et al., 2020; Grosberg & Charlop, 2014; Jung & Sainato, 2015; Kourassanis et al., 2015; Miltenberger & Charlop, 2015; Plavnick et al., 2015). All studies but Plavnick et al.

(2015) measured for both generalization and maintenance. Ezzeddine et al. (2020) and Grosberg and Charlop (2014) both looked at the percentage of social statements. Results show that video modeling is effective for some children with ASD.

The study by Jung and Sainato (2015) observed the percentage of intervals engaged with the game and peers as the dependent variables. After the introduction of the video model, engagement with games and peers increased for all three participants (Jung & Sainato, 2015). Kourassanis et al. (2015) and Miltenberger and Charlop (2015) looked at the percentage of correct steps completed independently. Results demonstrate participants met mastery criterion after the video model intervention.

Lastly, Plavnick et al. (2015) looked at the play initiations towards peers during a sharing and joining condition. Results show that none of the participants acquired the target behavior during the sharing condition. However, participants began directing initiations towards peers during the first phase of the joining condition (Plavnick et al., 2015). This finding suggests that there as an association between the environmental events depicted within the video models, the corresponding environmental events the child is experiencing, and the likelihood of participant performance and the behavior observed.

Independent Variables: Video Models

Of the twenty-one articles included in this review, video models were used as the sole intervention. Multiple electronic devices were used to provide these models to the participants. These devices included Apple iPads, iTouches, and iPhones as well as laptop computers and televisions. One study by Miltenberger and Charlop (2015) compared the effectiveness of video modeling presentation on an iPad (portable video modeling) versus a television. Results demonstrated that both video models led to the mastery of the target behaviors, but that

acquisition was slightly slower with the iPad model (Miltenberger & Charlop, 2015). Participants required more video model presentations when the intervention was implemented on the iPad.

Articles included in this review consisted of the use of different types of models within each video demonstration. These models consisted of the single or combined use of peers, adults (such as the therapist, familiar adult, or unfamiliar adult), parents, point of view modeling, or self. Effectiveness of video modeling across different models was largely non-variable.

Peer

Five out of the 21 studies included the use of only peers in the video models (Cardon et al., 2019; Kourassanis et al., 2015; Laubscher et al., 2019; Plavnick et al., 2015, Ulke-Kurkcuoglu, 2015). Models consisted of typically developing peers engaging in the target behavior of choice. Some target behaviors were chosen after observing these peers engaging in play in the natural environment.

Adult

Nine out of the 21 studies included the use of adult models (Akmanoglu & Pektas-Karabekir, 2020; Cannella-Malone et al., 2016; Charlop, & Miltenberger; Dueñas et al., 2019; Grosberg & Charlop, 2014; Jung & Sainato, 2015; MacManus et al., 2015; Macpherson, , 2015; Miltenberger & Charlop, 2015; Sherrow et al., 2015). Akmanoglu and Pektas-Karabekir (2020), Cannella-Malone et al. (2016) , Macpherson, Charlop, and Miltenberger (2015), Miltenberger and Charlop (2015), and Sherrow et al. (2015) all used a simple model of an adult engaging in the target behavior of choice. Dueñas et al. (2019) and Grosberg and Charlop (2014) all used models of multiple adults engaging together in the target behavior.

Two studies were unique in their use of adult models. In the study done by Jung and Sainato (2015) two males, one dressed as Mickey Mouse, were recorded playing the board game

Make ‘N’ Break. This served as the model for the participants Gabe and Ocean. Jody’s video model consisted of two adult females playing Candy Land, with one adult dressed as a princess. The costumes served to aid as a component of symbolic play and the opportunity for the participants to wear them was also provided. (Jung & Sainato, 2015). MacManus et al. (2015) showed only the hands of the adult model. Videos showed the adult manipulating the toys and materials and was segmented into three scenes with different sets of materials. One other article used an adult to provide a point of view model (Ezzeddine et al., 2020). These models were created using a third-person perspective and showed the familiar adults playing appropriately and engaging in conversation including social initiation, compliments, assertive statements, and statements of activity termination.

Parent

One out of twenty-one studies included the use of only a parent model (Besler & Kurt, 2016). In this study, the mothers of the participants were trained by the researchers to implement the video modeling.

Self

Two articles included the use of oneself as the model (Lee et al., 2017; Kurnaz & Yanardag, 2018). These studies consisted of the participant him or herself being recorded while engaging in the target behavior, and later watching it as the intervention model.

