IMPROVING THE PERFORMANCE OF PHYSICAL ACTIVITY SKILLS FOR CHILDREN WITH AUTISM SPECTRUM DISORDER THROUGH MODELING: A SYSTEMATIC REVIEW

By

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Abstract

IMPROVING THE PERFORMANCE OF PHYSICAL ACTIVITY SKILLS FOR CHILDREN WITH AUTISM SPECTRUM DISORDER THROUGH MODELING: A SYSTEMATIC REVIEW

Nathan C. Merrill

Objective: The purpose of this investigation was to examine the body of literature on modeling interventions to improve physical activity skills for children with Autism Spectrum Disorder. Methods: A systematic review was implemented to identify and further examine studies that met inclusion criteria. Searches were conducted through four electronic databases within the Humboldt State University Library and included: SPORTDiscus, PubMed/Medline, ERIC, and PsychINFO. A following search was conducted of an individual search of one major journal focused on disseminating research in adapted physical education (i.e., Adapted Physical Activity Quarterly [APAQ]) and one major journal focused on disseminating research for individuals with autism spectrum disorder (i.e., Research in Autism Spectrum Disorder). Results: A total of 97 articles were selected for abstract appraisal which resulted in a total of 3 articles that met inclusion criteria. This review collectively demonstrates the evidence modeling interventions can have on improving physical activity skills for children with Autism Spectrum Disorder.

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Introduction

This systematic review analyzed pertinent literature related to the impact of modeling (i.e., video, peer) on the performance of physical activity skills for children with autism spectrum disorder (ASD). ASD is a neurodevelopmental disorder characterized by varying degrees of communication, social interaction, and restrictive and repetitive behaviors and interests (Autism Speaks, 2018). ASD can be diagnosed through developmental screening and comprehensive diagnostic evaluations (Lord et al., 2006). Children with ASD collectively experience a degree of general motor impairment and usually do not exercise at moderate to vigorous physical activity (MVPA) levels as often as their typically developing peers (Bandini et al., 2013; Tyler, MacDonald, & Menear, 2014; Whyatt & Craig, 2012). These motor impairments are a result of barriers that children with ASD encounter, such as delays in motor planning (Obrusnikova & Cavalier, 2011). Therefore, this investigation is focusing on identifying how modeling interventions have impacted the performance of physical activity skills for children with ASD.

Performance Levels of Gross Motor Skills for Children with ASD

Performance levels of gross motor skills for children with ASD are usually characterized by under development and a lack of opportunities for improvement (Tyler et al., 2014). Movement impairments, such as lack of balance, slower speed of timed movements, manual dexterity, concepts of momentum, timing, and overall coordination

have all been reported when compared to their typically developing peers (Green et al., 2009; Staples & Reid, 2010; Whyatt & Craig, 2012). Further, researchers have reported children with ASD performing in the poor to very poor category on standardized test (i.e., TGMD-2, Ulrich; Berkeley et al. 2001). These results may be due to a lack of whole body coordination when performing simultaneous movements (i.e., requiring both legs and arms; Provost, Heimerl, & Lopez, 2007). Additionally, other researchers have reported children with ASD as having the same or similar levels of performance when compared to their chronological and mentally age-matched peers with developmental delays (Folio & Fewell, 2000). Although there has been a minute amount of research directly focused on the performance of gross motor skills, the results have been consistent within this population compared to their typically developing peers (Whyatt & Craig, 2012).

Barriers to the Development of Gross Motor Skills

Children with ASD encounter different types of barriers which may hinder the development of various physical activity skills such as gross motor skills, fine motor skills, and object control skills (Obrusnikova & Cavalier, 2011; Roberts & Barnard, 2005). The social ecological model which consist of six categories; (a) intrapersonal, (b) interpersonal, (c) institutional, (d) community, (e) public policy and (f) physical factors provides a guided framework on the different types of barriers that are prevalent to the development of physical activity skills for children with ASD (Obrusnikova & Cavalier, 2011). Intrapersonal barriers consist of characteristics (e.g., behavioral outbursts, social

impairments, repetitive behaviors) associated with ASD, while interpersonal barriers consist of animal and human behavior in relation to a child (e.g., peer support, pet sedentary behaviors, and family support; Obrusnikova & Cavalier, 2011). Institutional barriers consist of formal and informal contexts within social institutions (e.g., methods of instruction, degree of inclusion, time spent in activity; Obrusnikova & Cavalier, 2011; Must, Phillips, Curtin, & Bandini, 2015). Community barriers consist of the accessibility of physical activity programs (e.g., amount of programs, community infrastructure). Public policy barriers consist of laws that affect access to physical activity. Physical barriers consist of the physical context (e.g., quality or quantity of equipment; Obrusnikova & Cavalier, 2011; Must et al., 2015). Overall, intrapersonal, interpersonal, and physical barriers have been reported more frequently and researchers have suggested that these barriers hinder the development of physical activity skills for children with ASD within the physical education and extracurricular settings (Obrusnikova & Cavalier, 2011).

Physical Activity Levels for Children with ASD

Children with ASD usually do not exercise at MVPA levels as often as their typically developing peers (Bandini et al., 2013; Tyler et al., 2014). This lack of time that children with ASD experience in MVPA results in an increased likelihood of experiencing cardiovascular, pulmonary, and metabolic diseases (Roberts & Barnard, 2005). Researchers have reported that children with ASD also experience declines in physical activity as they continue to age (Macdonald, Esposito, & Ulrich, 2011). These

findings highlight the need for specialized physical education programs in order to bridge the gap of time spent in activity annually for children with ASD (Macdonald et al., 2011).

Evidence Based Practices

Evidence based practices (EBPs) are interventions that have shown efficacy and elicited positive student outcomes over time (Hutzler, 2011). According to the Every Student Succeeds Act of 2015 teaching practices must be based on evidence of effectiveness (Stahmer, Suhrheinrich, Schetter, & Hassrick, 2018). EBPs are essential to bridging the gap between research and application; it is important to note that over the years educators have utilized a number of terms to identify practices that are considered to be effective (Cook & Cook, 2013). These terms consist of best practices, recommended practices, research based practices, practices supported by scientifically based research, and EBPs and all have distinct meanings and imply a different standard of empirical support (Cook & Cook, 2013).

