

# Child Development Outcomes of DIR/Floortime™-based Programs: A Systematic Review

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## Revue systématique sur les résultats des programmes basés sur le modèle DIR/Floortime™

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**Key words:** Autistic disorder\*; Autism spectrum; Disorder; Evidence; Intervention studies\*.

**Mots clés :** Données probantes; Études d'intervention; Trouble autistique; Trouble du spectre de l'autisme.

### Abstract

**Background.** Occupational therapy is often part of the multi-disciplinary approach within the Developmental, Individual-differences, Relationship-based (DIR) Floortime™ Model. The model addresses the emotional development of children, which is considered to be critical for the other child developmental areas. **Purpose.** This review serves to inform practitioner decision-making about the use of this model, as no systematic reviews exist on child development outcomes. **Methods.** The systematic search included Medline, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Scopus, and Cochrane. For critical appraisal, the McMaster Critical Review was utilized. **Findings.** Nine studies were identified with varying quality levels. Outcomes were mostly reported for increased socio-emotional development. **Implications.** The evidence base for this model is emerging from a published research perspective. It is recommended that the use of this model be supported by sound clinical reasoning processes, intervention fidelity, use of valid outcome measures, and regular monitoring. Higher quality research is urgently needed to progress the research base for this intervention.

### Abrégé

**Description.** L'ergothérapie fait souvent partie de l'approche multidisciplinaire préconisée dans le modèle Developmental, Individual-differences, Relationship-based (DIR) Floortime™. Le modèle aborde le développement émotionnel de l'enfant qui est considéré comme étant déterminant pour les autres aspects du développement de l'enfant. **But.** Cette revue permet d'éclairer les prises de décision du praticien quant à l'usage de cette approche, puisque aucune revue systématique sur les résultats relatifs au développement de l'enfant n'existe à ce jour. **Méthodologie.** La recherche systématique a été effectuée dans les bases de données Medline, Embase, CINAHL, Scopus et Cochrane. Le McMaster Critical Review a été utilisé pour procéder à l'évaluation critique. **Résultats.** Neuf études de qualité variable ont été repérées. Les résultats présentés concernaient principalement l'amélioration du développement socio-émotionnel. **Conséquences.** La base de connaissances scientifiques pour ce modèle découle de la perspective d'études publiées. Les praticiens qui envisagent d'utiliser cette approche devraient s'appuyer sur des processus de raisonnement clinique solides et sur la fidélité des interventions, tout en ayant recours à des mesures des résultats valides et à un suivi régulier. Des recherches de plus grande qualité devront être menées sans plus tarder pour faire avancer la base de connaissances concernant cette intervention.

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## Introduction

A developmental delay has historically been described as occurring when a child fails to meet developmental milestones at the expected age in the areas of motor, language, cognition, and psycho-social development (First and Palfrey, 1994). These authors describe the well-adopted view that development is an interactional process between the child and the environment, with each being able to have a profound effect on the other. A developmental delay in one or more of the developmental areas can have a significant impact on a child's well-being and functioning in areas such as socialization, communication, learning, and movement. Autism Spectrum Disorder (ASD) is a condition commonly associated with the occurrence of developmental delays, with children potentially experiencing difficulties or delays in behaviour, communication, social interaction, special interests, and/or sensory processing (American Psychiatric Association, 2013). Developmental disorders such as ASD have been described as a result of a lack of adequate development of skills that may be caused by dysfunction of the child's nervous system or the reaction style from others, such as parents (Greenspan & Wieder, 2006). This links with the accepted view of the interactional role of the child and their environment in the child's development.

The Developmental, Individual-differences, Relationship-based (DIR) Floortime™ Model was developed by Stanley Greenspan and Serena Wieder in the 1980s (Raising Children Network, 2017) and is a model used with children with ASD and their parents. The model is a developmental approach focussing in the first instance on affection, with the fundamental assumption that emotions are the foundation of child development and learning. Emotional development is considered critical for developmental areas such as language, cognition, visuo-spatial processing and motor development (Greenspan & Wieder, 2006). The model supports child development and does so through early intervention and play (Hess, 2013). It aims to address interactions directed by the parent. Floor-based play with the child is conducted with a parent or professional, with the intervention tailored to the child's specific needs (Hess, 2013), in addition to an individualized, strength-based program for the child (Greenspan & Wieder, 2002). Floortime sessions are guided by the child, focussing on pretend play and conversation. Other activities are also incorporated to help the child to be regulated and engaged; these activities are generated based on the child's individual needs (Greenspan & Wieder, 2002). It focuses on the neurological processing differences of an individual child (Hess, 2013).

An occupational therapist is often part of the team implementing the DIR/Floortime™ Model. The model is well suited to core principles of occupational therapy, including that the family is viewed as client, that the focus is on facilitating full participation in the occupation of parenting, and that it is client-centred (Townsend & Polatajko, 2007). It is described as a comprehensive intervention targeting developmental deficits and building functional capacities (Greenspan, Wieder, &

Simons, 1998). The other elements of a multidisciplinary approach could include speech and language therapy, educational programs, physical therapy, occupational therapy, home and school programs, and counselling support for parents and guardians (Hess, 2013). The DIR/Floortime™ Model requires 15 or more hours of parent and clinician conducted intervention per week, with the parent ideally implementing the method in 20- to 30-minute sessions, eight to twelve times per day (DeWaay, 2011). This aligns with a key element of effective early interventions for children with ASD, identified by Prior, Roberts, Rodger, Williams, and Sutherland (2011) in their review, stipulating 15 to 25 hours per week.