Combination

Some studies included the use of more than one type of model. One study included the use of a parent and the therapist for the provided model (Kim, 2016). Mothers were chosen due to the fact that they tend to be real life play partners. Two studies included the use of both peer and adult models (Lee et al., 2020; Sani-Bozkurt & Ozen, 2015).

SCARF

Figures 2-4 shows the overall quality and rigor outcomes for the included studies after coding was conducted using the Single-Case Analysis and Review Framework spreadsheet. All outcomes are scored and averaged using a 0-4 rating scale. On the graphs, each data point depicts an individual study. These data points lie within four quadrants with the total score for quality and rigor on one axis and the outcome scores on the other (Ledford et al., 2016). Studies that fall in the upper right quadrant have high rigor and positive outcomes while studies with high rigor and less ideal outcomes fall in the lower right. Studies that fall to the upper left how lower rigor with high quality outcomes while the lower left depicts studies with low rigor and inconsistent outcomes (Ledford et al., 2016). Studies that do not include generalization or maintenance are not plotted on the scatterplot.

Overall, the quality and rigor of studies included in this review fell within the upper right quadrant range meaning that the studies included in this review contained primarily high rigor and positive outcomes. Among the included studies generalization was primarily measured for through either pre and post testing or experimentally. Maintenance was measured on average between one week and one month after the interventions. SCARF results were further broken down and coded for in terms of solitary and social play. Figures 3-4 show these results.

CHAPTER 4

Discussion

The purpose of this literature review was to identify, analyze and summarize the effectiveness of video modeling on the acquisition of play skills in individuals diagnosed with ASD, ID, or DD. The discussion compares the current results with Fragale 2014 by reviewing the articles published since this review took place and identifying the common characteristics of video modeling interventions and also assessing the quality and rigor of each study. After coding and assessing the included articles, the use of video modeling as the sole intervention was found to be an effective strategy in teaching play skills to individuals diagnosed with ASD or IDD. These skills were also shown to be generalized and maintained throughout the studies that measured for such occurrences (See Table 1). These positive outcomes of video modeling are consistent to the results found in the previous review (Fragale, 2014). Unlike Fragale (2014), this review focused on evaluating the effectiveness of video modeling as the sole intervention. It extended upon the findings through coding for quality and rigor, as well as including a broader population. It also provided examples as to what prerequisite skills may be beneficial to the effectiveness of video modeling; a limitation in the previous review.

All studies in this review showed an increased level of play skills following the implementation of video models. Research findings in Sani-Bozkurt and Ozen (2015) also suggest that there is no difference in the effectiveness of video modeling between peer and adult models. Though only the video modeling of this study was included in this review, Ulke-Kurkcuoglu (2015) found that there was no difference in the effectiveness of least to most

prompting and video modeling for teaching pretend play skills. Ezzeddine et al. (2020) demonstrated an important result in terms of video modeling. This study speaks to the fact that the effectiveness of video modeling is affected by the individual participant's imitative repertoire and cannot be deemed an effective intervention for all children with ASD (Ezzeddine et al., 2020).

A primary limitation to this review is in regard to the populations found. Multiple video modeling studies have included only participants with ASD but there is limited research in the area of individuals with other diagnoses. Future research should continue to measure the effectiveness of video modeling on participants diagnosed with intellectual and developmental disabilities other than ASD. As stated in Fragale (2014) there is also still a limited amount of knowledge about what specific prerequisite skills are necessary in order for video modeling to be effective across all participants. Future research should also focus on the area of generalization across settings, materials, and participants.

This review aimed to replicate and update the findings of Fragale (2014). Twenty-one articles were assessed and evaluated to determine the overall effectiveness of video modeling alone on the acquisition of play skills. Results indicate that video modeling is an effective intervention in relation to the acquisition, generalization, and maintenance of play skills in individuals diagnosed with ASD and IDD.

