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Journal of Autism and Developmental Disorders
https://doi.org/10.1007/s10803-021-05357-2

ORIGINAL PAPER

Effectivity of Play-Based Interventions in Children with Autism Spectrum Disorder and Their Parents: A Systematic Review

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Accepted: 4 November 2021

Abstract

Evidence of the effectivity of play-based interventions in children with autism spectrum disorder (ASD) was evaluated by PRISMA-based literature study and a Risk of Bias (RoB) assessment. Many of the 32 eligible randomized controlled trials (RCT) reported improved social interaction, communication, daily functioning and play behaviour. They also reported decreased problem behaviour, better parental attunement and parent–child interaction. We assessed 25/32 of the RCTs with high RoB, mainly related to homogeneity of the study population, lack of power, and performance bias. We concluded with due care that the effectivity of play-based interventions differed across RCTs, most reported improvements are found in ASD symptoms, everyday functioning, and parental attunement. In future research, findings should be replicated, taking account of the RoB.

Keywords Play-based intervention · Autism spectrum disorder · Children · Systematic review · Effectivity · Risk of bias

Play is typical behaviour of early childhood, universally embedded in children's nature and attractive through its joyfulness (Eberle, 2014). It creates a natural setting for parent–child interaction. Play seems to stimulate children's social-, physical-, emotional- and cognitive functioning and is therefore considered to be essential for their development (Burriss & Tsao, 2002). Play-based interventions are primarily used in young children and are effective for a variety of behavioural and emotional problems (Bratton & Ray, 2000; LeBlanc & Ritchie, 2001). Since children with autism spectrum disorder (ASD) show diminished early play quality, which can be associated with their difficulties in social development (González-Sala et al., 2021; Lin et al., 2017; Thiemann-Bourque et al., 2019; Wilson et al., n.d.; Ziviani et al., 2001), it is relevant to evaluate whether play-based interventions are effective in helping children with ASD.

Play starts in early childhood, develops through sequential stages, and continues into puberty (Pellegrini & Smith, 1998). Ginsburg (2007) stated that play stimulates four developmental domains that are essential to social development. The first is 'the social cognitive domain', in which play enhances the development of broader problem-solving abilities by stimulating the development of social skills such as joint attention, social referencing and mentalization (Pellegrini & Smith, 2005; Goswami, 2006; Kavanaugh & Harris, 1994). The second domain is physical functioning, in which play enhances the gross and fine motor skills and coordination (Lester & Russell, 2014). The third domain is emotional, in which play stimulates self-regulation functions

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Published online: 02 December 2021

by improving emotion and behaviour regulation (Berk et al., 2006; Power, 2000). The fourth domain concerns general neuro-cognitive development, in which play stimulates maturing of the neural system, including the brain circuits associated with social functioning and language skills (Byers et al., 1995; Dawson, 2008). All the domains are considered to be equally important and to support each other for development, fueled by play. Therefore, play can be seen as an essential activity for children's development. Children who experience play deprivation are more likely to develop aberrant social behaviour, cognitive developmental delays, and show a higher risk of developmental problems (Bick et al., 2017; Daunhauer et al., 2010; Rutter et al., 1999). In individuals with ASD, aberrant play is due to a neurodevelopmental disorder that is also associated with social and cognitive developmental problems.

On DSM-5 criteria, ASD has an estimated prevalence worldwide of around 1% (Lord et al., 2020). It has high diagnostic stability and often manifests with severe problems in all aspects of daily functioning (Verheij et al., 2015; Woolfenden et al., 2012). ASD is defined into two behavioural dimensions according to the DSM-5: (1) problems in social communication and social interaction, and (2) restricted, repetitive behaviours or interests (APA, 2014; Carrington et al., 2014). ASD is an early onset condition and infants of six months can already show differences in eye gaze shifting in response to social stimuli when compared to typical controls (Elsabbagh et al., 2012). Toddlers diagnosed with ASD show problems with object substitution, imitation play, and pretend play compared to toddlers with typical development (Charman et al., 1997). Their aberrant play development often continues into later childhood and affects their daily functioning (Charman et al., 1997). During free play, children with ASD can be confronted with peer frustration since children with ASD find it difficult to understand the social rules of play (Ziviani et al., 2001), which can leave them feeling isolated (Ziviani et al., 2001). Bringing up a child who has difficulties in making social connections may also be associated with higher levels of parenting stress, and since the child is not responsive to playful interaction, parents lack a natural setting in which to interact with their child and to support their development in this way (Crea et al., 2016; Dabrowska & Pisula, 2010; Keenan et al., 2016; Sawyer et al., 2010). Parental stress can increase the risk of emotional and behavioural problems in the child, creating an accumulation of negative interactions in the parent–child relationship (Smith et al., 2014; Zaidman-Zait et al., 2014).