Oono, Honey, and McConachie (2013) conducted a review into parent-mediated early intervention for young children with ASD. This review included the DIR/Floortime™ Model and had a broad focus on parent-mediated interventions. It included outcome measures related to parent outcomes, as well as children's outcomes. The authors concluded that some evidence exists for parent-mediated interventions, with low quality studies evident in existing research evidence. Positive outcomes were found in proximal indicators within parent-child interaction, and more distal in child language comprehension and reduction in autism severity.

Hess (2013) provided an overview of the DIR/Floortime™ Model, incorporating a discussion on the theoretical, conceptual, and practical underpinnings of the program. This author emphasizes that it provides a different approach than the prominent behavioural approaches by having a relational-based play focus, as well as by having a developmental and neurological focus. The DIR/Floortime™ Model was originally conceptualized to differ from traditional behavioural approaches that are primarily based on learning theory (e.g., Applied Behavioural Analysis; Lovaas, 1987). Mercer (2017) examined the DIR/Floortime™ Model as an ASD intervention, whilst describing the theoretical basis and current research, however, he did not conduct a systematic review. The author concluded that the theoretical base appears generally plausible, however, he describes the research base as weak with research design flaws.

In a thesis, DeWaay (2011) examined parents' perspectives of the program. The study found that parents reported the program to be effective with their child—both through reported satisfaction and perceived change, and through comparison with baseline and one-year follow-up measures of autism symptoms. Parents ranked the DIR/Floortime™ Model as one of the most effective treatments their child received. These positive perceptions by parents have also been found in previous studies by Solomon, Necheles, Ferch and Bruckman (2007), where overall parent satisfaction was 90 percent, and by Pajareya and Nopmaneejumrulers (2012), with a parent satisfaction rating of 62 percent.

In summary, publications exist providing some direction regarding the outcomes of the DIR/Floortime™ Model, illustrating positive perceptions by parents' surveyed and evident merits such as the incorporation of relational-based play, and a developmental and neurological focus. However no published

Table 1  
Eligibility Criteria

Studies	Participants	Interventions	Comparisons	Outcomes
<b>Inclusion Criteria</b>				
<ul style="list-style-type: none"> <li>– Any quantitative design</li> <li>– Publication date range: 2000 onwards, due to interest in recent research</li> <li>– English-only publications</li> </ul>	<ul style="list-style-type: none"> <li>– Children with identified developmental delay, including children with disabilities and disorders</li> <li>– Age range: 0– 12 years</li> <li>– Delays identified by a developmental professional</li> </ul>	<ul style="list-style-type: none"> <li>– DIR*/Floortime™ Model—Child-directed floor play involving a child and a parent, guided by a professional</li> <li>– Model can be used in conjunction with other intervention/s</li> <li>– Must have a parent-involvement component</li> </ul>	Any or no comparators	Children's psycho-social, motor, language, and cognitive development
<b>Exclusion Criteria</b>				
<ul style="list-style-type: none"> <li>– Qualitative research</li> <li>– Books and book chapters</li> <li>– Systematic reviews</li> <li>– Conference proceedings and abstracts</li> <li>– Theses</li> <li>– Letters and editorials</li> </ul>	Children without delays as identified by a developmental professional	<ul style="list-style-type: none"> <li>– Non-DIR*/Floortime™ Model—Intervention that is not child-directed floor play involving a child and a parent</li> <li>– Does not have a parent-involvement component</li> </ul>	N/a	Outcomes not pertaining to the development of children

\*Developmental, Individual Differences, and Relationship-based Program.

systematic reviews have been conducted on the outcomes of the DIR/Floortime™ Model on children's development. Due to the intensity and consequent costs involved in implementing the program, it was imperative to conduct a systematic review to provide direction for practitioners on the use of this model.

Various developmental assessments exist to measure the outcomes of intervention programs on children's development. Some instruments focus on distinct developmental areas (for example the Functional Emotional Assessment Scale or FEAS) and others focus on a combination of developmental areas (for example the Vineland Adaptive Behavioural Scales or VABS-2). When assessing the outcomes of the DIR/Floortime™ Model, Hess (2013) recommends incorporating the three major aspects of the model: (a) D—the Developmental Framework; (b) I—the underlying neurological processing differences; and (c) R—relationship and subsequent affective domains.

This review focussed on the following review question: What are the documented developmental outcomes for children who participated in DIR/Floortime™-based interventions?

## Methods

In identifying appropriate publications, a review protocol was established beforehand, with findings reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher, Liberati, Tetzlaff, Altman & The PRISMA Group, 2009). The review protocol was published on Prospero (January 31, 2018, CRD42018087042).

## Eligibility Criteria

A summary of the eligibility criteria for the systematic review is provided in Table 1.

