

Peer-Mediated Intervention to Teach Social Interaction to People with Autism: A Systematic Review

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Abstract

The effectiveness of peer-mediated intervention (PMI) in teaching social skills to people with Autism Spectrum Disorder (ASD) has been attributed to a variety of factors, and the systematic literature reviews and meta-analyses that evaluated the effectiveness of PMI in teaching social skills to people with ASD restricted their analysis mainly to studies conducted with children or in inclusive settings. Considering this, this systematic review sought to update and expand knowledge about the relevant variables for the effectiveness of PMI in teaching social skills to people with ASD. A comprehensive search was conducted across the Scopus, Web of Science, and PubMed databases using the term “autism*” in combination with the terms “peer mediated*”, “peer interaction*”, “peer training*”, and “peer mentoring”. This search strategy yielded 70 relevant articles for further analysis. In each article, various aspects were analyzed, including but not limited to: characteristics of participants and peers, experimental environment, PMI procedures implemented, integrity measures of teaching procedures, and acquisition, generalization, and maintenance results. It was found that most studies: 1) were conducted in schools, with children with typically developing peers; 2) implemented the PMI using teaching packages consisting of Instructions, modeling, prompt, role-play and feedback; 3) showed effective or partially effective acquisition results, especially when measures of the integrity of the procedure implementation were performed. It was suggested the need for further studies to evaluate the effect of PMI on generalization and maintenance of social behaviors and its effect to establish or increase these behaviors in adolescents and adults with ASD. Additionally, some limitations to be addressed in future reviews on this topic are discussed.

Keywords

Autism Spectrum Disorder, Peer-Mediated Intervention, Social Skills

1. Introduction

Individuals diagnosed with Autism Spectrum Disorder (ASD) experience a range of challenges in communication and social interactions (American Psychiatric Association, 2013). Social interaction encompasses both verbal and nonverbal exchanges, such as playing together, engaging in turn-taking during conversations, initiating conversations or activities directed at others, answering questions, making comments, and greetings (Therrien & Light, 2018; Watkins et al., 2018). Difficulties in developing these behaviors among individuals with ASD have been linked to various unintended consequences for this population. These consequences include an increased likelihood of engaging in inappropriate behaviors, difficulties with academic tasks (Lang et al., 2010), social isolation, and peer rejection (Petursdottir et al., 2007). Additionally, individuals with ASD may experience reduced independence, challenges in establishing interpersonal relationships, and difficulties in entering the job market (Howlin et al., 2004).

In many instances, individuals with ASD do not naturally develop social interaction skills without intensive teaching (Eigsti et al., 2011). Additionally, children with ASD who acquire social skills through intensive teaching with adults may encounter difficulties in generalizing these behaviors to interactions with their peers. They may struggle with initiating and maintaining conversations or interactions (Krantz et al., 1989; Lerman et al., 2015). Consequently, there has been a growing research focus on developing interventions that effectively teach social interaction responses to individuals with ASD in recent years (Martinez et al., 2019). Within this context, interventions that utilize procedures based on Applied Behavior Analysis have been identified as effective approaches for teaching these skills to individuals within the ASD population (Camargo et al., 2014, 2016; Watkins et al., 2021).

One promising intervention for promoting the development of social skills in individuals with ASD involves teaching typically developing peers within the same age group to implement procedures based on analytic-behavioral principles (e.g., Alwahbi & Hua, 2021; McFadden et al., 2014; Oh-Young et al., 2018; Thomas & Bambara, 2020). Known as peer-mediated intervention (PMI), this intervention equips peers of individuals with ASD with skills to prompt, reinforce, initiate, and respond to social interactions initiated by individuals with ASD, either towards themselves or towards others. Notable outcomes of PMI include improvements in conversational skills (Bambara et al., 2016; Hochman et al., 2015), collaborative play (Oppenheim-Leaf et al., 2012), toy sharing (Therrien & Light, 2018), and mands¹ (Lorah et al., 2014).

The effectiveness of PMI in teaching social skills to people with ASD has been attributed to a variety of factors, such as: peers can model appropriate social behaviors; and children with ASD, by interacting with peers, may have the oppor-

¹Mands are verbal responses controlled by motivational variables, which specifies the reinforcing consequence (Skinner, 1957). For example, a person who meets a friend she/he has not seen in a long time might say, "Give me a hug."

tunity to generalize skills already learned (Watkins et al., 2015). On the other hand, some potential limitations in the use of PMI have been pointed out: the use of typically developing peers may inadvertently highlight the deficits of the individual with ASD, leading to stigmatization and increased social exclusion; and PMI may be implemented less reliably than interventions implemented by professionals (Chan et al., 2009), and may be equal in effectiveness to interventions conducted directly by professionals in inclusive settings (Camargo et al., 2016).