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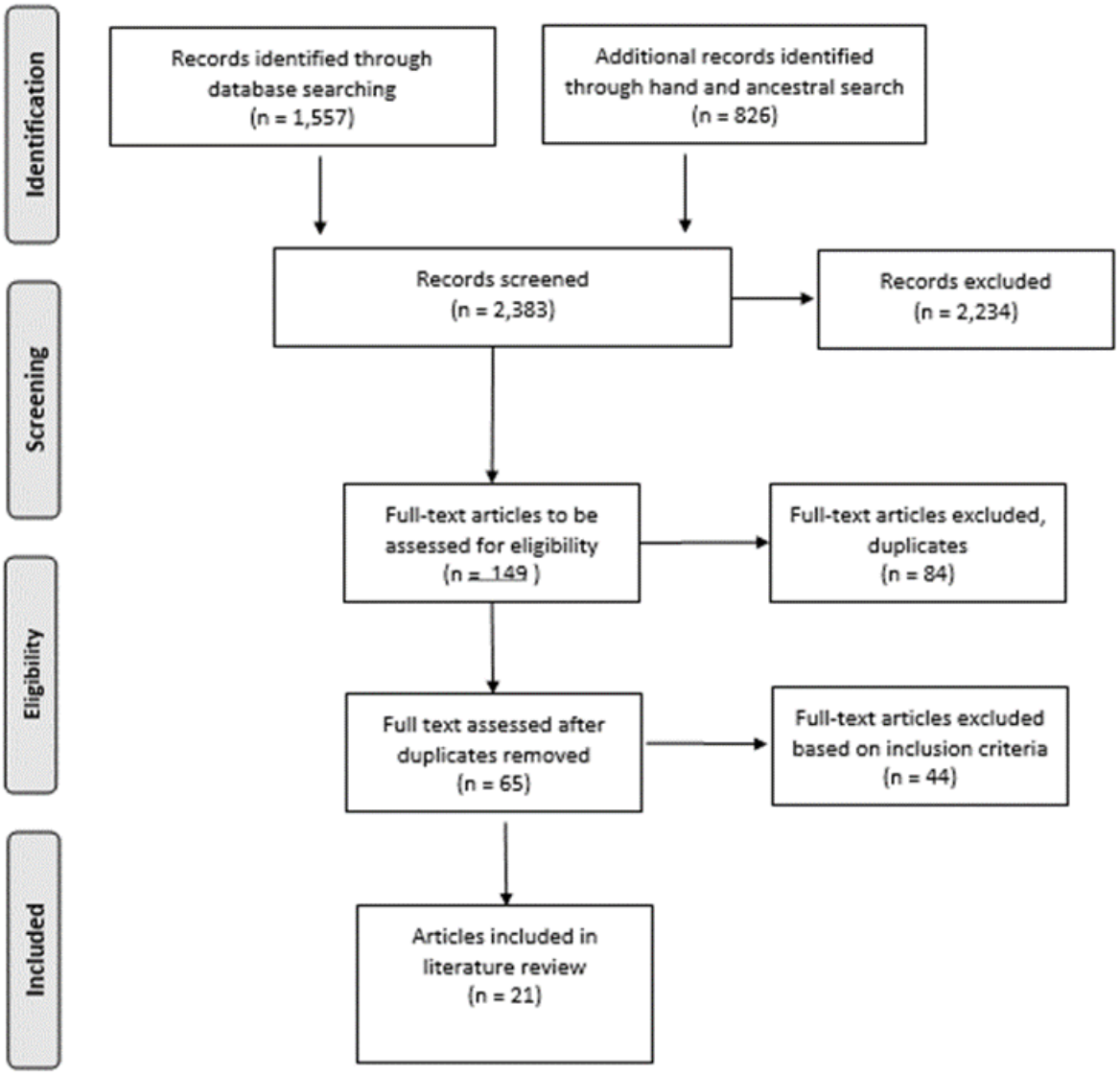
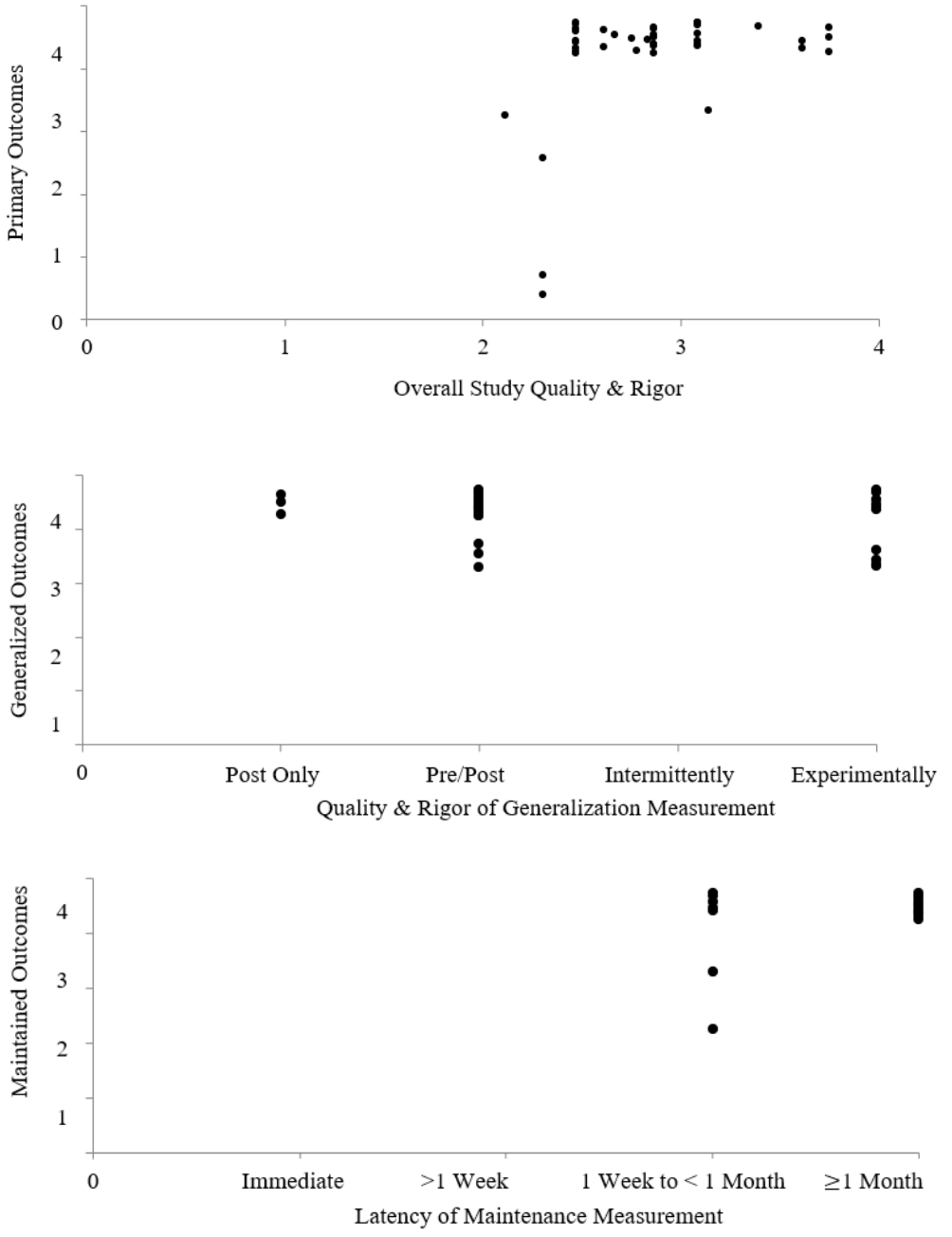