## Information Sources and Search

A search strategy and the search terms were developed alongside a librarian. In Table 2, the search strategy used is shown. Two reviewers ran a trial search independently and compared results prior to conducting a final search (on September 4, 2017) of the five electronic databases (Medline, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Scopus, and Cochrane). A search update was performed, searching the electronic databases from January 1, 2017 to February 18, 2019. Search results from each database were categorized and pooled using Endnote, with the inbuilt duplicate removal function utilized. All remaining articles were exported to Covidence software where the screening process took place.

## Study Selection

Two reviewers independently completed a title and abstract screening of the articles using the selection criteria. The reviewers met prior to commencement to ensure a consistent interpretation of the criteria. Disputes were resolved by group discussion amongst reviewers using the selection criteria, until full consensus was reached. Two reviewers then independently conducted a full text screening. No further intervention was needed from a third party, since full consensus was reached.

Table 2  
Search Strategies

E-Database	Search terms					Limits
	P	I	C	O		
Medline, Embase	No population specified (DIR Floortime™ is only used with children)	DIR Floortime or Floortime or floor time or Developmental Individual-difference Relationship-based or Developmental Individual difference Relationship based or floorplay* or floor play*	No comparator specified	Child Development/ develop* or growth or growing or behave*		English studies published in the year 2000 or after
CINAHL, Scopus, Cochrane	No population specified (DIR Floortime™ is only used with children)	“DIR Floortime” OR Floortime OR “floor time” OR “Developmental Individual-difference Relationship-based” OR “Developmental Individual difference Relationship based” OR floorplay* OR “floor play*”	No comparator specified	“Child Development” OR develop* OR growth OR growing OR behave*		English studies published in the year 2000 or after

Reasons for exclusion at full text stage included not published in English, not meeting inclusion criteria regarding publication type, wrong outcomes, populations, and study design (see Figure 1 for modified PRISMA Flow Diagram). Pearling was conducted on the remaining full text articles, with one article included.

### Data Collection and Integration Process

Data were independently extracted and collated into a Microsoft Word document by two reviewers. The data was then compared and a full agreement was reached. Data items extracted include the following: date of study; location of study; study design; participants' information (age, gender, diagnosis, and severity of condition); outcome measures; outcomes; and settings of interventions and duration of intervention (refer Table 3). A meta-analysis of the data was not possible, due to the differences in study designs and outcome measures used in the studies; therefore data were integrated narratively.

### Critical Appraisal

Critical appraisal was conducted using the McMaster Critical Review Form for Quantitative Studies (Law et al., 1998), chosen because it can accommodate varying study designs. All reviewers discussed the items on the tool prior to commencement to ensure consistent interpretation. Each reviewer independently read and scored the selected articles, by selecting 'yes', 'no' or 'not stated' to each question. 'Not applicable' (N/A) was used if the item was not relevant to the study. The location of the relevant information in the articles was recorded next to each question providing a reference point for reviewers. A total score out of 14 was given, correlating to the number of questions addressed in the critical appraisal tool ('yes' equalling one, 'no', 'not stated' and 'not applicable' equalling zero). This allowed for meaningful interpretation of scores and comparison of results across studies.

Inconsistencies were managed by group discussions using evidence from the articles as a point of validation. The group results were collated and initial agreement was calculated, with a percentage of initial agreement being produced (see Table 4). After discussion, a full agreement was reached. Each study was assigned to a level on the Australian National Health and Medical Research Council hierarchy of evidence based on group discussion and consensus (National Health and Medical Research Council, 2009).

## Results

### Study Selection

The study selection process summarized in Figure 1 shows the number of studies identified in each stage. The initial search strategy returned fifty results, with an additional 14 results returned from the second search, and six additional records identified through other sources. After duplicates were removed, 43 articles progressed to the title and abstract screening, with 14 being excluded. The full texts of the remaining 29 articles were screened. Twenty articles were excluded for inappropriate type of publication, outcomes, patient population and study design, and not being available in English. Of the studies identified through other sources, two were identified through pearling by reviewing reference lists. However, one of these studies (Greenspan & Wieder, 2007) was not deemed appropriate for inclusion, as the authors explicitly stated that the study was not intended to be an outcome study. The other study (Casenhiser, Shanker & Stieben, 2011) was included as it met the eligibility criteria. Four studies (Carpente 2016; Mahoney & Solomon, 2016; Reis, Pereira & Almeida, 2018; Solomon et al., 2014) were recommended for inclusion by expert opinion. Carpenete (2016) was excluded due to not having a parent-involvement component in the intervention, and Mahoney and Solomon (2016) was excluded as it was a secondary analysis of the Solomon et al. (2014) study and did not focus on child