A number of systematic literature reviews and meta-analyses have sought to further the knowledge about the variables relevant to the effectiveness of PMI in teaching social skills to people with ASD (Chan et al., 2009; Chang & Locke, 2016; Gunning et al., 2019; Martinez et al., 2019; Wang et al., 2011; Watkins et al., 2015; Zhang & Wheeler, 2011). Chan et al. (2009) conducted a literature review (42 articles published between 1978 and 2008) that examined the effectiveness of PMI in teaching social and academic skills to people with ASD. Participant and peer characteristics, peer teaching procedures, PMI procedures used, procedure reliability, and outcomes were analyzed. The results of the review pointed to the effectiveness of PMI for teaching social and academic skills, but showed the need for evaluations of the generalization and maintenance of behaviors.

Wang et al. (2011) conducted a meta-analysis (13 studies published between 1994 and 2008) to examine the effectiveness of PMI and video modeling (providing a model through videos of the response to be emitted) in teaching social skills to children with ASD. The results showed the efficacy of both procedures, with video modeling proving to be more effective for younger children. This effect was not observed in the studies that used PMI, but the authors pointed out that in these studies the older children were only 10 years old, suggesting the need for future reviews to analyze the role of PMI in studies with older participants.

Zhang and Wheeler (2011) conducted a meta-analysis (45 studies published between 1977 and 2006) to investigate the effectiveness of PMI in teaching social interaction to children with ASD up to eight years of age. Characteristics of participants with ASD and peers, variables manipulated and measured in the intervention, and acquisition, maintenance, and generalization outcomes were analyzed. The results pointed to the effectiveness of PMI for teaching social skills to children with ASD in this age group. These results were replicated by Martinez et al. (2019) who conducted a literature review (18 articles published between 2008 and 2017) restricting the analysis to studies that employed single subject designs to evaluate the use of IMP in teaching social skills to children with ASD up to eight years of age.

Watkins et al. (2015) conducted a literature review (14 articles published between 2008 and 2014) to evaluate the effectiveness of PMI in teaching social skills to students with ASD in inclusive educational settings (regular classrooms or other school settings in which people with ASD could interact with teachers

and/or peers with typical development). The following aspects were reviewed: types of inclusive settings, characteristics of participants and peers, PMI strategies used independent variables, acquisition, generalization, and maintenance outcomes, measures for assessing the integrity of applying the procedure and social validity. The review results indicated the effectiveness of PMI in teaching social skills to children, adolescents, and adults with ASD in inclusive settings.

The result on the effectiveness of PMI for teaching social skills to children with ASD in inclusive settings was replicated by [Gunning et al. \(2019\)](#), who conducted a literature review (31 articles published between 1980 and 2018) restricting the analysis to studies with preschool participants (up to 6 years old). These two reviews pointed to the need to expand knowledge about the relationship between participant characteristics and the choice of PMI procedure implemented, about the effects of PMI in other types of settings, and about teaching social skills to adolescents and adults with ASD.

[Chang and Locke \(2016\)](#) conducted a literature review (without restriction on year of publication), to evaluate the methodological quality of studies that used group designs to study the effect of PMI in teaching social skills to children with ASD. Five articles were located, in which six primary quality indicators were evaluated: participant characteristics, independent variables, comparison condition, dependent variables, data analysis, and use of statistical tests. The results showed that the studies presented good methodological quality and were developed in inclusive settings.

As can be seen, the systematic literature reviews and meta-analyses that evaluated the effectiveness of PMI in teaching social skills to people with ASD restricted their analysis mainly to studies conducted with children ([Martinez et al., 2019](#); [Wang et al., 2011](#); [Zhang & Wheeler, 2011](#)) or in inclusive settings ([Chang & Locke, 2016](#); [Gunning et al., 2019](#); [Watkins et al., 2015](#)). The review that did not present these restrictions was conducted 13 years ago ([Chan et al., 2009](#)), and it did not evaluate data on the maintenance and generalization of the behaviors analyzed in the studies.

Considering the above, the present systematic review sought to update and expand knowledge about the relevant variables for the effectiveness of PMI in teaching social skills to people with ASD. To this end, a comprehensive analysis was conducted about the characteristics of the participants with ASD and peers, experimental environment, peer teaching procedures, PMI procedures adopted, evaluated behaviors, implementation of integrity measures of the teaching procedures, and acquisition, generalization, and maintenance results obtained in studies that used PMI in teaching social skills to people with ASD.

2. Method

2.1. Search Procedure

The systematic review adhered to the guidelines recommended by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) ([Page et](#)

al., 2021). The search was conducted across three databases: PubMed, Web of Science, and Scopus. The search strategy involved combining the term “autism” with the Boolean operator “AND” and the terms “peer mediated*,” “peer interaction*,” “peer training*,” and “peer mentoring.” No specific period was set for the search, and only articles published in English and available in peer-reviewed journals were included. The final search in the databases was conducted on October 10, 2021.