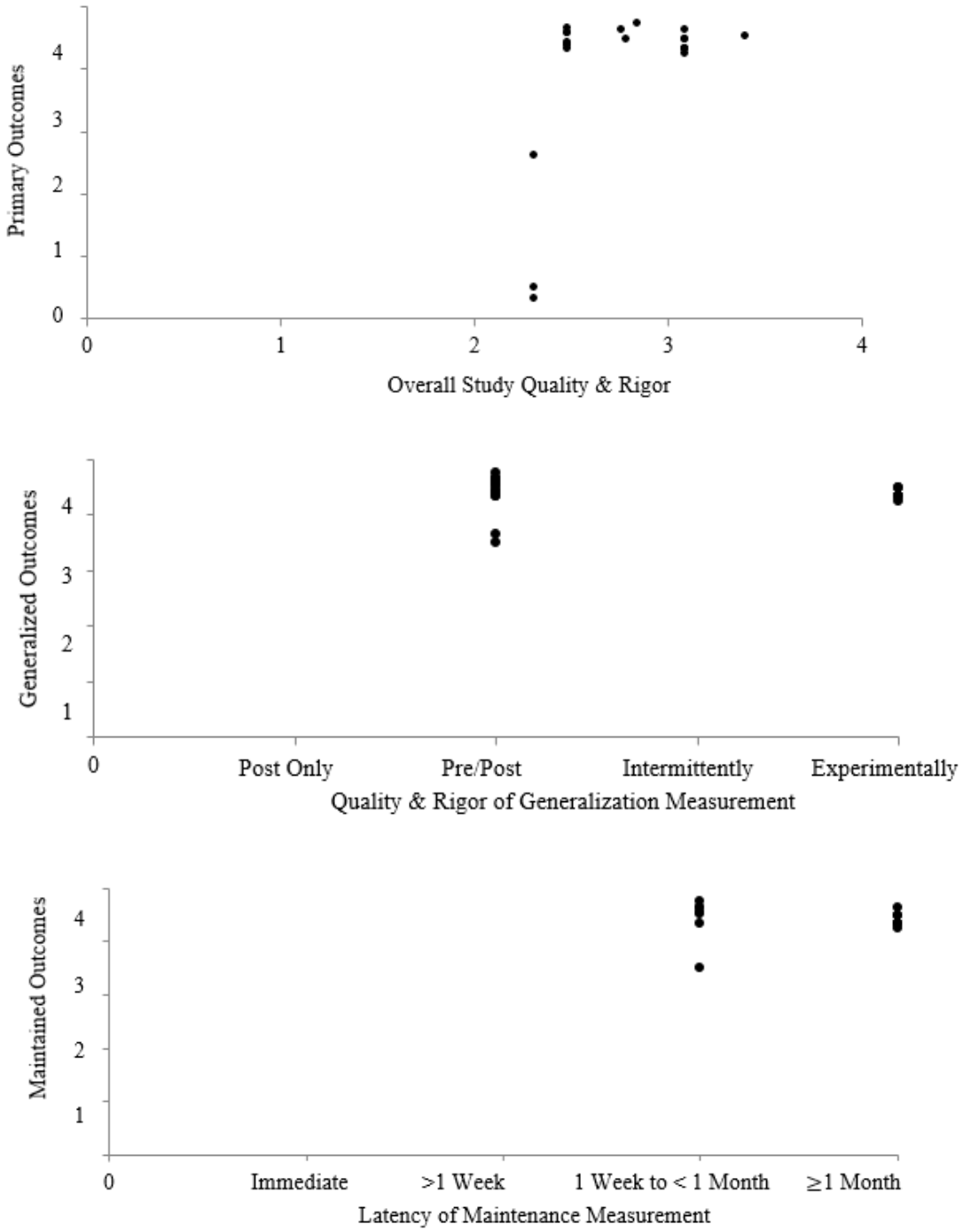