As play is an important aspect of social and cognitive development and children with ASD have aberrant play development, this raises the question whether play-based interventions in children with ASD are effective (Burriss & Tsao, 2002; Ziviani et al., 2001). There is substantial evidence that interventions for children with ASD can enhance their social-, language- and play skills. A meta-analysis of 32 randomized controlled trials (RCT) on behavioural-, social communicational- and multimodal interventions for pre-school children with ASD suggested increased reciprocity of social interaction towards others after intervention (Tachibana et al., 2017). Another meta-analysis of 20 interventions targeting pragmatic language skills in children with ASD showed effect sizes ranging from 0.16 to 1.28 (Parsons et al., 2017). Pragmatic language interventions focussing on the child were found to be more effective than interventions mediated by the parent. Children with ASD receiving an intervention for pragmatic language skills improved moderately compared to waiting list controls (Parsons et al., 2017). Interventions on play skills, delivered by a trained professional and directed at the child with ASD, showed enhanced levels of play, game play skills, functional play, symbolic play, reciprocal play, and more diversity of spontaneous play (Bernard-opitz, 2002; Field et al., 2001; Goods et al., 2013; Kasari et al., 2006; Quirmbach et al., 2008; Shire et al., 2017a, 2017b). Parent-mediated interventions on play skills showed enhanced play levels, joint engagement, and symbolic play, but also less object engagement play (Kasari et al., 2010, 2014, 2015). Results from teacher-mediated interventions on play skills showed increased interactions with peers, and improved simple-, functional- and symbolic play (Chang et al., 2016; Kamps et al., 2015; Kretzmann et al., 2015; Wong, 2013), whereas peer-mediated interventions on play skills show decreased time spent in isolation or solitary engagement (Kasari et al., 2012, 2016). Play-based interventions focussed on the child with ASD showed better results for enhanced play skills compared to interventions focussing on the parent, teacher or peer (Kent et al., 2020). In summary, there is evidence that interventions, preferably focussed on the child with ASD, can enhance social interaction, communication and play skills. Although, in some studies the parent–child relationship and/or parental stress are included as secondary research questions, to our knowledge, there are no systematic reviews of RCT's evaluating the effects of play-based interventions specifically focussing on the interaction of children with ASD with their parents or on the effect of play-based interventions on parental stress. As attuning to the special needs of a child with ASD might result in challenging parenting for these parents and behavioral problems in the child may trigger parental stress, parental stress can lead to more pronounced emotional, behavioral- or psychological problems in the child, creating a bidirectional effect within the parent–child relationship (Marsack-Topolewski & Church, 2019; Rao & Beidel, 2009; George et al., 2006; Smith et al., 2014; Zaidman-Zait et al., 2014).

In this study we explored the reported effects of play-based interventions on the DSM-5 criteria: social communication and restricted, repetitive behaviours or interests. Herein we distinguished between play-based interventions

targeting social interaction and/or communication and/or restricted, repetitive behaviours or interests. We also explored the reported effects of play-based interventions on children's daily functioning, severity of problem behaviour, and their play skills. In addition, we examined the effects on parental attunement, frequency and quality of parent–child interaction, and the reported degree of parenting stress. To study the effects of play-based interventions on all these factors, we performed a systematic review of RCTs. Possible bias in the reported findings was evaluated by performing a Cochrane risk of bias (RoB) assessment (Higgins & Green, 2008).