A total of 683 articles were located in the three databases. After reading the titles, 274 articles were excluded for being duplicates. Next, the abstracts of the remaining 409 articles were read, and were selected those that: 1) featured at least one participant with ASD; 2) presented empirical research of a behavior analytic perspective, using a single case design; 3) used some PMI for the establishment/enhancement of social interactions of participants with ASD. For those articles where it was not possible to verify all inclusion criteria from reading the abstract, the method section was read. Thus, 339 articles that did not fit within these criteria were excluded, resulting in the selection of 70 articles that were included in the review (see **Figure 1**).

2.2. Data Extraction

The 70 articles selected for analysis were read in their entirety and the following information was examined: 1) Profile of participants and peers: number of participants and peers, gender, age, and diagnosis; 2) Experimental environment; 3) Procedure used for peer teaching; 4) Implementation procedures of the PMI (independent variables); 5) Behaviors evaluated (dependent variables); 6) Implementation of integrity measures of the teaching procedures; and 7) Acquisition, generalization, and maintenance results found.

2.2.1. Agreement on Article Search

A second reviewer did a new search in each database using the procedures described above. The agreement index was obtained for each database using the following calculation: (lowest number of articles found/major number of articles found) \times 100. The average agreement between the databases was 99%.

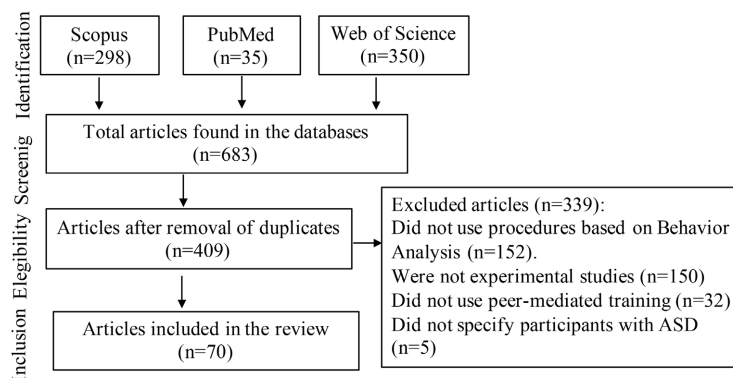


Figure 1. Number of articles obtained from the identification, screening and eligibility phases to final inclusion in the review.

2.2.2. Agreement on Inclusion of Articles

To calculate the agreement between evaluators regarding the inclusion of articles, 30% (N = 123) of the articles found in the databases were analyzed by a second evaluator. Agreement was considered when both reviewers independently reached the same opinion about the inclusion or non-inclusion of the article in the study sample. The agreement index was obtained by dividing the number of agreements by the sum of agreements plus disagreements and multiplying by 100. The percentage of agreements was 100%.

2.2.3. Agreement on Data Extraction

A second reviewer analyzed 30% (N = 21) of the articles selected, identifying the characteristics of each variable selected for analysis (see Section 2.2. Data Extraction). Agreement was considered when both reviewers independently obtained the same result for each category analyzed. The same formula described in the previous section was used to obtain the agreement index, and an average agreement index of 92% was verified.

3. Results

Information about the characteristics of participants and peers, experimental environment, peer teaching procedures, PMI procedures and evaluated behaviors, integrity of teaching procedure implementation, and results of the 70 articles included in this review is summarized below. A detailed description of this information for each article can be found in the table available at:

<https://www.researchgate.net/publication/371599929>.

3.1. Participants' Characteristics

Table 1 presents the data regarding the diagnosis, age, gender, and initial repertoire of the participants.

Out of the total 235 participants included in the study, the majority, specifically 203 individuals (86.4%), were diagnosed with ASD. The remaining participants exhibited other forms of developmental delay (e.g., Down's syndrome, N = 10, 4.2%), language delay (N = 6, 2.5%), global developmental delay (N = 15; 6.4%), and fragile X syndrome (N = 1; 1.4%). Regarding gender, 186 participants (79.1%) were male and 49 (20.9%) were female.

In terms of participant age distribution, the study included individuals across various age groups. Specifically, 23 participants (9.8%) fell within the two to three-year-old range, 55 (23.4%) were between four and five years old, 36 (15.3%) fell within the six to seven-year-old range, 41 (17.4%) were between eight and 11 years old, 52 (22.1%) were between 12 and 17 years old, and 24 participants (10%) were over 18 years old. One study did not report the exact age of the participants (Simpson, 2020). Most studies were conducted with children (79.1%, N = 47) (e.g., Urlacher et al., 2016; Yuan & Chen, 2020). Twenty-two studies (31.3%) were conducted with adolescent participants (e.g., Thomas & Bambara, 2020) and ten with adults (14.3%) (Ashbaugh et al., 2017; Davis et al., 2017).

Table 1. Number of participants and articles in the categories diagnosis, age, gender, and initial repertoire.