Figure 1. PRISMA



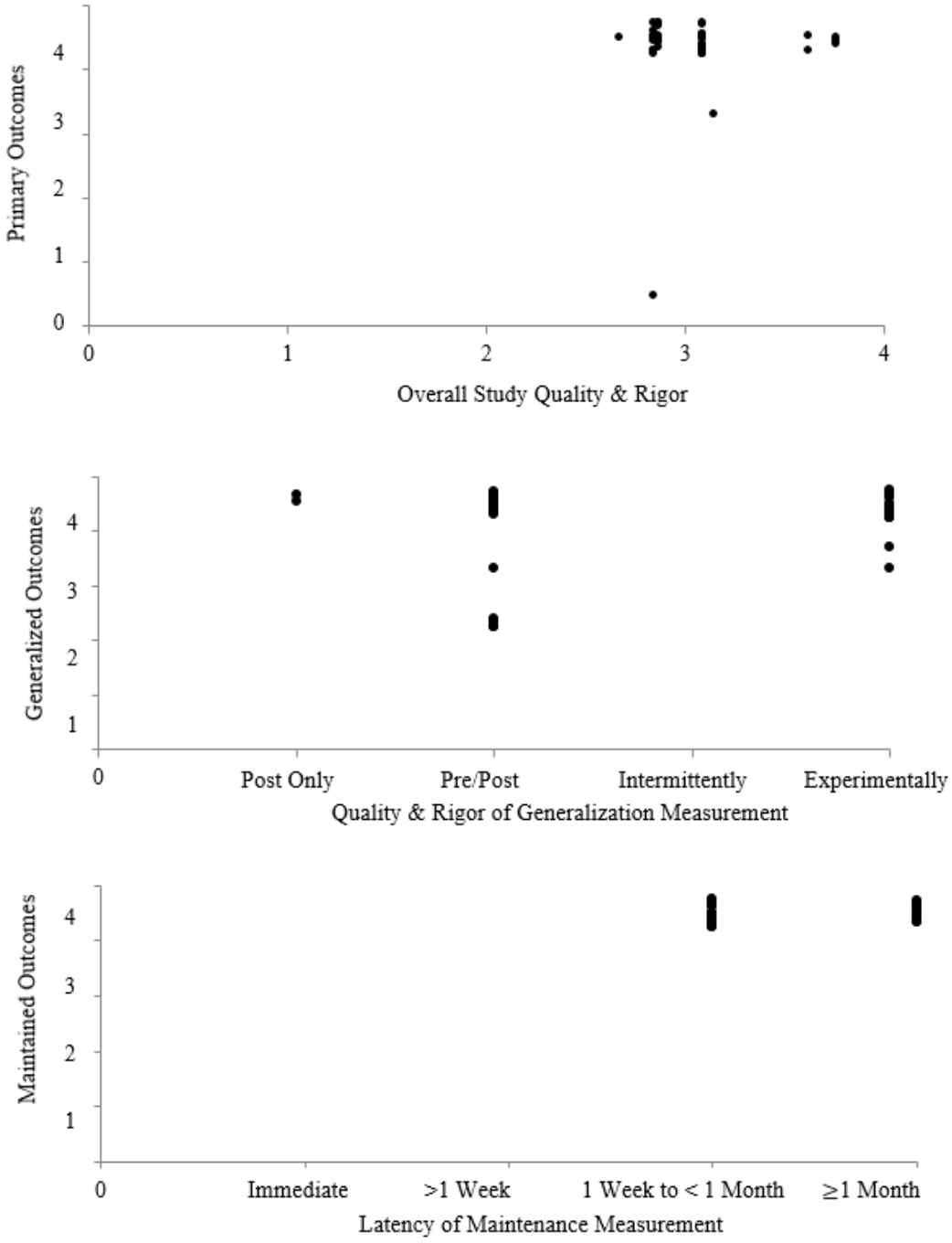
Intermittently = during the course of a single case design (e.g., in baseline and intervention conditions) but with fewer than three data points in each condition. Experimentally = in the context of a single case design with at least three data points per condition.

Figure 2. Overall SCARF Results



Intermittently = during the course of a single case design (e.g., in baseline and intervention conditions) but with fewer than three data points in each condition. Experimentally = in the context of a single case design with at least three data points per condition.

Figure 3. Solitary Play SCARF Results



Intermittently = during the course of a single case design (e.g., in baseline and intervention conditions) but with fewer than three data points in each condition. Experimentally = in the context of a single case design with at least three data points per condition.

Figure 4. Social Play SCARF Results

Table 1. Summary of Studies

Author(s)	Participants	Solitary/Social	D.V.	Play Activity	VM Type/Model	Design	General./Main
(Akmanoğlu & Pektaş-Karabekir, 2020)	N=3 (3 males, ages 5-6; ASD)	Solitary	% of correct responses	Leisure Skills; drawing a 6-part figure	Model on iPad; Adult	MP across participants	Yes
(Besler & Kurt, 2016)	N=3 (3 males, ages 5-6; ASD)	Solitary	Ratio of correct responses	Functional Play; Legos	Model on Computer, Parent	MP across participants	Yes
(Cannella-Malone et al., 2016)	N=9 (7 males, 2 females; ages 10-21; ASD & ID)	Social	% of correct steps completed	Functional; task specific to individual (ex: origami, silly selfies)	Model on iPhone; Adult	MP across behaviors	Yes
(Cardon et al., 2019)	N=8 (7 males, 1 female; ages 3-4; ASD)	Social	% of correct responding	Functional play: Sharing puzzle pieces, block building	Model on iPad; peers	Withdrawal	Yes
(Dueñas et al., 2019)	N=3 (2 males, 1 female; age 4; ASD)	Social	Frequency of unscripted verbalizations and	Symbolic play; Lakeside Lodge	Model on iPad; Adult	MP across participants	Generalization