Modeling

Modeling was considered an EBP by the National Professional Development Center (NPDC, 2015) and National Autism Center (NAC, 2015; Sam, 2016 & Odom, Collet-Klingenberg, Rogers, & Hatton, 2010). Modeling can be effectively utilized by a parent, family member, or a variety of professionals to help increase a learner's ability to perform a new target skill or behavior (Sam, 2015). Modeling requires the learner to observe someone correctly performing a target skill or behavior, and it is most effective

when paired with prompting and reinforcement (Sam, 2015). Researchers have reported that modeling is also utilized to prompt or prime new skills and behaviors, as well as, an effective instructional strategy for improving academic, social, communication, and play skills in early intervention, preschool, elementary school, and high school settings (Landa, Holman, O'neill, & Stuart, 2011;Sam, 2015).

Peer Modeling

Peer modeling refers to information that is transferred through the observation of a peer and has been shown to be effective in improving skills (e.g., requesting assistance, joining an activity, following directions, greetings) for young children and elementary aged children with ASD (Battaglia & Radley, 2014; Hartup, 1992). Peer modeling is a type of peer-mediated instruction and intervention and is considered to be effective in increasing social and communication skills (Battaglia & Radley, 2014; McConnell, 2002; Laushey & Heflin, 2000). Further, researchers have demonstrated that when working with a child with ASD the peer model should be a peer in similar size and stature and someone who has a developed relationship with the child (e.g., teacher, paraprofessional, therapist, parent; Sam, 2015).

Video Modeling

Video modeling is an intervention that uses technology (i.e., video recording and display equipment) to provide a visual model of a targeted behavior or skill (Cox, 2018). There are four main types of video modeling: (a) basic video modeling, (b) video self-

modeling, (c) point-of-view video modeling, and (d) video prompting (Cox, 2018). The term video modeling is used broadly to encompass the perspective of the intervention and the use of self or others (e.g., peer or adult) as the model (Delano, 2007). Video modeling recordings may be created for a wide array of skills (e.g., social, communication, functional) and in a variety of settings (e.g., home, school, community; Delano, 2007) and can be displayed on a computer, television monitor, or on various hand-held devices including a tablet or Smart phone (Bittner, Rigby, Silliman-French, 2017). Video modeling is often combined with prompting and reinforcement to maximize the learner's ability to generalize a new skill or behavior (Cox, 2018).

Modeling Interventions Outside of the Physical Education Setting

Modeling interventions have been considered to be effective in improving a wide variety of skills across a variety of settings (i.e., playground, classroom, theater) outside of the physical education setting. This table demonstrates the efficacy modeling interventions have had in improving skills for children with ASD. These skills may also translate over to the physical education, as well as demonstrate the potential modeling interventions can have in developing physical activity skills.

Table 1 Modeling Study Characteristics

Authors and Year	Purpose	Intervention	Outcomes	Discussion
Plavnick (2012)	To construct a viewing and attending progression (e.g., routine for student implementation of video modeling) of a skill on a portable device for children with ASD	Video modeling	During imitation training, Joey progressed and was able to attend to the iPhone 3G for up to 26 s after 60 total trials delivered over five training days. After learning to attend to the video screen, Joey started imitating picture exchange communication as displayed by the video model during imitation training. Joey later demonstrated generalization of the attending response to request preferred events from educators.	This study helped show that a child with ASD who did not initially attend to a video screen could benefit from video modeling. The participant in this study did not attend to a video screen or imitate the behavior of a peer video model prior to intervention. The training progression used during the attending training condition lead to a rapid increase in duration of attending behavior. Joey successfully communicated behaviors consisted of chasing, delivering a ball, and performing a high five.
Cardon & Wilcox (2010)	To determine if reciprocal imitation training and video modeling were effective in promoting imitation acquisition for children with ASD	Video modeling and reciprocal imitation training	This study utilized two teaching methods (e.g., video modeling, experimenter demonstration) All three participants in the video modeling condition demonstrated increased gains in the frequency of actions imitated by their second session. All three participants in the video modeling training condition were able to generalize their imitation skills with the experimenter and a caregiver using never before seen toys.	Participants in the video modeling condition demonstrated a rapid increase in their imitation skills overall, whereas the participants in the reciprocal imitation training condition showed more of a steady increase over sessions. This study helped show that Video modeling is a technique that can support object imitation acquisition in very young children with autism who watch television. Both response intervention training and video modeling were effective at promoting varying levels of imitation acquisition that maintained and generalized.
Charlop-Christy & Freeman (2000)	To compare the effectiveness of in vivo modeling (e.g., ongoing peer	Video and in vivo modeling	Children's behaviors generalized after presentations of video modeling, but did not generalize after in-vivo modeling. Three	Video modeling led to quicker acquisition of skills than in vivo modeling. The results of this study suggest that video modeling is an effective and efficient technique for teaching

Authors and Year	Purpose	Intervention	Outcomes	Discussion
	modeling) and video modeling in improving target behaviors for children with ASD		participants required approximately twice as many presentations for their performance to reach criterion in the in vivo condition. The amount of time it took to train the models and to implement all the in vivo modeling sessions was greater than the amount of time needed for the video modeling conditions in every case except for one participant	children with autism a number of different behaviors. All five children acquired their specific target behaviors quickly after the video modeling intervention. Video modeling also promoted generalization of these tasks across different persons, settings, and stimuli, whereas in vivo modeling did not.
Sancho, Sidener, Reeve, & Sidener (2010)	To directly compare the effectiveness of two types of video modeling for teaching play skills to children with ASD	Video modeling	Both participants attended to the video during 100% of time across all sessions in both conditions (e.g., video priming, simultaneous video modeling). Procedures appeared to be equally effective in terms of acquisition of targeted performances for one participant. For the other participant, targeted performances were acquired more quickly in the simultaneous video modeling condition.	Both video modeling procedures proved to be effective in teaching and producing maintenance of play skills. However, video priming without the use of prompts and reinforcement may be more effective compared to simultaneous video modeling.
Ozen, Batu, and Birkan (2012)	To determine if video modeling was effective in teaching sociodramatic play skills in small group settings for children with ASD	Video modeling	This study revealed that all participants successfully learned sociodramatic play skills in a small group setting. The total numbers of training sessions implemented were 48. The data collected showed that video modeling was	Video modeling was effective in teaching sociodramatic play skills in a small group setting. The social validity data also showed that children were happy to participate in this study. Video modeling is also considered to be a child friendly technique for children with ASD.