Categories	Characteristic	N° of participants	N° de articles
Diagnosis	ASD	203 (86.4%)	59 (84.3%)
	Other development delays	32 (13.6%)	11 (15.7%)
Age	2 and 3	23 (9.8%)	12 (17.1%)
	4 and 5	55 (23.4%)	25 (35.7%)
	6 and 7	36 (15.3%)	19 (27.1%)
	8 up to 11	41 (17.4%)	19 (27.1%)
	12 up to 17	52 (22.1%)	22 (31.4%)
	18 or more	24 (10.2%)	10 (14.3%)
	Not reported	4 (1.7%)	1 (1.4%)
Gender	Male	186 (79.1%)	67 (95.7%)
	Female	49 (20.9%)	33 (47.1%)
Initial repertoire	Functional vocalization	189 (80.4%)	53 (75.7%)
	Non-vocalizations	35 (14.9%)	12 (17.1%)
	Vocalization not functional or not understandable	11 (4.7%)	5 (7.1%)

Note: In the categories related to participants' age and gender, in the description of the number of articles the total number is higher than 70 (total number of articles included in the systematic review). This is because articles containing at least one participant with the indicated characteristic were counted for each characteristic.

Regarding initial repertoire, most participants (N = 189) had functional vocalizations (e.g., mands, tacts, intraverbals², etc.) at the beginning of the study (e.g., Chung et al., 2007), whereas 35 had no vocalizations (e.g., Trembath et al., 2009). Eleven (11) participants emitted vocalizations, however they were not functional or understandable (e.g., Thiemann-Bourque et al., 2016).

3.2. Peers' Characteristics

A total of 479 peers participated in the experiments (considering experiments that provided this information). Two studies did not describe the characteristics of the peers (Kamps et al., 2014; Lorah et al., 2014) and 68 (97.2%) provided information such as age, gender, number of peers, and presence or absence of developmental delay (see Table 2) (e.g., Oh-Young et al., 2018; Thomas & Bamba, 2020; Yuan & Chen, 2020).

²Tacts are verbal responses controlled by non-verbal stimuli, maintained by generalized reinforcement (Skinner, 1957). For example, a child who is learning the name of dog breeds says "Cocker spaniel" when seeing a dog of that breed, being praised by his parents. Intraverbals are verbal responses thematically controlled by verbal stimuli, maintained by generalized reinforcement (Skinner, 1957). For example, a child who is being taught to say his name or age, responds "John" when hearing "What is your name?", and responds "Five years old" when hearing "How old are you?", being praised in both cases.

Table 2. Number of peers and articles in the categories diagnosis, age, gender, and number of peers per participant.

Categories	Characteristic	No. of peers	No. de articles
Diagnosis	Typical development	449 (93.8%)	65 (92.8%)
	Atypical development	30 (6.2%)	3 (4.3%)
Age	2 and 3		9 (12.8%)
	4 and 5		17 (24.3%)
	6 and 7		8 (11.4%)
	8 up to 11		11 (15.8%)
	12 up to 17		21 (30%)
	18 or more		4 (5.7%)
	Not reported		20 (28.6%)
Gender	Male	164 (34.2%)	41 (58.6%)
	Female	184 (38.4%)	41 (58.6%)
	Not reported	131 (27.3%)	23 (32.8%)
Number of peers per participants	Up to 5		23 (32.8%)
	6 or more		36 (51.4%)
	Not reported		11 (15.7%)

Note: In the categories related to participants' age and gender, in the description of the number of articles the total number is higher than 70 (total number of articles included in the systematic review). This is because articles containing at least one participant with the indicated characteristic were counted for each characteristic.

Regarding diagnosis, most studies (95.7%, $N = 67$) had no peers with developmental delay (e.g., [Ashbaugh et al., 2017](#); [Bambara et al., 2016, 2018](#)). Three studies had at least one peer with some developmental delay (Down syndrome, [Davis et al., 2017](#); language delay, [Shafer et al., 1984](#); unspecified delay, [Kamps et al., 1994](#)). In addition, three studies used siblings of at least one of the participants as peer ([Chung et al., 2007](#); [Strasberger & Ferreri, 2013](#), [Tsao & Odom, 2006](#)).

In 45 studies, the peers were between two and 11 years old (e.g., [Urlacher et al., 2016](#); [Yuan & Chen, 2020](#)), in 21 they were between 12 and 17 years old (e.g., [Schmidt & Stichter, 2012](#); [Thomas & Bambara, 2020](#)), and in three articles they were 18 years old and older ([Ackerman et al, 2021](#); [Bambara et al., 2016](#); [Hochman et al., 2015](#)). In 20 articles, peers' age was not reported (e.g., [Kamps et al., 2014](#)).