Methods

Search Strategy

A systematic literature review was performed using several online databases (Medline, Embase, Psych INFO, Cochrane and Google Scholar), searching for all the available literature up to March 2021. The search conformed to PRISMA guidelines (Page et al., 2021). The following Boolean string was used: 'play therapy' OR 'play based therapy' OR 'play intervention' OR 'play based intervention' OR 'play based treatment' AND 'autism' OR 'autism spectrum disorder' OR 'ASD' AND 'randomized controlled trial' OR 'RCT'.

Study Selection

Studies were considered for inclusion if they evaluated a play-based intervention which was provided within a health care setting. Study designs needed to be RCT's and to present quantitative data on their results. The studies had to be written in English and published in a peer-reviewed journal. Titles and abstracts from the initial search were independently screened by two researchers, who compared their evaluations on the inclusion/exclusion criteria (RCT on a play-based intervention for children with ASD) to reach a consensus. If there was disagreement on inclusion, the researchers made a full text screening to establish consensus. If there were still doubts, they consulted a third researcher to review the full text of the study and reach a final decision together. An additional search was performed by snowballing studies and review articles on play-based interventions for children with ASD to screen for other eligible articles that had not been otherwise identified (Greenhalgh & Peacock, 2005). By snowballing we mean finding literature by using documents relevant to the literature search subject as a starting point. Consult the bibliography in these documents (book or journal article) to find other relevant titles on this subject.

Data Extraction

We evaluated the included RCTs on nine domains. First, we evaluated the effects of play-based interventions on the primary dimensions of ASD symptoms: (1) social interaction, (2) communication, and (3) restricted, repetitive behaviours or interests. Secondly, the effect of play-based interventions on the impact of ASD on everyday functioning of the child was evaluated based on the domains of (4) daily functioning, (5) problem behaviour severity, and (6) play skills. Thirdly, we evaluated the effects on parenting-related domains through (7) parental attunement to the specific needs of children with ASD, (8) frequency and quality of the parent–child interaction, and (9) level of parental stress. Effectiveness and, if present, the magnitude of the effects through effect sizes (ES) of play-based interventions on these nine outcome domains were evaluated. ES was considered small when $d \leq .20$, medium at $d = .20 - .80$, and large when $d \geq .80$ (Peet et al., 2005).

Risk of Bias in Individual Studies

To evaluate potential sources of bias in findings, we used the Cochrane Collaboration's tool for assessing risk of bias (RoB) (Higgins & Green, 2008; Higgins et al., 2011). This tool does not provide an overall score but offers seven RoB assessment categories on which we evaluated the studies. RoB categories were: (1) random sequence generation, (2) allocation concealment, (3) blinding of participants and personnel, (4) blinding of outcome assessment, (5) incomplete outcome data, (6) selective reporting, and (7) other bias (Higgins et al., 2011). We choose to remove the category 'blinding of participants and personnel' from the RoB assessment, since it is impossible to blind participants for the (play-based) intervention they received, nor to blind personnel to the treatment condition. To compensate for this, blinding of outcome assessment was rated with 'high risk' if outcome measures only relied on parents' self-reports. After the initial RoB assessment, we contacted the first authors of the RCTs rated with 'unclear risk of bias' in any of the RoB categories. They were asked to elaborate on the 'unclear risk(s) of bias' rating(s). The authors' response was then analysed for RoB using the same procedure and the assessment was adjusted if necessary.

Results

We removed duplicates, books, theses, dissertations, poster presentations, and non-peer reviewed articles from the initial search results (n = 70), which resulted in 32 studies. Another 22 studies were identified through the references of these 32 studies. After screening the abstracts of these 54 studies, 22 were excluded for the following reasons: (1) they did not include explicit play-based interventions, (2) they did not include children or not just children with ASD, and (3) they only provided qualitative data on outcomes. To summarize: 32 eligible RCTs were included in our systematic review (Fig. 1). Interrater reliability after screening of the abstracts was 81.1%. Interrater reliability after full text screening was 100%. Within these 32 RCTs, 11 studies share subject groups, however with different questions and outcome measures see Table 1[5 & 6, 7 & 8, 14–16, 21 & 22, 26 & 27]. One study [20] is a follow up study with different outcome measures than the primary study. Due to the large time span covered by this literature review, different classification systems with regard to ASD diagnosis (DSM-III to DSM-5) are used within the included studies. In order to provide an accurate overview of the classification system used, we present in Table 1 for each of the 32 studies the classification system used. In addition, a variety of comorbidity was found, which is also shown in Table 1.