Authors and Year	Purpose	Intervention	Outcomes	Discussion
			an effective way to teach sociodramatic play skills (e.g., role playing skills) to children with ASD.	
Hine & Wolery (2006)	To evaluate the effectiveness of point-of-view video modeling on performance of play actions by children with ASD	Video modeling	The results displayed that video modeling was effective in teaching specific actions for toys and sensory materials to two girls with ASD. In three of four behavior sets the children acquired new play behaviors in the absence of reinforcement and without instructional cues.	Video modeling interventions capitalize on the visual strengths of ASD. This study indicates that video modeling positively improves play skills after implementation and served to be efficient in terms of intervention preparation. In full, video modeling interventions can be effective in improving play skills for children with ASD.
Egel, Richman, & Koegel (1981)	To assess the effectiveness of peer models in facilitating new targeted behaviors for children with ASD	Peer modeling	All participants were responding below 50% during baseline condition with no model. After peer models were implemented participants met 80% criterion of new targeted behaviors. Once peer models were removed participants maintained correct responses.	This investigation suggests peer modeling to be effective in accommodating children with ASD in learning new targeted behaviors.
Corbett, Gunther, Comins, Price,Ryan , Simon, & Rios, T. (2011)	To evaluate a theatrical intervention program (e.g., socioemotional functioning and stress control) designed to improve socioemotional functioning for children with ASD	Peer modeling & video modeling	There were no statistical differences in pre-post comparisons. It is unclear whether the intervention had any effect or if the sample size was too small to detect definitive results.	The participants showed small improvements in social perception, face identification, and theory of mind skills. This study infers that reciprocal social interaction through in vivo modeling, video modeling, and role playing may facilitate social awareness in children with ASD.

Authors and Year	Purpose	Intervention	Outcomes	Discussion
Wilson (2013)	To compare video and in vivo modeling as classroom-based social-communication interventions for children with ASD	In vivo modeling and video modeling	Three participants responded to one or both treatments. The outcomes favored video modeling in the first case, in vivo modeling in the second, and both were equally effective in the third case. These results vary from other investigations that have shown video modeling to be as effective or even more effective compared to in vivo modeling for children with ASD.	This study suggests that children with ASD may learn more efficiently through in vivo modeling, or possibly even a combination of modeling interventions. These results offer evidence on the efficacy of both modeling interventions for children with ASD. These results also show the need for additional research on investigating the characteristics or skills best suited towards the specific type of modeling intervention to implement for children with ASD.
Locke, Rotheram-Fuller, & Kasari (2012)	To expand and strengthen the efficacy of existing literature on typically developing peer models for children with ASD	Peer modeling	Results showed that typically-developing peer models were socially adept and better connected to children with ASD compared to their non-peer models from start to end of the intervention. These findings also convey that there are specific characteristics in children that reoccur when selecting a peer model and there was no negative stigma attached to filling this role.	This Study shows that teachers often select students who are perceived as popular and that also demonstrate competent social skills. These could be helpful characteristics in peer models to help further develop the social skills of children with ASD. A child with ASD may experience more opportunities to further develop their social skills and overall acceptance by the group just by affiliation with a popular peer model.
Ganz, Bourgeois, Flores, & Campos (2008)	To investigate the efficacy of an intervention to improve peer imitation skills for children with ASD	Peer imitation training	Results showed visually cued imitation training to be effective increasing both prompted and unprompted behaviors for three out of the four participants.	This study showed an improvement in imitation skills for children with ASD and developmental delays. The study utilized visual cues and prompting to improve peer imitation. This strategy may be easier for a teacher to utilize instead of consistently repeating verbal reminders for children to imitate their peers in a small group setting.

Authors and Year	Purpose	Intervention	Outcomes	Discussion
Cihak, Fahrenkrog, Ayres, & Smith (2010)	To examine the effects of using video-modeling transition procedures for children with ASD	Video modeling And response based prompting	The mean number of independent transitions made by students during baseline was 7%. Implementation of the video modeling intervention increased independent transitions by students to 77%.	This study demonstrates that children with ASD who have severe behavior problems can improve behavioral functioning in the general education setting through video modeling transition training. Video modeling and response based prompting elicited independent transitions by children with ASD in a public school general education setting.

Literature Review

This systematic review focused on pertinent literature pertaining to how modeling has impacted the performance of physical activity skills for children with ASD. The literature examined in the current review includes literature related to the impact of modeling (i.e., peer modeling, video modeling) on the performance of physical activity skills.

Gross motor skills

Performing gross motor skills for children with ASD can be a safe and inexpensive option to improving overall health (i.e., increased muscle mass) and quality of life (i.e., health related disease prevention; Bittner et al., 2017; Obrusnikova & Cavalier, 2011; Staples & Reid, 2010). Gross motor skills are those involving the large muscles of the body, as in walking, jumping, and kicking (Mechling & Swindle, 2003). Researchers have reported that children with ASD have demonstrated improvements in completing gross motor tasks with the use of video modeling (Mechling & Swindle, 2003). Additionally, Kourassanis, Jones, and Fienup (2015) reported that peer video modeling improved children′s performance of chained gross motor behaviors across social games. Children with ASD have also been shown to experience a decrease in behavioral outbursts during and after activity sessions that require the use of gross motor skills (Bittner et al., 2017). For these reasons, individuals working with children with

ASD should implement instructional strategies (e.g., modeling) that increase gross motor skills for children with ASD.

Modeling

Utilizing modeling benefits instructors by providing a more economical approach to accommodating children with ASD compared to one-on-one instruction (Taylor & Dequinzio, 2012). Instructors will need to teach and improve observational skills for children with ASD, such as attending to others, imitating actions after a delay, and identifying and discriminating results. Observational learning is aimed to help the learner imitate or reproduce a modeled behavior and can be implemented to help the student learn vicariously through the modeling of a target (Bandura & Walters, 1977). Researchers have reported that children with ASD have benefited from modeling through improvements in numerous skills (Bellini & Akullian, 2007). These improvements can be linked to an increase in observation skills that are essential to target skill or behavior acquisition during modeling (Cardon & Wilcox, 2011). Developing these skills will be important for helping a child with ASD transition into a group setting (Taylor & Dequinzio, 2012).

Peer Modeling

Peer modeling, before and during an activity, has shown to be effective for children with ASD in developing new target skills and target behaviors (i.e. how to request assistance, join an activity, following group instruction; Battaglia & Radley,

2014). Small group settings utilizing peer video modeling, peer modeling, and ongoing peer modeling during an activity have shown to be effective in developing social skills, observational skills, and chained social game behaviors for children with ASD (D'Ateno, Mangiapanello, & Taylor 2003; Kourassanis et al., 2015; MacDonald, Sacramone, Mansfield, Wiltz, & Ahern, 2009). Peer modeling is considered to be most effective when the model is similar in stature and appearance to the learner, as well as, respected by the learner (Sam, 2015). Peer modeling can be provided by a typically developing peer or a peer with a disability who has mastered the targeted skill or behavior (Laushey & Heflin, 2000). Peer modeling also helps children with ASD to develop peer networks. Peer networks are relationships that children with ASD build with their peers during experiences interacting with one another while they are learning and developing new skills. Children with ASD may be able to benefit from these peer networks outside of the structured class environment (Sam, 2015). Ongoing peer modeling during an activity is a practical intervention that instructors can implement when teaching children with ASD in a group setting (D'Ateno et al., 2003; Kourassanis et al., 2015; MacDonald et al., 2009). Ongoing peer modeling is a practical intervention because the opportunity to implement this intervention is typically always available when teaching children with ASD in a group setting. For these reasons, individuals working with children with ASD should implement peer modeling interventions to improve social and observational skills in order to enhance the development of physical activity skills.