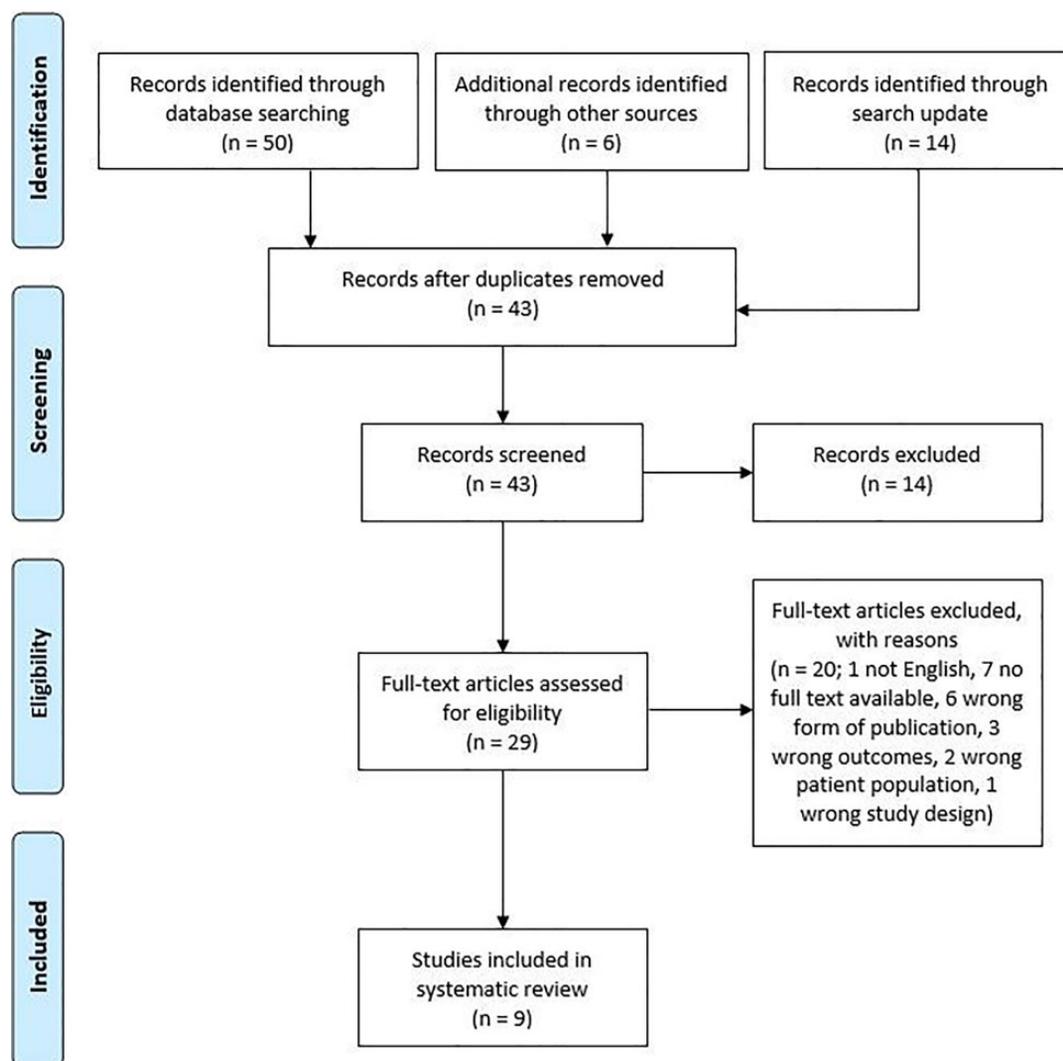


Figure 1. Modified prisma flowchart

development outcomes. Reis et al. (2018) and Solomon et al. (2014) were included as both met the eligibility criteria.

### Study Characteristics

As seen in Table 3, the nine studies included in this review were published from 2007 to 2018. They consisted of three randomized control trials, one case-control design, five pre-post tests, and one single subject experimental design. Four of the studies were conducted in Asia (Thailand and Taiwan), four in North America, and one in Portugal.

### Participant Characteristics

As can be seen in Table 3, the age ranges of the participants were between two to twelve years. All participants had a reported diagnosis of ASD, including Autism, Asperger's Syndrome, or other Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS). Severity was reported by all

studies except for Pajareya and Nopmaneejumruslers (2012) and Solomon et al. (2014). Severity of symptoms across the seven studies ranged from mild to severe, with four studies that included children within the mild to severe category, two studies that had children from the mild to moderate range, and one study with children within the severe category. There was, however, inconsistency with how severity was measured. Sample sizes ranged from one to 128, with two studies having small sample sizes of 11 (Liao et al., 2014) and one (Dionne & Martini, 2011).

The articles varied regarding culture, location of study and socio-economic levels of participants, with many studies commenting on the influence of these factors. Pajareya and Nopmaneejumruslers (2011) found that most parents and caregivers participating in the study did not know how to play with their children at the start of the program. These authors stated that this may be explained by the location in which the study took place and the Thai culture. Similarly, Liao et al. (2014) stated