Among the 479 peers reported by the studies, 184 (38.4%) were female and 164 (34.2%) were male. The gender of 131 peers (27.3%) was not reported. Regarding the number of peers, 23 studies (32.8%) had up to 5 peers per participant (e.g., [Alwahbi & Hua, 2021](#); [Covey et al., 2021](#)) and 36 (51.4%) had six or

more peer (e.g., Bambara et al., 2018; Brain & Mirenda, 2019). Eleven studies (15.7%) did not report this information (e.g., Biggs et al., 2018; Davis et al., 2017).

3.3. Experimental Environment

Taking in account the studies present in this review, 60 (85.7%) were conducted in schools (e.g., Bambara et al., 2018; Simpson, 2020; Thomas & Bambara, 2020), six (8.6%) in care and/or research centers (e.g., Katz & Girolametto, 2015; Lorah et al., 2019), and one was conducted in participants' homes (Tsao & Odom, 2006). Three studies were conducted in more than one setting, such as: school and participants' home (Kim, 2019), care and/or research center and participants' home (Davis et al., 2017), and care and/or research center, school, and participants' home (Ashbaugh et al., 2017).

Most studies conducted in schools were implemented in classrooms (24.2%), corresponding to 17 experiments (e.g., Hundert et al., 2014). In addition, 12.9% (N = 9) were conducted in resource rooms (e.g., Kamps et al., 2014), 11.4% (N = 8) were conducted during snack time (e.g., Lee & Lee, 2015), 5.7% (N = 4) during recess in settings such as playground and sports court, and 1.4% (N = 1) in the library (Thiemann & Goldstein, 2001). Thirteen studies (18.3%) were conducted in more than one location in the school (e.g., Thiemann-Bourque et al., 2016) and eight (11.4%) did not specify the exact location in the school (e.g., Hatzenbuehler et al., 2019).

3.4. Peer Teaching Procedures

Table 3 shows the data on the teaching procedures implemented with peers to mediate the training targeting participants with ASD.

Table 3. Number of studies for each procedure used during peer teaching.

Peer teaching procedure	Number of studies
Instruction, modeling, role play and feedback	23 (32.9%)
Instruction, prompt, and reinforcement	8 (11.4%)
Instructions, modeling, prompt, role play and feedback	7 (10%)
Instructions, modeling, prompt, and feedback	7 (10%)
Oral instructions, role play and feedback	6 (8.6%)
Instructions and modeling	2 (2.8%)
General responses to peer questions about PMI	13 (18.5%)
Not reported	4 (5.7%)

Note: Instructions—the experimenter presents written/oral descriptions of the responses to be emitted. Modeling—the experimenter presents models of the responses to be emitted. Role-play—the experimenter acts out with the peer the responses to be made (sometimes in the role of the peer, sometimes in the role of the person with ASD). Feedback—the experimenter tells the peer if the responses are being emitted correctly or incorrectly. Prompt—the experimenter presents cues (physical or verbal) to assist the emission of responses. Reinforcement—the experimenter reinforces correct responses.

One experimenter was present along with the peer during the implementation of the procedure giving instructions, providing prompts and/or feedbacks in 40% (N = 28) of the studies (e.g., Banda et al., 2010; Biggs et al., 2018; Davis et al., 2017). A training package consisting of oral and/or written instructions, modeling, role-play, and feedback was employed in 32.9% (N = 23) of the studies (e.g., Bambara et al., 2016, 2018; Brain & Mirenda, 2019). Seven studies (10%) used a training package consisting of the previous components and physical, vocal, or textual prompt (e.g., Banda et al., 2010; Kim, 2019; Thiemann-Bourque et al., 2016). Seven studies (10%) used oral and/or written instruction, modeling, prompt, and feedback (e.g., Banda et al., 2010; Hundert et al., 2014) and six studies (8.6%) provided oral instruction, role play, and peer feedback (e.g., Davis et al., 2017).

Two studies conducted peer training using instructions and modeling (Chung et al., 2007; Hughes et al., 2011) and eight studies (11.4%) used instructions, prompt, and feedback (e.g., Urlacher et al., 2016). Furthermore, in 18.5% of the studies (N = 13) the experimenters only responded in a general way to peer questions about PMI (e.g. Ashbaugh et al., 2017; Thomas & Bambara, 2020), and four studies (5.7%) did not provide information about peers' training procedures (e.g., Strasberger & Ferreri, 2013).

3.5. PMI Procedures and Evaluated Behaviors

Figure 2 presents the PMI procedures and the evaluated behaviors identified in this review.