Video Modeling

Researchers have reported children with ASD perform at higher levels when information is presented to them visually as opposed to verbally (Obrusnikova & Cavalier, 2011; Must et al., 2015). Utilizing video modeling to prepare a child with ASD for an upcoming activity provides the child the opportunity to view the modeled demonstration of a targeted skill multiple times before participating in a given activity (Bittner et al., 2017; Kourassanis et al., 2015). Additionally, this procedure prepares the child with ASD to participate and further develop the targeted skill during the scheduled activity and may increase the amount of time engaged in the target activity when compared to traditional teaching styles (Bittner et al., 2017; Kourassanis et al., 2015). Further, teachers have supported elementary school as an appropriate time to implement video modeling to improve gross motor skills for children with ASD (Mechling & Swindle, 2003), as video modeling has shown to be effective in improving a variety skills (i.e. transitional skills, chained skills, sociodramatic play skills) in a small group setting (Corbett, et al., 2011; Smith, Ayres, Mechling, & Smith, 2013). The above reports provide support for the effectiveness that video modeling can have on teaching children with ASD a wide array of targeted skills. For these reason professionals working with children with ASD should consider implementing video modeling in the physical education setting to improve physical activity skills.

Purpose Statement

The purpose of this investigation was to determine how modeling has impacted the physical skills of children with ASD.

Method

Search strategy

Key terms identified for this investigation were determined through a review of past literature pertaining to the performance of gross motor skills for children with autism spectrum disorder (ASD). Ten key terms were identified and were grouped into three categories: (a) disability, (b) modeling type, and (c) gross motor skill. Disability key terms consisted of: autism, autism spectrum disorder, Asperger's syndrome, and pervasive development disorder-not otherwise specified (PDD-NOS). Modeling type key terms consisted of: modeling, video modeling, and peer modeling. Finally, gross motor skill key terms included: fundamental skills, gross motor, locomotor skills, object control skills, and ball skills. A combination of these terms were searched throughout four academic databases within the Humboldt State University Library and included: SPORTDiscus, PubMed/Medline, ERIC, and PsychINFO. The primary researcher also included an individual search of one major journal focused on disseminating research in adapted physical education (i.e., Adapted Physical Activity Quarterly [APAQ]) and one major journal focused on disseminating research for individuals with autism spectrum disorder (i.e., Research in Autism Spectrum Disorder).

Inclusion Criteria

For this investigation the inclusion criteria implemented by the primary researcher within the initial screening process for each piece of literature reviewed consisted of the following: (a) the study took place in a physical education setting, (b) the study had to have at a minimum one participant with a diagnosis of ASD, (c) the study had to have implemented one type of modeling (i.e., modeling, video modeling, peer modeling) as the intervention to improve at least one gross motor skill, (d) the study was written in the English language, (e) the study was published in a peer-reviewed journal between 2007 and 2017, and (f) the study had to have at least one participant with ASD aged 5 to 12 years. See figure 1 for an illustration of the inclusion criteria utilized for this investigation.

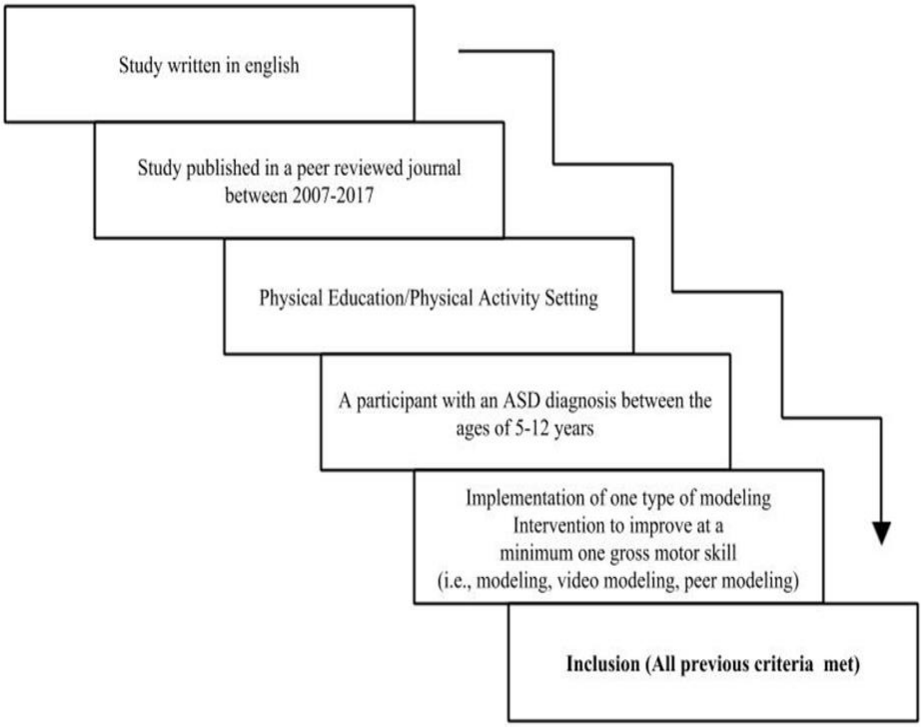

Figure 1. Inclusion Criteria Progression

Data Extraction

Data extraction for each study consisted of the following: (a) authors and year published, (b) purpose, (c) intervention used, (d) outcomes, and (e) discussion. Method and population characteristics within the included studies were selected for data extraction. The primary researcher extracted and coded the data. In studies using different diagnostic criteria, prevalent data based on the more recently published diagnostic criteria were extracted. The studies formed two groups: those that assessed the implementation of a modeling intervention (i.e., modeling, video modeling, peer modeling); and those that assessed the simultaneous implementation of multiple modeling interventions (i.e., video modeling and peer modeling).