Table 3  
Study Characteristics and Summary of Findings

Study location	Study design	Population (n), age range and severity	Intervention, duration and setting	Average hours of intervention per week	Comparator	Child development outcome measures	Main results as stated in publications
<b>Casenhiser et al. (2011), Canada</b>	RCT	ASD (determined by ADOS and ADI), n = 51, 24–59 mths, mild to severe	MEHRI, 52 wks, clinic by clinicians and at home by parents. DIR/FloorTime™ Model-based program	2 with therapists + 25 with parents (3 per day)	Community treatment (speech therapy, occupational therapy, social skills group, specialised day care, and alternative treatments)	mCBRS CASL/PLS-4	<b>mCBRS:</b> Larger increase in social interaction items (attention to interactions, involvement in interactions, initiation of joint attention, and enjoyment in interaction) than control group <b>CASL/PLS-4:</b> No difference between groups in receptive and expressive language skills
<b>Dionne and Martini (2011), Canada</b>	Single-subject, pre-post	ASD (determined by CARS), n = 1, 42 mths, mild and moderate	FTP Approach, 7 wks, parent implemented at private clinic under guidance of occupational therapist	3 (calculated by reviewers)	No comparator	CoC	<b>CoC:</b> Significant increase in number of reciprocal communication “circles” between parent and child at end of intervention
<b>Liao et al. (2014), Taiwan</b>	Pre-post	ASD (determined by verbal IQ scores and level of functional language/social adaptation), n = 11, 45–69 mths, mild and moderate	DIR, 10 wks, at home by parents after attending training and with guidance of occupational therapist	10	No comparator	FEAS VABS-2	<b>FEAS:</b> Significant increase in total score and the items: engagement and relating: two-way purposeful interaction and social problems. Other areas without significant improvement: self-regulation and interest in the world, behavioral organization, representational capacity, and representational differentiation. <b>VABS-2:</b> Significant increase in total score and the items: communication, daily living skills, socialization items without significant improvement: motor skills
<b>Pajareya and Nopmaneejumrusters (2011), Thailand</b>	RCT	ASD or PDD-NOS (determined by CARS), n = 32, 24–72mths, mild to severe	DIR, 12 wks, at home by parents after attending training and with guidance from professional trained in rehabilitation medicine	15.2	Routine care: behavioural intervention	FEAS CARS FEDQ	<b>FEAS:</b> Significant increase in total score compared to control group (results for sub-items not provided) <b>CARS:</b> Significant greater decrease in autism symptoms (focussing on social development) than control group (results for sub-items not provided) <b>FEDQ:</b> Significant increase in total score compared to control group (results for sub-items not provided; sub-items include: shared attention and regulation; engagement and relating; purposeful emotional interaction; social problem solving; creating ideas; and thinking logically)
<b>Pajareya and Nopmaneejumrusters (2012), Thailand</b>	Pre-post	ASD or PDD-NOS (determined by CARS), n = 34, 24–72mths, mild to severe	DIR, 52 wks, at home by parents after attending training and with guidance from professional trained in rehabilitation medicine	14.2	No comparator	FEAS CARS FEDQ	<b>FEAS:</b> Increase in median scores (sub-items not provided) <b>CARS:</b> Decrease in median scores in autism symptoms (focussing on social development) - sub-items not provided

(continued)

Table 3 (continued)

Study location	Study design	Population (n), age range and severity	Intervention, duration and setting	Average hours of intervention per week	Comparator	Child development outcome measures	Main results as stated in publications
<b>Prapattthanakunwong et al.(2018), Thailand</b>	Pre-post	ASD (determined by DSM-4), n = 42, 24–144mths, 76% severe	DIR, ranged from 1 to 96 mths, at home by parents, assumed after training and with support from a practitioner	Parents: 11.6 (calculated by reviewers)	No comparator	FEDL CGI-I	<b>FEDQ:</b> Increase in median scores (sub-items not provided) <b>FEDL:</b> Most children showed increase in socio-emotional development: “most children had the level of child development . . . equal to 1.0 (35.7%) on starting . . . and equal to 3.0 (21.4%) at the last visit” (p. 4) <b>CGI-I:</b> 21 children showed improvement in overall development (50%) and 19 children were minimally improved (45.2%)
<b>Reis et al. (2018), Portugal</b>	Pre-post	ASD (determined with the ADOS), n = 25; 33–68 mths, severity N/S	DIR: floortime, sensory integration or speech therapy, 10 mths, parent implemented component guided by psychologist, additional sensory integration by occupational therapist or speech therapy by speech therapist, in natural contexts for child	Parents and therapists: 30 mins–1 hr	No comparator	Assessment Scale of Children with ASD	<b>Assessment Scale of Children with ASD:</b> statistically significant improvements after intervention for social communication and sensory processing
<b>Solomon et al. (2007), United States</b>	Pre-post	ASD or Asperger’s Syndrome or PDD-NOS (determined by medical evaluation), n = 68, 24–72 mths, mild to severe	The PLAY Project Home Consultation Program, 52 wks, at home by parents. DIR/Floortime™ Model -based program	>15 (n = 31) 10–14 (n = 21) <10 (n = 14) - as stated	No comparator	FEAS	<b>FEAS:</b> Increase in total scores in socio-emotional development
<b>Solomon et al. (2014), United States</b>	RCT	ASD or PDD-NOS (determined by DSM-4, ADOS, SCQ), n = 128, 32–71mths, severity N/S	Play and Language for Autistic Youngsters (PLAY) Project Home Consultation program. 12 mths, at home by parents with consulting therapists	Monthly 3 hr home visits	Usual community services (special education public preschool services)	CBRS Mullen Scales of Early Learning MCDI FEAS	<b>CBRS:</b> Child attention and initiation improved in PLAY group <b>Mullen Scales of Early Learning:</b> No significant effects <b>MCDI:</b> Improvements in all items except “Vocabulary understood” <b>FEAS:</b> Improvement in socioemotional behaviour