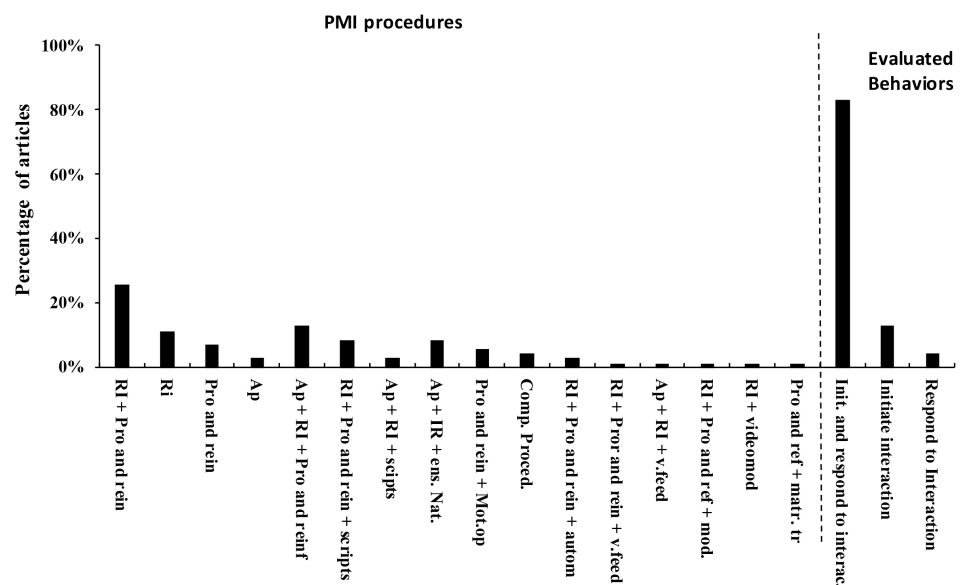


Figure 2. Percentage of articles containing the different PMI procedures and evaluated behaviors identified in this review. RI = response initiation; Pro and rein = prompt and reinforcement; Ap = approach; Script = scripts; nat. teac. = naturalistic teaching; Mot. op. = change in motivational operations; Comp. proc. = comparison between procedures (ap × RI; RI × pro and rein; IR + promp and rein × modeling); self-m. = self-monitoring; vfeed = video feedback; mod. = modeling; videomod. = video modeling; matr. tr = matrix training.

Regarding the different procedures used in PMI, in 25.8% of the studies ($N = 18$) (e.g., [McFadden et al., 2014](#)) peers initiate some type of interaction and delivered prompts and reinforcement for participants' correct responses. In eight studies (11.4%) (e.g., [Hughes et al., 2013](#)) the response initiation procedure was employed. Prompt and reinforcing procedure was used in 7.1% ($N = 5$) of studies (e.g., [Katz & Girolametto, 2015](#)), and the approach procedure (peers physically approach participants but do not initiate interaction) in two (e.g., [Lorah et al., 2014](#); [Tsao & Odom, 2006](#)).

In nine studies (12.9%) (e.g., [Katz & Girolametto, 2015](#)) PMI was implemented with experimenter reinforcing participants and peers' behaviors. Eight studies (11.4%) used scripts (visual cues—pictures or written—that specify the response to be emitted) in conjunction with initiation, prompt, and reinforcement ([Alwahbi & Hua, 2021](#); [Bambara et al., 2016](#); [Bambara et al., 2018](#); [Ganz et al., 2012](#); [Petursdottir et al., 2007](#); [Thomas & Bambara, 2020](#)) and approach and initiation ([Hughes et al., 2011](#); [Hughes et al., 2013](#)), and six studies (8.6%) (e.g., [Pierce & Schreibman, 1997](#)) used naturalistic teaching (teaching model) in conjunction with initiation, prompt, and reinforcement by peers.

Four studies (5.8%) (e.g., [Ashbaugh et al., 2017](#)) used peer-providing prompt and reinforcement in conjunction with motivational variables (variables that change the reinforcing value of a stimulus and the probability of occurrence of the behaviors that previously resulted in the production of that stimulus—[Michael, 1988](#)). Three studies compared different procedures for implementing PMI: peer approaching versus peer initiating interaction ([Schmidt & Stichter, 2012](#)), peer initiating interaction versus peer providing prompts plus reinforcement ([Straing et al., 1979](#)), and peer initiating interaction and providing prompt and reinforcement for the participant versus modeling ([Oh-Young et al., 2018](#)).

Two studies ([Haring & Breen, 1992](#); [Morrison et al., 2001](#)) used self-monitoring (the participant monitors his or her own behavior) in conjunction with initiation, prompt, and reinforcement. Two studies ([Chung et al., 2007](#); [Thiemann & Goldstein, 2001](#)) used video feedback (providing feedback through videos for participants' expected responses) in conjunction with initiation, prompt, and reinforcement ([Chung et al., 2007](#)), approach, and initiation ([Thiemann & Goldstein, 2001](#)).

Modeling in conjunction with initiation, prompt, and reinforcement was used in one study ([Hochman et al., 2015](#)). One study ([Dueñas et al., 2021](#)) used the interaction initiation procedure in conjunction with video modeling, and another one ([Hatzenbuehler et al., 2019](#)) used a procedure involving matrix training (a procedure aimed at behavioral generativity—some responses are directly trained and the emergence of new responses are tested from recombining the presentation of antecedent stimuli) in conjunction with prompt and peer-provided reinforcement.