Reliability of search procedures and inter rater agreement

The evaluation process consisted of the primary researcher reviewing all potential abstracts based on results from the key terms within each of the 5 databases. All articles that were determined to have met the inclusion criteria were noted by the primary researcher and placed onto an excel file ,within Google Docs, that provided the author and year of publication, as well as, the abstract and a hyperlink to the article for the a thesis committee member to review. If the thesis committee member determined that an article met the inclusion criteria for this study the thesis committee member would mark the box labeled "accept" within the excel file. If the thesis committee did not agree that the article met the inclusion criteria for this study the thesis committee member would mark the box labeled "not accept" within the excel file. In the event of a disagreement on the selection of articles for this study both the primary researcher and the thesis committee would meet face-to face to review the article and inclusion criteria to determine eligibility. After reviewing all potential abstracts the primary researcher and thesis committee determined that 3 studies met the inclusion criteria for this investigation. The primary researcher also evaluated two major academic research journals APAQ and Research in Autism Spectrum Disorder. The primary researcher evaluated studies within these journals publications ranging from 2007-2017. The primary researcher made an initial determination on whether each study identified met inclusion criteria. After a complete review none of the studies met inclusion criteria during the initial evaluation of both academic journals. In total, 3 studies were agreed

upon for final inclusion. This approach was utilized to establish a measure of inter-rater agreement on study selection and analysis.

Table 2 Study Characteristics meeting inclusion Criteria

Authors and Year	Purpose	Intervention	Outcomes	Discussion
Bittner, Rigby, Silliman-French, Nichols, & Dillon (2017)	To determine the effect of the Exercise Buddy (EB) app in increasing physiologic responses during physical activity versus practice style teaching methods for children with ASD.	Video modeling	The EB app elicited greater peak energy expenditure from the participants versus practice-style instruction while performing gross motor skills (e.g., locomotor). However, there was no difference between the teaching methods while performing object control skills. As for gross motor skills (e.g., locomotor), the EB app elicited a greater peak heart rate response from the participants versus practice-style instruction, However, this was not true for object control skills.	The two major findings from this study consisted of greater peak energy expenditure and heart rate response while utilizing the EB app to perform gross motor skills (e.g., locomotor) compared to practice style teaching methods. These findings are noteworthy because the implementation of the EB app may elicit similar average cardiovascular and metabolic responses when compared to practice style teaching methods.
Kourassanis, Jones, and Fienup (2015)	To extend the efficacy of video modeling on social game behavior acquisition for children with ASD.	Video and peer modeling	During baseline for "Duck Duck Goose," Participant 1's, performance ranged from 17 % to 25 % correct. Participant 2's, performance ranged from 0 % to 8 % correct. When the intervention began, Participant 1 and Participant 2 experienced an increase of 70%-75% of independent performance execution during post-video probes.	This study extends the growing literature on the efficacy of using peer-video modeling to teach social skills to children with ASD. Both participants' performance met mastery criterion after being presented with the peer-video model demonstrations. These interventions may be effective for instructing groups of children.
Mechling and Swindle (2013)	To examine the efficacy of video modeling to teach fine and gross motor tasks, and to determine if the effects differ across two groups with different disabilities.	Video modeling	Participants in both groups (e.g., moderate intellectual disability, ASD) showed improvement in ability to perform both types of tasks with implementation of video modeling. Students in group one successfully completed the gross motor tasks independently correct compared to fine motor tasks.	All participants' demonstrated improvement in completing fine and gross motor tasks during video modeling sessions compared to testing conditions with no video model demonstrations. All Participants were able to successfully complete 78.5% of the tasks after observing video modeling demonstrations.

Results

The purpose of this review was to evaluate pertinent literature focused on how modeling impacts the performance of physical activity skills for children with autism spectrum disorder (ASD). Therefore, the sections within this chapter will be divided into the following order: (a) Study Selection, (b) Study Characteristics, and (c) Summary of Evidence.

Study Selection

The search retrieved a total of 97 articles. The primary researcher and the thesis committee member screened all articles by title, abstracts, and full study evaluation to determine eligibility. The interrater agreement for the screening of articles was 100%. Three articles were accepted as scientifically admissible for this investigation. See Figure 2 below for an illustration of the study selection for this investigation.

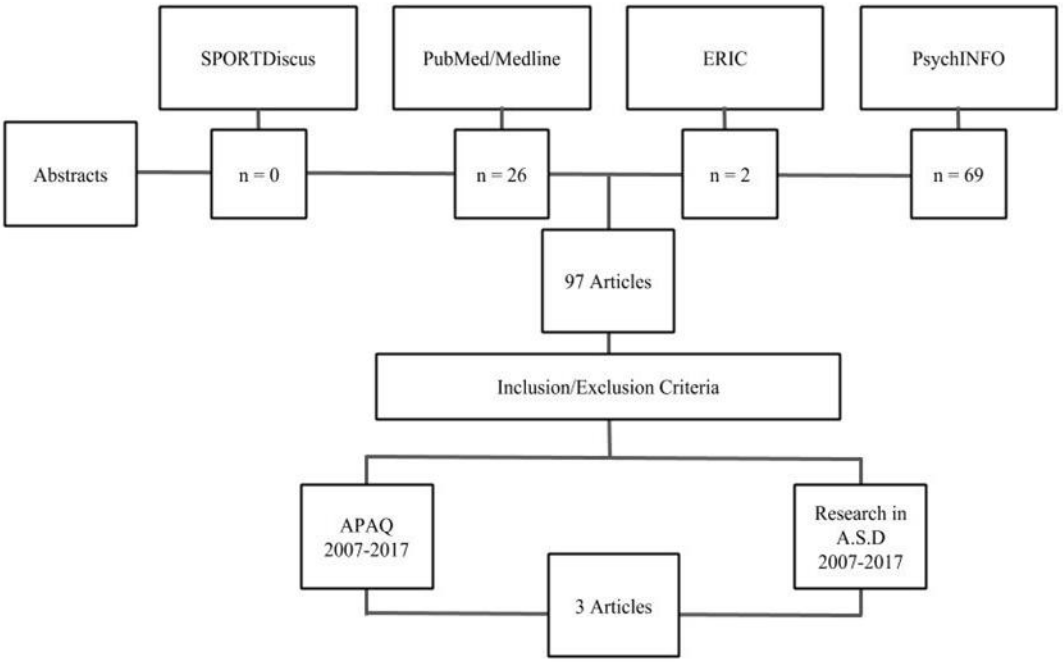

Figure 2. Search Strategy and Article Classification

Study Characteristics

In the first study, Bittner et al. (2017) utilized purposive sampling to recruit 6 participants (i.e., aged 5 to 10) who had a previous diagnosis of ASD from the Texas Woman's University outreach program. The testing protocol began with the researcher recording height and weight of each participant to calculate body mass index (BMI). Each Participant was then fitted with an Actiheart Monitor (CamNtech Inc., 2002). The Actiheart Monitor was utilized to measure energy expenditure and heart rate for each participant within the investigation. Participants were required to wear the Actiheart Monitor for the duration of each physical activity session (i.e., 12 minutes). Within each session participants began with 12 minutes of no activity (i.e., resting time) followed by a

12 minute period where each participant performed motor tasks (i.e., five locomotor, 5 object control) based on two instructional strategies (i.e., practice-style; ExerciseBuddy application) followed by a motor task. Motor tasks were developed from the Test of Gross Motor Development-2 (Ulrich, 2000) and each motor task trial lasted 2-minutes post teaching method. During both instructional strategies the instructor (i.e., research assistant) gave one general positive feedback statement (e.g., "Nice try") to each participant. Testing protocols were randomized each week with a different combination of teaching method and motor task for a total of four sessions (i.e., 1 per week).