Play-Based Interventions for Children with ASD

Nine play-based interventions presented effectivity data on the treatment of a total of 1206 children with ASD: (1) Pivotal Response Treatment (PRT), n = 10 RCTs[1–10]; (2) Joint Attention Symbolic Play Engagement Regulation (JASPER), n = 8 RCTs[11–18]; (3) Developmental, Individual-differences & Relationship-based model (DIR)/Floortime), n = 4 RCTs[19–22];(4) Early Start Denver Model (ESDM), n = 3 RCTs[23–25]; (5) PLAY project, n = 2 RCTs[26,27]; (6) Parent–Child Interaction Therapy (PCIT), n = 2 studies[28,29]; (7) Lego® therapy, n = 1 study[30]; (8)

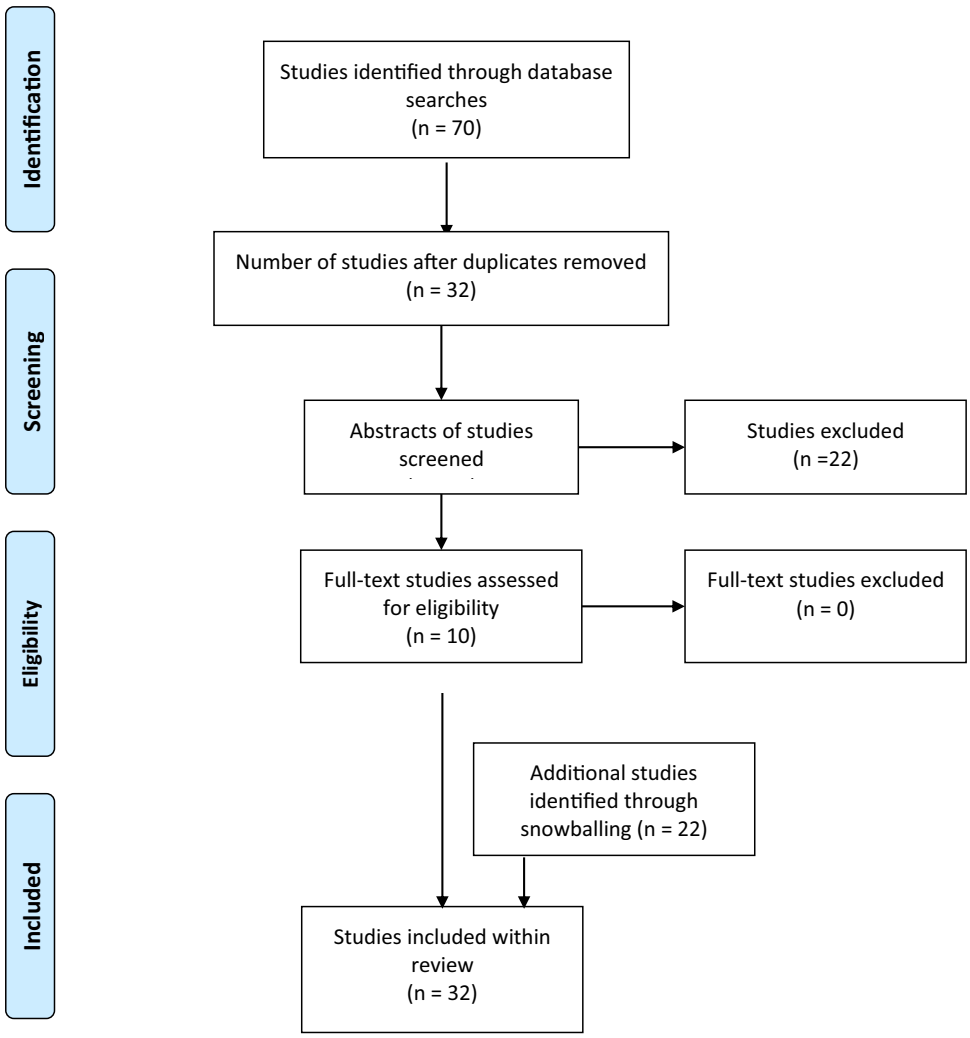

Fig. 1 Flow chart of screened, excluded and included articles

Table 1 Specific outcome variables, effectivity, and risk of bias on play-based interventions for children with ASD, reported by study