**Abbreviations:** **RCT:** Randomised Control Trial; **ASD:** Autistic Spectrum Disorder; **PDD-NOS:** Pervasive Developmental Disorder - not otherwise specified; **DIR:** Developmental, Individual-Difference, Relationship-based Model; **FTP:** Floor Time Play; **FEAS:** Functional Emotional Assessment Scale; **VABS-2:** Vineland Adaptive Behavioural Scales; **CARS:** Childhood Autism Rating Scale; **FEDQ:** Functional Emotional Developmental Questionnaire; **CoC:** Circles of Communication; **MEHRI:** Milton and Ethel Harris Initiative; **ADOS:** Autism Diagnostic Observation Schedule; **ADI:** Autism Diagnostic Interview; **mCBRS:** Modified Child Behaviour Rating Scale; **CASL:** Comprehensive Assessment of Spoken Language; **PLS-4:** Preschool Language Scale IV; **SCQ:** Social Communication Questionnaire; **MCDI:** MacArthur Communicative Development Inventories, **FEDL:** Functional Emotional Developmental Level, **CGI-I:** Clinical Global Impressions-Improvement Scale, **N/A:** not applicable, **N/S:** not stated.

Table 4  
Critical Appraisal of Included Studies

Authors	3		4		5			6				Total score	NHMRC level	Initial inter-rater agreement before consensus			
	I	2	A	B	A	B	A	B	C	A	B				C	D	7
Casenhiser et al. (2011)	Y	Y	Y	N	Y	N/S	Y	N	N/A	Y	Y	Y	Y	Y	10/14	II	90%
Dionne and Martini (2011)	Y	Y	Y	N	Y	NS	N	N	N/A	N	Y	Y	N/A	Y	7/14	IV	90%
Liao et al. (2014)	Y	Y	Y	N	Y	Y	Y	N	N/A	Y	Y	Y	N	Y	10/14	IV	80%
Pajareya and Nopmaneejumruslers (2011)	Y	Y	Y	N	N	Y	Y	N	N/A	Y	Y	N	Y	Y	9/14	III-I	90%
Pajareya and Nopmaneejumruslers (2012)	Y	Y	Y	Y	N	Y	Y	N	N/A	Y	N/S	Y	Y	Y	10/14	IV	95%
Prapaththanakunwong et al. (2018)	Y	Y	Y	Y	Y	Y	N	N/S	N/S	Y	Y	Y	Y	Y	10/14	III-II	100%
Reis et al. (2018)	Y	Y	N	N	Y	Y	Y	N	N	Y	Y	Y	N	Y	9/14	III-II	85%
Soloman et al. (2007)	Y	Y	Y	N	Y	Y	Y	N	N/A	Y	Y	Y	Y	Y	11/14	IV	95%
Solomon et al. (2014)	Y	Y	Y	Y	Y	Y	Y	Y	N/A	Y	Y	Y	Y	Y	13/14	II	100%

N/S = Not stated.

N/A = Not applicable.

1 = Purpose, 2 = Background literature, 3A: Sample description, 3B: Sample justification, 4A: Reliability of outcome measures, 4B: Validity of outcome measures, 5A: Intervention description, 5B: Contamination, 5C: Co-intervention, 6A: Statistical significance, 6B: Analysis methods, 6C: Clinical importance, 6D: Drop-outs, 7 = Conclusions.

that many of the mothers participating in the study did not know how to play with their children at the start of intervention. In comparison, the two studies conducted by Solomon et al. (2007, 2014) found that the participating parents in their study were well equipped to play with their children. The study by Prapaththanakunwong, Kiatrungrit, Honganguansri, and Nopmaneejumruslers (2018) found that most of their parents had good knowledge about and attitude towards the model, and participated well in implementing the model.

Regarding the earning of families as an indication of socioeconomic status, Casenhiser et al. (2011) discussed that socioeconomic status may have impacted the amount of time that the parents in their study were able to spend with their child doing the DIR/Floortime™ Model. These authors stated that most of their families were classified as high income earning, which was also the case reported in Prapaththanakunwong et al. (2018) and Solomon et al. (2014). No other study reported on the earning of the families; however, they did report on parents' educational level, with most studies (n = 6) having a large proportion of parents reported to have a higher educational level: 75 percent had a bachelor's degree or higher (Pajareya and Nopmaneejumruslers, 2011; Solomon et al., 2007); similarly 80 percent of the parents in the study by Pajareya and Nopmaneejumruslers (2012), 77% in Casenhiser et al. (2011) and 50 percent in Solomon et al. (2014) had a higher education level. Most of the parents participating in the Liao et al. (2014) study were reported to have received at least a tertiary education.