The behaviors evaluated in the studies were analyzed into three categories: initiating peer interaction (e.g., greeting, mands, initiating physical play or games, and physical approach), responding to peer interaction (e.g., responding to mands,

following instructions, and emitting intraverbal behavior), or both (initiating and responding to peer interactions). In most studies (82.9%, $N = 58$) (e.g., Yuan & Chen, 2020) behaviors of initiating interaction and responding to peer interaction were evaluated. Nine studies (12.9%) (e.g., Petursdottir et al., 2007) measured only participants' performance of initiating peer interaction, and three studies (4.3%) (Alwahbi & Hua, 2021; Hatzenbuehler et al., 2019; Kemp et al., 2019) only participants' performance of responding to peer interaction.

3.6. Integrity of Teaching Procedure Implementation

In 72.8% ($N = 51$) of the studies analyzed in this review some measure of procedure implementation integrity was performed (e.g., Ashbaugh et al., 2017; Bambara et al., 2016, 2018). The remaining 19 (27.1%) studies reported no measure of the reliability of implementation of the teaching procedure (e.g., Lorah et al., 2014).

Integrity of teaching procedure implementation was measured for experimenter behaviors in 32.9% of experiments ($N = 23$) (e.g., Katz & Girolametto, 2015), for peer behavior in 11 (15.7%) (e.g., Thomas & Bambara, 2020), and for experimenter and peer behaviors in 17 (24.2%) (e.g., Schaefer et al., 2018).

3.7. Analysis of Results

The acquisition, maintenance, and generalization results obtained in the studies were analyzed (see Figure 3). The results were considered as effective (performance increased for all participants and dependent variables), partially effective (performance increased for part of the participants and/or part of the dependent variables), or not effective (performance did not increase for any participant or dependent variable).

Acquisition was effective in 82.9% ($N = 58$) of studies (e.g., Yuan & Chen, 2020). One study had non-effective acquisition (Trembath et al., 2009) and 12.9% ($N = 9$) had partially effective results (e.g., Sreckovic et al., 2017). Two studies did not measure acquisition, only generalization of behavior already learned by participants (MacFarland & Fisher, 2019; Schmidt & Stichter, 2012).

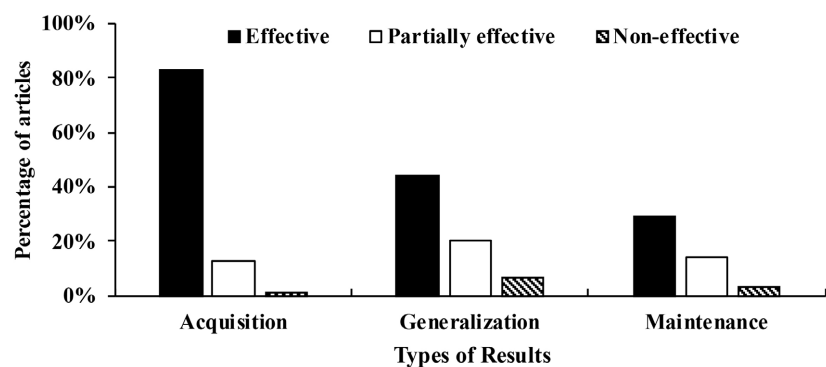


Figure 3. Percentage of effective, partially effective, and non-effective acquisition, generalization, and maintenance results in the reviewed articles.

Maintenance was measured in 45.7% (N = 32) of the studies. It was effective in 28.5% (N = 20) (e.g., Athamanah & Cushing, 2019), not effective in two (Ganz et al., 2012; Morrison et al., 2001) and partially effective in 14% (N = 10) (e.g., Dueñas et al., 2021). Generalization tests were performed in 71.4% (N = 50) of the studies: results were effective in 44.3% (N = 31) (e.g., Covey et al., 2021), not effective in 7.1% (N = 5) (e.g., Petursdottir et al., 2007) and partially effective in 20% (N = 14) (e.g., Oh-Young et al., 2018).

4. Discussion

This systematic review sought to update and expand knowledge about the relevant variables for the effectiveness of PMI in teaching social skills to people with ASD. A comprehensive analysis was conducted about the characteristics of the participants and peers, experimental environment, peer teaching procedures, PMI procedures, evaluated behaviors, implementation of integrity measures of the teaching procedures, and acquisition, generalization, and maintenance results obtained in studies that used PMI for teaching social skills to people with ASD. Overall, the results obtained add to those presented in previous reviews (e.g., Chan et al., 2009; Gunning et al., 2019; Martinez et al., 2019; Watkins et al., 2015), strengthening the evidence on the effectiveness of PMI for inducing the acquisition of social skills by children with ASD.