Author(s)	Participants	Solitary/Social	D.V.	Play Activity	VM Type/Model	Design	General./Main
			play actions; % of correct imitations				
(Ezzeddine et al., 2020)	N=6 (5 males, 1 female; ages 5-9; ASD)	Social	% of scripted statements emitted	Leisure skills; board games & video games	Third person P.O.V on iPad; Adult	MP across activities	Yes
(Grosberg & Charlop, 2014)	N=4 (3 males,1 female; ages 7-9; ASD)	Social	% of persistence of play bids	Symbolic play & leisure Skills; board games, pretend tool play	Model on iTouch; therapist	MB across participants	Yes
(Jung & Sainato, 2015)	N=3 (2 males, 1 female; ages 5-6; ASD)	Social	% of intervals engaged with game and peers	Leisure Skills; Candy Land, Make and Break	Model on iPad; Adult	MP across participants	Yes
(Kim, 2016)	N=3 (2 males, 1 female; ages 6-9; ASD)	Solitary	Scripted & unscripted verbalizations & play actions	Functional play; Cooking and Animal playsets	Model on laptop; parent and therapist	MB across children	Yes

Author(s)	Participants	Solitary/Social	D.V.	Play Activity	VM Type/Model	Design	General./Main
(Kourassanis et al., 2015)	N=2 (1 male, 1 female; ages 5-6; ASD & DD)	Social	% of correct ind. steps	Leisure Skills; Duck Duck Goose & Hokey Pokey	Model on TV; peers	MB across 2 games	Yes
(Kurnaz & Yanardag, 2018)	N=4 (3 males, 1 female; age 7; ASD)	Solitary	% of correct steps in TA	Leisure Skills; Xbox	Model on laptop; Self	MP across subjects	Yes
(Laubscher et al., 2019)	N=2 (1 male and 1 female; age 8; ASD and TD)	Social	# of symbolic communicative turns taken	Symbolic play; vet clinic, action figures, ocean toys	Model on iPad; peers	MP	No
(Lee et al., 2017)	N=1 (male; age 5; ASD)	Solitary	% of correct play actions	Functional play; farm, doctor, and rescue toys	Model on laptop; Self	MP across toys	Yes
(Lee et al., 2020)	N=3 (3 males; ages 4-5; ASD)	Solitary	# of correct steps	Symbolic Play; cleaning and doll haircut	Model on laptop; Peer and adult	MP across behaviors	Yes

Author(s)	Participants	Solitary/Social	D.V.	Play Activity	VM Type/Model	Design	General./Main
(MacManus et al., 2015)*	N=3 (3 males; ages 5-6; ASD	Solitary	% of actions and vocalizations completed in chain	Functional play; bank , superhero mansion, castle	Model on DVD player; adult	MP across participants & play sets	Generalization
(Macpherson, Charlop, & Miltenberger, 2015)	N=5 (4 males, 1 female; ages 9-11; ASD)	Social	% of compliment verbalizations & gestures	Leisure Skills; Kickball	Model on iPad, Adult	MB across participants	Generalization
(Miltenberger & Charlop, 2015)	N=2** (2 males; ages 7 &11; ASD)	Solitary (P1) & social (P2)	# of pretend play verbalizations (P1); Correct Responding (P2)	Symbolic play; batman and Star Wars (P1); Leisure Skills, Go fish (P2)	Model on iPad & TV; Adult	MB across participants & AATD	Yes
(Plavnick et al., 2015)	N=3 (3 males; ages 5-6; ASD)	Social	Initiations directed towards peers	Leisure Skills; books, blocks, bingo	Model on laptop; peers	Reversal	No

Author(s)	Participants	Solitary/Social	D.V.	Play Activity	VM Type/Model	Design	General./Main
(Sani-Bozkurt & Ozen, 2015)	N=3 (2 males, 1 female; ages 5-6; ASD)	Solitary	# of correct steps in TA	Symbolic play; soup cooking and first aid	Model on laptop; peer and adult	AATD	Yes
(Sherrow et al., 2015)	N=3 (3 males; ages 17-18; ASD & ID)	Solitary	% steps completed in TA	Leisure Skills; Wii	Model on computer; Adult	MP across participants	Maintenance
(Ulke-Kurkcuoglu, 2015)***	N=3 (2 males, 1 female; ages 5-6; ASD)	Solitary	# of correct steps in TA	Symbolic Play; making pizza, doing laundry, repairing car	Model on laptop; peer	AATD	Yes

Note: MP=Multiple Probe; MB= Multiple Baseline; AATD= Adapted Alternating Treatment Design; ASD= Autism Spectrum Disorder; ID= Intellectual Disability; DD= Developmental Disability TD= typically developing; T.A. = task analysis

*Study included matrix training but met inclusion criteria because it was to promote generalization, not as an intervention

**Review excluded 3 participants whose targeted behavior did not meet inclusion criteria

*** Comparison intervention of Least to Most prompting excluded from this review