	References	Participants				Play-based intervention	Specific outcome variable		p
		N	Age (years)	DSM	Comorbidity		Child	Parent	
(1)	Schreibman et al. (1991)	19	2;8—7;2	DSM-III-R	Severe deficits in language, social behavior, play skills, engaged in frequent self- stimulatory, ritualistic, compulsive and tantrum behaviors	PRT		Positive affect	.008**
(2)	Nefdt et al. (2010)	27	> 5;0	DSM-IV	> 20 functional words	PRT	Functional verbal utterances		.001***
								Language opportunities	.000***
								Observed confidence	.001***
								Fidelity implementation	.000***
(3)	Hardan et al. (2015)	53	2;1–6;9	DSM-IV-TR	Communication delayed	PRT	Imitative gestures		.001***
							Non-verbally prompted behaviour		.002**
							Expressive language		.004**
							Receptive language		.028*
							Clinical severity		.003**
							Clinical improvement		.001***
							Total utterances		.038*
							Unintelligible		.762
							Communication		.041*
							Verbally prompted		.725
							Spontaneous words		.06
							Mean length utterance		.059
							Words out of 396		.736
							Words out of 680		.284
							Expressive language		.165
							Social responsiveness		.776
(4)	Schreibman and Stahmer (2014)	44	1;7–3;8	DSM-IV-TR	Speech delays from no words till 1 – 10 words	PRT	Expressive communication		.000***
							Words produced		.000***
							Communication		.037*
							Expressive one word		.001***
(5)	Mohammadzaheri et al. (2014)	30	6;0–11;0	DSM-IV-TR	IQ 50 – 60 (n = 27), IQ 60 – 70 (n = 5)	PRT	Communication		.01**
							Mean length of utterances		.01**

Table 1 (continued)

	References	Participants				Play-based intervention	Specific outcome variable		p
		N	Age (years)	DSM	Comorbidity		Child	Parent	
(6)	Mohammadzaheri et al. (2015)	30				PRT	Disruptive behaviour		.0001***
(7)	Gengoux et al. (2019)	43	2;0–5;0	DSM-5	Significant language delay on PLS-5	PRT	Total utterances		.026*
							Autism symptoms		.001**
							Social communication		.004*
							Words out of 369		.018*
							Words out of 680		.022*
							Clinical severity		.019*
							Clinical intensity		.001***
							Expressive language		.775
							Early learning		.519
							Social communication		.806
(8)	McDaniel et al. (2020)	43				PRT	Reciprocal vocal contingency		.04*
(9)	Vernon et al. (2019a, 2019b)	26	1;5–4;5	DSM-5	No comorbid medical/psychiatric conditions	PRT (PRISM)	ADOS severity		.001***
	Pilot						Early learning		.000***
							Language gain		.026*
							Receptive vocabulary		.006**
							Visual reception		.42*
							Fine motor		.009**
							Communication		.028*
							Receptive language		.006**
							Expressive vocabulary		.131
							Adaptive functioning		.124
							Expressive language		.28
							Auditory compensation		.28
							Expressive communication		.11
							Daily living		1.00
							Socialization		.91
							Motor skills		.51
(10)	Barret et al. (2020)	21	2;1–3;9	DSM-5	NM	PRT (PRISM)	Social responsiveness		.03*
	Pilot						Mean length utterance		.03*

Table 1 (continued)