## Types of Intervention

Some variations between studies occur in the administration procedures, making comparison between studies difficult. Four of the studies used the DIR/Floortime™ Model as an intervention (Liao et al., 2014; Pajareya & Nopmaneejumruslers, 2011; Pajareya & Nopmaneejumruslers, 2012; Prapaththanakunwong

et al., 2018), whereas the other five of the studies used interventions that are based on the principles of the DIR/Floortime™ Model. One study (Reis et al., 2018) explicitly mention incorporating speech therapy and also sensory integration, by an occupational therapist, for some children. The intervention duration varied from three short-term interventions of six, seven, ten and twelve weeks, and five longer-term interventions: 10 months (n = 1 study) and 52 weeks (n = 4 studies). One study indicated a variation of duration between 1 and 96 months (Prapaththanakunwong et al., 2018). There was also a large variation in the average hours of intervention administered per week. Six studies (Casenhiser et al., 2011; Liao et al., 2014; Pajareya and Nopmaneejumruslers, 2011; Pajareya and Nopmaneejumruslers, 2012; Prapaththanakunwong et al., 2018; Solomon et al., 2007) completed an average of over ten hours per week, meeting the minimum recommendation of two to five hours per day, specified in the DIR Program (Raising Children Network, 2017).

Parent involvement was a component of all the studies (due to the inclusion criterion). Pajareya and Nopmaneejumruslers (2011, 2012) implemented parent training, with no direct interaction with the children themselves by the program administrators. This included a one-day training workshop that taught the parents how to use the principles of the model, followed by one-on-one training sessions with a focus on the techniques. Videotaping child-parents' interaction was used as a tool to support the parents' performance. Similarly, in the Liao et al. (2014) study, the mothers of the participating children attended a three-week, one-on-one training course. Soloman et al. (2007) also used parent training of monthly half-day training sessions. Casenhiser et al. (2011) used parent training and video-taped sessions. In two of the studies (Prapaththanakunwong et al., 2018; Reis et al., 2018), parent training was described as "coaching" and "modelling," and similarly in the Dionne and Martini (2011) study, it was described with words such as "demonstration", "guiding," and "encourage". The

intervention in the Solomon et al. (2014) study is not well described, and is assumed by the reviewers to not be formal training sessions.

### Outcome Measures Used and Outcomes

Across the studies, there was a large variation in the use of outcome measures (refer Table 3). In addition, the outcome measures used in the studies focused mostly on the emotional and social developmental areas, failing to focus on all developmental areas, such as cognition and motor development. The FEAS was the most frequently used primary outcome measure in five of the studies. The FEAS is an observational tool used to measure emotional development in children by assessing the developmental levels proposed by the DIR/Floortime™ model authors, Greenspan et al. (2001), with a range of socio-emotional aspects included. The Functional Emotional Developmental Questionnaire (FEDQ) is also based on the Greenspan developmental levels, and is used in the two studies by Pajareya and Nopmaneejumruslers (2011, 2012) with socio-emotional items included. The Childhood Autism Rating Scale (CARS) used in the two studies by Pajareya and Nopmaneejumruslers (2011, 2012) measures severity of autism, with a focus on social development (Schopler, Reichler, Devellia & Daly, 1988). Similarly, the Circles of Communication (CoC) used in Dionne and Martini (2011) measures social development by assessing a child's ability to engage in consecutive reciprocal communication "circles" with the parent (Greenspan et al., 1998). The Child Behaviour Rating Scale was used in two studies (Casenhiser et al., 2011, Solomon et al., 2014), and it measures the social interaction between the child and the parent. This outcome measure includes five areas (attention to activity/ interaction, involvement in interaction, compliance, initiation of joint activity, and enjoyment in interaction). Other outcome measures were used in single studies (See Table 3).

In Table 3, it can be seen that the most prominent developmental area in which positive outcomes were indicated across the studies was the socio-emotional area, with the use of various outcome measures. Positive results were found on the FEAS outcome measure in five studies, on the FEDQ used in two studies, the CARS (n = 2 studies), CoC (n = 1 study), CBRS (n = 2 studies), FEDL (n = 1 study), the Assessment of Child Socio-Communication (n = 1 study), the Assessment Scale of Children with ASD (n = 1 study), and the VABS-2 (n = 1 study), acknowledging that studies may have used more than one of these measures. Other developmental changes did not show improvements: the VABS-2 showed no changes in motor development (n = 1 study), the Mullen Scales showed no changes in fine motor and visual perception (n = 1 study), and language showed no changes in the Preschool Language Scale (n = 1 study) and the Mullen Scales (n = 1 study). One study showed improvement in children's overall development. Some studies however, looked at total scores for assessments (such as FEAS) and did not include an analysis of the individual developmental areas.

### Critical Appraisal of Studies

The results of the studies' quality are summarized in Table 4. Solomon et al. (2014) and Casenhiser et al. (2011) were randomized control trials and were scored on the NHMRC level II, which was the highest level of evidence within the studies. Pajareya and Nopmaneejumruslers (2011) was scored at NHMRC level III-I, and the remainder of the studies scored at III-II or IV. The studies displayed methodological weaknesses to varying degrees.

Casenhiser et al. (2011), Pajareya and Nopmaneejumruslers (2011), and Solomon et al. (2014) were the only studies to be randomized; therefore the rest of the studies are subject to selection bias. Measurement bias was prevalent in four of the studies, with these studies not stating whether all the outcome measures they used to obtain the results from the intervention are reliable or valid (Dionne & Martini, 2011; Liao et al., 2014; Pajareya & Nopmaneejumruslers, 2011; Pajareya & Nopmaneejumruslers, 2012). Casenhiser et al. (2011) used a modified outcome measure, which has not been validated. Pajareya and Nopmaneejumruslers (2011, 2012) stated that FEAS is valid and reliable; however, the validity and reliability of the other outcome measures used are not stated.