In the second study, Kourassanis et al. (2015), recruited two participants (i.e., five and six years old) from a social skills group run by the first author at an unspecified location. The Study took place at a regularly scheduled center based program (i.e., social skills group). After participants arrived and engaged in some of the scheduled social skills group activities, a researcher escorted the participants to a separate room that contained the viewing equipment (i.e., TV, DVD player) to participate in the study. This study utilized a multiple baseline design across two social games. Within each intervention session participants first performed a social game (i.e., "Duck Duck Goose") without video modeling, feedback, or reinforcement, followed by Participants viewing a video modeling demonstration (i.e., 40 second video clip). Participants then performed the same social skill game (i.e., "Duck Duck Goose") with feedback (i.e., praise) to measure the immediate effects of video modeling. Researchers implemented the first social skill game "Duck Duck Goose" a 3 minute break (i.e., resting time) followed by the same testing protocol for the second social skill game "Hokey Pokey". Once

participants completed both social skill games they returned to their regularly scheduled social skills group. Each intervention session was recorded (i.e., video recorder).

In the third study, Mechling and Swindle (2013) recruited 6 children (i.e., aged 7 to 11) from a public school classroom at an unspecified location. Three of the children had a previous diagnosis of a moderate intellectual disability and the other 3 students had a previous diagnosis of ASD. Testing protocol took place in a separate room where viewing software and equipment (i.e., PowerPoint, Dell Latitude D620 laptop) were located. Testing protocol was done individually and it began with a no video probe to evaluate performance of a task set (i.e., 3 fine motor, 3 gross motor) with each participant. This was followed by a video modeling intervention (i.e., Gross and fine motor skill demonstration). Video Modeling clips (i.e., 6 to 19 seconds) contained voice over verbal cues for successful task completion as well as task initiation (i.e., “Do your Work” or “Work Time”). Participants then had one minute to complete a specific task after viewing the video demonstration. The video modeling interventions continued for a minimum of six sessions or until task performance data stabilized or decreased. This testing protocol (i.e., no video probe, video modeling) was replicated for each participant twice more to conclude one testing session. This study conducted 3 testing sessions per participant for a total evaluation of 18 motor tasks (i.e., 9 fine motor, 9 gross motor) with each testing session evaluating one task set (i.e., 3 fine motor, 3 gross motor). Testing sessions were conducted 3 days per week until all participants completed full evaluation.

Summary of Evidence

The Bittner et al. (2017) study consisted of the ExerciseBuddy application eliciting a greater peak energy expenditure response by participants versus practice style instruction during locomotor performance (i.e., p =.04). In addition, the ExerciseBuddy application elicited a greater peak heart rate response during locomotor performance (i.e., p =.02) compared to practice-style instruction. The study conducted by Kourassanis et al. (2015), the participant's baseline phase performance during social skills games ranged from 0 to 25 percent during each social skill game (i.e., "Duck Duck Goose", "Hokey Pokey"). Post video modeling demonstrations elicited an increase in participant's performances which ranged between 95 to 100 percent after video modeling intervention testing sessions. Finally, in the study conducted by Mechling and Swindle (2013), found that participants performed a greater percentage of gross motor tasks after viewing video modeling interventions compared to the baseline performances without video modeling interventions. While the above results are limited in the number of studies and participants, there is evidence that supports the use of video modeling interventions to improve physical activity skills for children with ASD.

Discussion

The purpose of this investigation was to assess the effectiveness of modeling interventions on improving physical activity skills for children with ASD. Following a comprehensive investigation of the literature, screening process and study appraisal, three studies were considered admissible for inclusion. In addition, a second search was conducted to further demonstrate the general effectiveness modeling interventions have had on improving general skill and performance for children with ASD. The results of this investigation collectively demonstrated that modeling interventions have been effective in improving a variety of skills (i.e., gross motor skills, object control skills, sociodramatic play skills, social skills, socioemotional skills, attending progression skills, imitation acquisition skills, and play skills) for children with ASD.

Video Modeling

The results of this investigation indicate that video modeling interventions can be effective towards improving physical activity skills for children with ASD. These results have been confirmed by a number of researchers (e.g., Bittner et al., 2017; Mechling & Swindle, 2013) who have demonstrated the efficacy of video modeling over different settings (e.g., classroom, gym setting) and age levels (i.e., 3 to 21). These results are consistent with past literature that has demonstrated video modeling to be an effective intervention for improving skills, such as social play skills (Sancho, Sidener, Reeve, & Sidener, 2010), scoiodramatic play skills (Ozen, Batu, & Birkan, 2012), and toy play

behaviors (Hine & Wolery, 2006) for children with ASD. Based on the research included in the various settings, the researcher believes video modeling can be an effective tool for children with ASD, but is apprehensive to support video modeling as an EBP within the physical education setting based on the minute amounts of literature support found in this investigation.

Video Modeling and Peer Modeling

The results of this investigation indicate that video modeling coupled with peer modeling interventions can be effective towards improving physical activity skills for children with ASD. These results have been confirmed by researchers (e.g., Kourassanis et al., 2015) who have demonstrated the efficacy of video modeling coupled with peer modeling in a gym setting and age levels (i.e., 3 to 21). These results are consistent with past literature that has demonstrated video modeling to be an effective intervention for improving skills, such as developmental skills (Charlop-Christie, Le, & Freeman, 2000), socioemotional functioning skills (Corbett et al., 2011), Social communication skills (Wilson, 2013) for children with ASD. Based on these results the researcher believes video modeling coupled with peer modeling can be an effective tool for children with ASD, but is apprehensive to support video modeling as an EBP within the physical education setting based on the minute amounts of literature support found in this investigation.