Virtually all of the PMI procedures reviewed showed effective or partially effective acquisition results. Only one study showed non-effective acquisition results (Trembath et al., 2009). In it, PMI was implemented with a naturalistic teaching procedure together with initiation, prompt, and reinforcement by peer. However, it should be noted that five of the six studies that used this combination of procedures to implementing PMI achieved effective results. There are positive features already pointed out in the literature regarding the use of peers as mediators in teaching social skills to individuals with ASD, such as greater possibilities of maintenance and generalization of the behaviors learned (e.g., Watkins et al., 2015), because there is, in the individual's daily life, the presence of different peers, which favors a greater number of interaction opportunities (Bass & Mulick, 2007).

However, most of the studies analyzed in the present review were conducted with children and the minority were conducted with adolescents and adults, corroborating the data obtained by Chan et al. (2009). Thus, although the vast majority of the results obtained in the studies analyzed were effective, there is limited data proving the effectiveness of this type of training in increasing social interactions in adolescents and adults with TEA. Most studies conducted with adolescents and adults sought to establish responses of initiating and maintaining peer interaction. Only one study aimed to teach adolescents to respond to an interaction performed by peers (responding to greetings). With respect to the studies conducted with adults, all sought to teach participants work-related social skills (mands and intraverbal responses: asking questions and responding to feedback received from peers, for example).

This systematic review shows that 44.3% and 28.5% of the studies achieved total effectiveness in generalization and maintenance results, respectively, and only 7.1% (generalization) and 2.8% (maintenance) showed ineffective results. Even though the percentage of effective generalization and maintenance results is a majority, these data do not allow for a solid conclusion about the effectiveness of peer-mediated interventions to generalization and maintenance of the behaviors learned, since a considerable part of the analyzed studies did not measure such variables: 28.5% of the studies did not measure generalization and 54.3% did not measure maintenance, a result consistent with that found in previous studies (e.g., [Chang & Locke, 2016](#); [Gunning et al., 2019](#)). Considering the importance of maintenance of the learned behavior and its generalization to new environments/people, the scarcity of such data in the evaluated studies limits the scope of their results. Future studies should seek to overcome this gap.

It can also be highlighted that effective results were obtained for all participants in whom peers whom had some developmental delay mediated training. This was also observed in studies that trained siblings to mediate training. These promising findings can be further explored in future studies.

Another important point to consider refers to measures of integrity of procedure implementation. The reliability with which the procedure is performed may be lower when the intervention is peer mediated ([Chan et al., 2009](#)). Even though most studies performed and specified the teaching procedure performed with the peer to implement the PMI, a small percentage of studies (39.9%) presented data regarding the measure of reliability of implementation of the procedure by the peer. When integrity measures were performed, they were mostly performed by evaluating the performance of the experimenter (57.1% of experiments).

The majority of studies that evaluated the integrity of peer implementation of the procedure obtained fully effective acquisition results (93% of studies). Only one study obtained partially effective results (but they were effective for the majority of participants). For the studies that did not use measures of the integrity of the behaviors exhibited by the peer during the implementation of the PMI, 67% obtained fully effective acquisition results, and the remainder (33%) had partially effective acquisition results. This data points out that the evaluation of the integrity of the procedure's application, as it is a measure that ensures the reliable application of the procedure in all its stages, directly interferes in the efficiency of the training and, consequently, in the results obtained.

The age of the peers is pointed out in the literature as a possible variable that may influence the reliability of implementing the training procedure and consequent performance of children with ASD. [Watkins et al. \(2015\)](#) discuss that younger, preschool children would have limited abilities to implement the teaching procedures. However, in the present review, in 37.6% of the studies the training was mediated by peers aged three to five years, and the results were effective for most studies (92.3%). Future studies should seek to evaluate the replicability of these data.

The present review has some limitations. One concerns the criteria used to consider acquisition results as effective/partially effective/not effective. They were defined based on the authors' written report and/or any increase/decrease in the participants' performance observed in the graphs presented in the studies. The same criterion was used when analyzing the maintenance and generalization results. Future reviews may seek to evaluate results using some measure of the effect size for single case design (e.g. Tau-U; Parker et al., 2011). Furthermore, the effectiveness of the results was assessed regardless of whether or not remedial procedures were used to achieve the proposed objectives. In future reviews, the presence of remedial procedures may be a variable to be analyzed.

5. Conclusion

The effectiveness of peer-mediated intervention (PMI) in teaching social skills to people with ASD has been attributed to a variety of factors, and the systematic literature reviews and meta-analyses that evaluated the effectiveness of PMI in teaching social skills to people with ASD restricted their analysis mainly to studies conducted with children or in inclusive settings. Considering this, this systematic review sought to update and expand knowledge about the relevant variables for the effectiveness of PMI in teaching social skills to people with Autism Spectrum Disorder (ASD). The results obtained indicated that the PMI is effective for inducing the acquisition of social skills by children with ASD. Most studies were conducted with children in inclusive schools and a considerable part of the studies did not conducted generalization and maintenance tests. These are important gaps that need to be explored in future studies.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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