	References	Participants				Play-based intervention	Specific outcome variable		p
		N	Age (years)	DSM	Comorbidity		Child	Parent	
							Total words		.47
							Novel words		.09
								Social bids	.40
(11)	Lawton and Kasari (2012)	16	3;0–5;0	NM	No seizures, physical disorders, co- morbidity with other syndromes or diseases	JASPER	Initiated joint attention (CO)		.005**
							Pointing (CO)		.005**
							Showing (CO)		< .01**
							Showing (ESCS)		.025*
							Supported engagement		< .05*
							Object engagement		< .01**
							Looking (CO)		> .05
							Giving (CO)		.067
							Initiated joint attention (ESCS)		.221
							Pointing (ESCS)		.350
							Giving (ESCS)		.461
							Initiated joint attention (PI)		.227
							Pointing (PI)		> .05
							Showing (PI)		> .05
							Giving (PI)		> .05
							Looking (PI)		> .05
(12)	Goods et al. (2013)	15	3;0–5;0	NM	Less than 10 spontaneous, functional, and communicative words + all with developmental delay	JASPER	Spontaneous play		.04*
							Less unengaged		.05*
							Requesting gestures (CO)		.01**
							Initiated joint attention		> .05
							Requesting gestures (ESCS)		> .05

Table 1 (continued)

	References	Participants				Play-based intervention	Specific outcome variable		p
		N	Age (years)	DSM	Comorbidity		Child	Parent	
(13)	Kasari et al. (2014)	112	2;0–5;0	NM	MSEL age > 12 months. Parents with low income. No genetic co-morbidities	JASPER	Joint engagement		.003**
							Initiated joint attention		.05*
							Symbolic play types		.002**
							Functional play types		.46
(14)	Kasari et al. (2015)	86	0;0–3;0	NM	No significant physical disabilities	JASPER	Joint engagement		.01*
							Functional play		.02*
							Highest play level achieved		.01*
							Joint engagement (CO)		.02*
							Initiated joint engagement		.28
							Symbolic play		.45
							Receptive language		.98
							Expressive language		.99
								Difficult child	> .05
								Parent domain	.51
(15)	Gulsrud et al. (2016)	86				JASPER		Communication	.01**
								Environment arrangement	.01**
								Mirrored pacing	.01**
								Prompting	.01**
(16)	Shire et al. (2016)	86				JASPER	Joint engagement		.01**
								Responsivity	.01**
(17)	Chang et al. (2016)	66	3;0–5;0	NM	NM	JASPER	Joint engagement		.0019***
							Initiated joint attention (TCX)		.022*
							1-word use		.039*
							2-word use		.007**
							3-word use		.007**
							Behaviour requests		.018*
							1-word requests		.006**
							Simple play time		.001***

Table 1 (continued)

	References	Participants				Play-based intervention	Specific outcome variable		p
		N	Age (years)	DSM	Comorbidity		Child	Parent	
							Functional play time		.027*
							Simple play improvement		.01**
							Functional play improvement		.004**
							Mental age improvement		.003**
							Visual receptiveness		.04*
							Fine motor skills		.02*
							Receptive language		.013*
							Expressive language		.58
							2-word requests		> .05
							3-word requests		> .05
							Symbolic play time		.583
							Symbolic play improvement		.15
							Initiated joint attention (ESCS)		.60
							Behaviour requests (ESCS)		.25
(18)	Shire et al. (2017a, 2017b)	114	2;0–3;0	NM	Cerebral atrophy (n = 1), language delays (n = 5), global developmental delays (n = 2)	JASPER	TCX Initiated joint engagement (IJA)		.001***
							Initiated behaviour requests (IBR)		.001***
							1-word IJA		.050*
							2-word IJA		.003**
							1-word IBR		.044*
							2-word IBR		.019*
							Functional play time		.001***
							Play improvement		.001***
							Social communication		.001***
							SPACE Initiated joint attention		.066
							SPACE IBR		.279
							Simple play		.593
							Functional play		.662

Table 1 (continued)

	References	Participants				Play-based intervention	Specific outcome variable		p
		N	Age (years)	DSM	Comorbidity		Child	Parent	
							Symbolic play		.158
(19)	Pajareya and Nopmanee-jumruslers (2011)	32	2;0–6;0	DSM-IV	NM	DIR/Floortime	Functional emotional assessment		.031*
							Autism symptoms		.004**
							Emotional development		.007**
(20)	Pajareya and Nopmanee-jumruslers (2012)	32		DSM-IV	NM		Functional emotional assessment		.001***
	Follow-up on						Autism symptoms		.001***
							Emotional development		.001***
(21)	Casenhiser et al. (2013)	51	2;0–4;11	NM	No Developmental/neurological delays		Initiation joint attention		.001***
							Enjoyment in interaction		.05*
							Developmental quotient		.038*
							Attention to activity		.05*
							Involvement		.01*
							Compliance		> .05
								Co-regulation	.01*
								Expression of enjoyment	.05*
								Joining	.001***
								Reciprocity	.01*
								Use of affect	.001***
								Sensory motor	> .05
								Independent thinking	> .05
(22)	Casenhiser et al. (2015)	51					Number of utterances		.002**
							Mean length of utterances		.015*
							Spoken communicative acts		.001***
							Obligatory response		.021*
							Contingent response		.003**
							Filled pauses		.366
							Response to comments		.433