Peer Modeling

The results of this investigation indicate peer modeling interventions to be effective towards improving discrimination task skills (Egel, Richman, & Koegel, 1981) and social skills (Locke, Rotheram-Fuller, Kasari, 2012) for children with ASD. These results have demonstrated the efficacy of peer modeling in a playground and classroom setting and age levels (i.e., 3 to 21). Based on these results the researcher believes peer modeling can be an effective tool for improving discrimination task skills and social skills for children with ASD, but is apprehensive to support video modeling as an EBP within the physical education setting based on the minute amounts of literature support found in this investigation.

Conclusions

The investigation examined the evidence supporting modeling interventions for improving physical activity skills for children with ASD. As a second part of this investigation the researcher also provided supplemental literature to support the efficacy of modeling for children with ASD across a variety of skills. Results throughout this investigation indicate that modeling may be an effective intervention for improving gross motor skills for this population. Therefore, the researcher believes that modeling interventions, such as video modeling, video modeling plus peer modeling, and peer modeling should be implemented as an instructional tool within the daily schedules of children with ASD. In conclusion, the researcher believes this daily application within a

variety of settings, including physical education across all school aged children would provide ample support for the NPDC's claim of modeling as an EBP for children with ASD.

Future Research

Future research should continue expanding the literature on the impact of modeling interventions on improving physical activity skills for children with ASD. Future research should also examine which modeling interventions in combination with other identified EBPs (e.g., video modeling & peer modeling, modeling & peer modeling, modeling & video modeling) are most effective for improving physical activity skills for children with ASD. Additionally, future research should examine which modeling interventions or combination of modeling interventions are most effective in improving physical activity skills at each general ASD diagnosis level (i.e., level 1, level 2, level 3).

References

Autism Speaks . (2012, July 24). Retrieved January 27, 2018, from https://www.autismspeaks.org/

Battaglia, A. A., & Radley, K. C. (2014). Peer-mediated social skills training for children with autism spectrum disorder. *Beyond Behavior*, *23*(2), 4-13.

Bandini, L. G., Gleason, J., Curtin, C., Lividini, K., Anderson, S. E., Cermak, S. A., ... & Must, A. (2013). Comparison of physical activity between children with autism spectrum disorders and typically developing children. *Autism*, *17*(1), 44-54.

Bandura, A., & Walters, R. H. (1977). Social learning theory (Vol. 1). Englewood Cliffs, NJ: Prentice-hall.

Berkeley, S. L., Zittel, L. L., Pitney, L. V., & Nichols, S. E. (2001). Locomotor and object control skills of children diagnosed with autism. *Adapted Physical Activity Quarterly*, *18*(4), 405-416.

Bellini, S., & Akullian, J. (2007). A meta-analysis of video modeling and video self-modeling interventions for children and adolescents with autism spectrum disorders. *Exceptional children*, *73*(3), 264-287.

Bittner, M. D., Rigby, B. R., Silliman-French, L., Nichols, D. L., & Dillon, S. R. (2017). Use of technology to facilitate physical activity in children with autism spectrum disorders: A pilot study. *Physiology & behavior*, *177*, 242-246.

Cardon, T. A., & Wilcox, M. J. (2011). Promoting imitation in young children with autism: A comparison of reciprocal imitation training and video modeling. *Journal of Autism and Developmental Disorders*, *41*(5), 654-666.

Carr, E. G., & Darcy, M. (1990). Setting generality of peer modeling in children with autism. *Journal of Autism and Developmental Disorders*, *20*(1), 45-59.

Cihak, D., Fahrenkrog, C., Ayres, K. M., & Smith, C. (2010). The use of video modeling via a video iPod and a system of least prompts to improve transitional behaviors for students with autism spectrum disorders in the general education classroom. *Journal of Positive Behavior Interventions*, *12*(2), 103-115.

Charlop-Christy, M. H., Le, L., & Freeman, K. A. (2000). A comparison of video modeling with in vivo modeling for teaching children with autism. *Journal of autism and developmental disorders*, *30*(6), 537-552.

Cook, B. G., & Cook, S. C. (2013). Unraveling evidence-based practices in special education. *The Journal of Special Education*, *47*(2), 71-82.

Corbett, B. A., Gunther, J. R., Comins, D., Price, J., Ryan, N., Simon, D., ... & Rios, T. (2011). Brief report: theatre as therapy for children with autism spectrum disorder. *Journal of autism and developmental disorders*, *41*(4), 505-511.

Cox, A., & AFIRM Team. (2018). Video modeling. Chapel Hill, NC: National Professional Development Center on Autism Spectrum Disorder, FPG Child Development Center, University of North Carolina. Retrieved from http://afirm.fpg.unc.edu/video-modeling

Curtin, C., Anderson, S. E., Must, A., & Bandini, L. (2010). The prevalence of obesity in children with autism: a secondary data analysis using nationally representative data from the National Survey of Children's Health. *BMC pediatrics*, *10*(1), 11.

D'Ateno, P., Mangiapanello, K., & Taylor, B. (2003). Using video modeling to teach complex play sequences to a preschooler with autism. *Journal of Positive Behavior Interventions*, *5*(1), 5–11.

Delano, M. E. (2007). Video modeling interventions for individuals with autism. *Remedial and Special Education*, *28*(1), 33-42.

Egel, A. L., Richman, G. S., & Koegel, R. L. (1981). Normal peer models and autistic children's learning. *Journal of applied behavior analysis*, *14*(1), 3-12.

Folio, M. R., & Fewell, R. R. (2000). *Peabody developmental motor scales: Examiner's manual*. Pro-ed.

Ganz, J. B., Bourgeois, B. C., Flores, M. M., & Campos, B. A. (2008). Implementing visually cued imitation training with children with autism spectrum disorders and developmental delays. *Journal of Positive Behavior Interventions*, *10*(1), 56-66.

Green, D., Charman, T., Pickles, A., Chandler, S., Loucas, T., Simonoff, E., & Baird, G. (2009). Impairment in movement skills of children with autistic spectrum disorders. *Developmental Medicine & Child Neurology*, *51*(4), 311-316.

Hartup, W. W. (1992). Having Friends, Making Friends, and Keeping Friends: Relationships as Educational Contexts. ERIC Digest.

Hine, J. F., & Wolery, M. (2006). Using point-of-view video modeling to teach play to preschoolers with autism. *Topics in Early Childhood Special Education*, *26*(2), 83-93.

Hutzler, Y. S. (2011). Evidence-based practice and research: A challenge to the development of adapted physical activity. *Adapted Physical Activity Quarterly*, *28*(3), 189-209.

Kourassanis, J., Jones, E. A., & Fienup, D. M. (2015). Peer-video modeling: Teaching chained social game behaviors to children with ASD. *Journal of Developmental and Physical Disabilities*, *27*(1), 25-36.