Performance bias and treatment infidelity may be present in the studies by Dionne and Martini (2011) and Liao et al. (2014) as they did not implement the recommended number of hours, which is 15 or more hours per week. All the studies would be at risk of contamination as the studies did not state they attempted to avoid it. Avoiding co-intervention is not applicable for all the studies, as it would be unethical for a child receiving the DIR/Floortime™ Model to be denied other interventions that are considered standard practice in caring for a child with ASD.

Pajareya and Nopmaneejumruslers (2012), Praphattanakunwong et al. (2018), and Solomon et al. (2014) used a power calculation to determine the sample size. Therefore, the other six studies may not have adequate sample sizes to reduce the role of chance. Dionne and Martini (2011), a single subject and case-control study, does not have a justified sample size and statistical significance was not reported on.

### Discussion

Nine studies with varying methodological quality were uncovered in this review. Results from the included studies show an increase in children's socio-emotional development, as measured by various outcome measures. These developmental outcomes are consistent with the focus of the model, which is on emotional development in the first instance, and with the fundamental assumption that emotions are the foundation of child development and learning. According to the authors of this model (Greenspan and Wider, 2006), emotional development is considered critical for the developmental areas such as language, cognition, visual-spatial, and motor development.

Studies focussed on other developmental areas (such as cognitive, motor, and language development), to a limited extent. Further research that confirms positive developmental outcomes in the area of socio-emotional development, and which extends the focus on other developmental areas, is urgently needed to support the evidence-based for this approach.

Studies varied in their reporting of parent characteristics (e.g., socio-economic status, culture, and educational level). These factors may be important to understand as it relates to parent involvement in the intervention. Praphatthanakunwong et al. (2018) found that high parent engagement was associated with better improvement in child development. Pajareya and Nopmaneejumrulers (2011) stated that the Thai culture may have had an influence on the parents' and caregivers' ability to play with their children at the start of the program. Future research to unpack the influence of parent characteristics is important to understand parent engagement more. In addition, other factors such as autism severity, family dynamics, and other environmental factors should be considered as these all impact children's development (Bradley et al., 1989). In addition, most of the included studies involved parents from high educational backgrounds, indicating that the results are not reflective of parents of all educational backgrounds. All the studies were conducted in different countries, with local assessment and program practices, as well as culture, that potentially could impact the results. Generalizability of the results is therefore limited to the broader population. Further high-quality research should include control groups, have adequate sample sizes, use consistent outcome measures, include detailed description of the participants, and adhere to prescribed program implementation, to allow for increased credibility of results and meta-analyses.

### Implications for Occupational Therapy Practice and Research

Evidence for the DIR/Floortime™ Model is emerging, with improvements shown in the socio-emotional area of children with ASD. Other areas of development have received limited focus by existing studies. Further high-quality research is needed to confirm and expand the research evidence-base. The field may benefit from the development of guidelines for practice, with expert practitioner input combined with current research.

If the DIR/Floortime™ Model is selected as an intervention, it is important that the effectiveness of the intervention is monitored at regular intervals using a well-validated and reliable outcome measure, to help determine the intervention outcomes. The FEAS is a well-validated measure that fits with the model and focusses on socio-emotional development. Other well-validated assessments that cover the other developmental areas of motor, cognition, and language should be used. Use of outcome measures should be triangulated with a range of sources such as

general observation of developmental changes by the parents/caregivers in a variety of environments.

Evidence-based practice consists of client and therapist input (Canadian Association of Occupational Therapists, 2009); it is therefore critical that parents are central when applying this model, and that the therapist's sound clinical reasoning is applied. Client input and feedback as part of the therapist's regular monitoring should be obtained at all stages of implementation. With the therapist guiding the parent in decision-making, evidence-based practice should be applied by considering the current status of research in the field, the therapist's expertise, and client-related factors. Furthermore, understanding the client's background (e.g., culture, socio-economic status, and educational level) may lead to further insights into parent engagement during application of this model.

### Limitations of this Review

A limitation of this review is that it is subject to publication bias, as only published research studies in English were included. Unpublished studies may provide further understanding of the effects the DIR/Floortime™ Model, especially these. Although an extensive search was conducted, it is possible that relevant studies may have been missed.

### Conclusion

Currently the published research base for the DIR/Floortime™ Model is emerging, with a small number of studies ( $n = 9$ ) with varying methodological quality, uncovered in this review. The outcomes of the currently published studies illustrate developmental outcomes for children with ASD in the area of socio-emotional development. However, methodological issues have been identified in the small number of studies, requiring that these outcomes need to be interpreted with caution. Further research on the model is urgently needed to progress the evidence-base of this intervention.

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### Key messages

- The DIR Floortime™ Model aims to primarily promote emotional development, with a consequent influence on other areas of child development and learning.
- The published research evidence base for the use of the model is emerging with nine studies uncovered, of varying methodological quality.
- Practitioners are recommended to support the use of this model with sound clinical reasoning processes, intervention fidelity, use of valid outcome measures, and regular monitoring.

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