Laushey, K. M., & Heflin, L. J. (2000). Enhancing social skills of kindergarten children with autism through the training of multiple peers as tutors. *Journal of Autism and Developmental Disorders*, *30*(3), 183–193.

Landa, R. J., Holman, K. C., O'neill, A. H., & Stuart, E. A. (2011). Intervention targeting development of socially synchronous engagement in toddlers with autism spectrum disorder: a randomized controlled trial. *Journal of Child Psychology and Psychiatry*, *52*(1), 13-21.

Lang, R., Kuriakose, S., Lyons, G., Mulloy, A., Boutot, A., Britt, C., ... & Lancioni, G. (2011).Use of school recess time in the education and treatment of children with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders*, *5*(4),1296-1305.

Locke, J., Rotheram-Fuller, E., & Kasari, C. (2012). Exploring the social impact of being a typical peer model for included children with autism spectrum disorder. *Journal of autism and developmental disorders*, *42*(9), 1895-1905.

Lord, C., Risi, S., DiLavore, P. S., Shulman, C., Thurm, A., & Pickles, A. (2006). Autism from 2 to 9 years of age. *Archives of general psychiatry*, *63*(6), 694-701.

MacDonald, M., Esposito, P., & Ulrich, D. (2011). The physical activity patterns of children with autism. *BMC research notes*, *4*(1), 422.

MacDonald, R., Sacramone, S., Mansfield, R., Wiltz, K., & Ahearn, W. H. (2009). Using video modeling to teach reciprocal pretend play to children with autism. *Journal of Applied Behavior Analysis*, *42*(1), 43 –55.

McConnell, S. R. (2002). Interventions to facilitate social interaction for young children with autism: Review of available research and recommendations for educational intervention and future research. *Journal of autism and developmental disorders*, *32*(5), 351–372.

McMinn, D., Acharya, R., Rowe, D. A., Gray, S. R., & Allan, J. L. (2013). Measuring activity energy expenditure: accuracy of the GT3X+ and actiheart monitors. *International Journal of Exercise Science*, *6*(3), 5.

Mechling, L. C., & Swindle, C. O. (2013). Fine and gross motor task performance when using computer-based video models by students with autism and moderate intellectual disability. *The Journal of Special Education*, *47*(3), 135-147.

Must, A., Phillips, S., Curtin, C., & Bandini, L. G. (2015). Barriers to physical activity in children with autism spectrum disorders: relationship to physical activity and screen time. *Journal of Physical Activity and Health*, *12*(4), 529-534.

Nadel, J., Aouka, N., Coulon, N., Gras-Vincendon, A., Canet, P., Fagard, J., & Bursztejn, C. (2011). Yes they can! An approach to observational learning in low-functioning children with autism. *Autism*, *15*(4), 421-435.

Obrusnikova, I., & Cavalier, A. R. (2011). Perceived barriers and facilitators of participation in after-school physical activity by children with autism spectrum disorders. *Journal of Developmental and Physical Disabilities*, *23*(3), 195-211.

Odom, S. L., Collet-Klingenberg, L., Rogers, S. J., & Hatton, D. D. (2010). Evidence-based practices in interventions for children and youth with autism spectrum disorders. Preventing school failure: *Alternative education for children and youth*, *54*(4), 275-282.

Ozen, A., Batu, S., & Birkan, B. (2012). Teaching play skills to children with autism through video modeling: Small group arrangement and observational learning. *Education and Training in Autism and Developmental Disabilities*, 84-96.

Plavnick, J. B. (2012). A practical strategy for teaching a child with autism to attend to and imitate a portable video model. *Research and Practice for Persons with Severe Disabilities*, *37*(4), 263-270.

Provost, B., Heimerl, S., & Lopez, B. R. (2007). Levels of gross and fine motor development in young children with autism spectrum disorder. *Physical and Occupational Therapy in Pediatrics*, *27*(3), 21–36.

Roberts, C. K., & Barnard, R. J. (2005). Effects of exercise and diet on chronic disease. J*ournal of Applied Physiology*, *98*(1), 3-30.

Sancho, K., Sidener, T. M., Reeve, S. A., & Sidener, D. W. (2010). Two variations of video modeling interventions for teaching play skills to children with autism. *Education and Treatment of Children*, *33*(3), 421-442.

Sam, A., & AFIRM Team. (2015). Modeling. Chapel Hill, NC: National Professional Development Center on Autism Spectrum Disorder, FPG Child Development Center, University of North Carolina. Retrieved from http://afirm.fpg.unc.edu/modeling

Sam, A., & AFIRM Team. (2016). Modeling. Chapel Hill, NC: National Professional Development Center on Autism Spectrum Disorder, FPG Child Development Center, University of North Carolina. Retrieved from http://afirm.fpg.unc.edu/modeling

Smith, M., Ayres, K., Mechling, L., & Smith, K. (2013). Comparison of the effects of video modeling with narration vs. video modeling on the functional skill acquisition of adolescents with autism. *Education and training in autism and developmental disabilities*, 164-178.

Stahmer, A. C., Suhrheinrich, J., Schetter, P. L., & Hassrick, E. M. (2018). Exploring multi-level system factors facilitating educator training and implementation of evidence-based practices (EBP): a study protocol. *Implementation Science, 13*(1), 3.

Staples, K. L., & Reid, G. (2010). Fundamental movement skills and autism spectrum disorders. *Journal of autism and developmental disorders*, *40*(2), 209-217.

Srinivasan, S. M., Pescatello, L. S., & Bhat, A. N. (2014). Current perspectives on physical activity and exercise recommendations for children and adolescents with autism spectrum disorders. *Physical therapy*, *94*(6), 875-889.

Taylor, B. A., & DeQuinzio, J. A. (2012). Observational learning and children with autism. *Behavior Modification*, *36*(3), 341-360.

Tissot, C., & Evans, R. (2003). Visual teaching strategies for children with autism. *Early Child Development and Care*, *173*(4), 425-433.

Tyler, K., MacDonald, M., & Menear, K. (2014). Physical activity and physical fitness of school-aged children and youth with autism spectrum disorders. *Autism research and treatment, 2014*.

Ulrich, D. A. (2000). TGMD 2–Test of gross motor development examiner's manual. *Austin TX: PRO-ED*, *2*.

Wilson, K. P. (2013). Teaching social-communication skills to preschoolers with autism: Efficacy of video versus in vivo modeling in the classroom. *Journal of autism and developmental disorders*, *43*(8), 1819-1831.

Whyatt, C. P., & Craig, C. M. (2012). Motor skills in children aged 7–10 years, diagnosed with autism spectrum disorder. *Journal of autism and developmental disorders*, *42*(9), 1799-1809.