Table 1 (continued)

	References	Participants				Play-based intervention	Specific outcome variable		p
		N	Age (years)	DSM	Comorbidity		Child	Parent	
(23)	Dawson et al. (2016)	48	1;0–2;5	DSM-IV	No neurodevelopmental disorder of known etiology, significant sensory or motor impairment, major physical problems, seizures, use of psychoactive medications, history of serious head injury and/or neurologic disease, alcohol/drug exposure during prenatal period and ratio IQ below 35 measured with MSEL	ESDM	Early learning		.044*
							Visual reception		.046*
							Receptive language		.051*
							Expressive language		.033*
							Adaptive behaviour		.011*
							Communication		.015*
							Daily living skills		.013*
							Motor skills (VABS)		.009**
							Fine motor (MSEL)		.503
							Socialization		.263
							Repetitive behaviour		.545
							ADOS severity score		.422
(24)	Rogers et al. (2019a, 2019b)	44	1;0–2;5	DSM-IV	NM		Early learning		.0001***
							Autism symptoms		.0001***
							Overall language		.01*
							Adaptive behaviour		.20
								Parent fidelity	.006**
(25)	Rogers et al. (2019a, 2019b)	118	1;4–2;0	DSM-IV	NM		Early learning		.47
							Language		.02*
							Overall development		.08*
							Autism symptoms		.33
							Adaptive behaviour		.24

Table 1 (continued)

	References	Participants				Play-based intervention	Specific outcome variable		p
		N	Age (years)	DSM	Comorbidity		Child	Parent	
(26)	Solomon et al. (2014)	86	2;8–5;11	DSM-IV	NM	PLAY project	Autism symptoms (ADOS)		.001***
							Problem behaviour		.001***
							Attention		.01*
							Initiation		.001***
							Child interaction		.05*
							Social communication		> .05
							Developmental quotient		> .05
							Words & gestures		> .05
							Words & sentences		> .05
								Maternal behaviour	.001***
								Responsivity	.001***
								Affect/animation	.001***
								Achievement orientation	.001***
								Directive	.01*
								Parental stress	> .05
								Depression	> .05
(27)	Mahoney and Solomon (2016)	86					ADOS Severity		.001***
							ADOS Social Affect		< .05*
							ADOS Comparison		> .05
							ADOS restricted, repetitive behaviours or interests		> .05
(28)	Ginn et al. (2017)	39	3;1–6;5	NM	Intellectual disability not excluded	PCIT	Intensity disruptive behaviour		.001***
							Disruptive behaviour		.02*
							Social awareness		.02*
							Receptive language		.85
							Word count		.85
							Social responsiveness		.11
								Positive following	.001***
								Negative leading	.001***
								Total stress	.19
(29)	Scudder et al. (2019)	19	3;0–7;0	DSM-V	IQ > 75 IQ > 30 mnd	PCIT	Problem behaviour intensity		.029*

Table 1 (continued)

	References	Participants				Play-based intervention	Specific outcome variable		p
		N	Age (years)	DSM	Comorbidity		Child	Parent	
							Problem behaviour frequency		> .05
							Compliance		> .05
								Pride skills	.001***
								Negative skills	.001***
								Parental stress	> .05
(30)	Owens et al. (2008)	31	6;0–11;0	NM	IQ > 70	LEGO	Autism symptoms		.05*
							Maladaptive behaviour		.05*
							Communication		> .05
							Socialisation		> .05
							Self-initiated social interaction		> .05
							Duration of social interaction		> .05
								Parent satisfaction	> .05
(31)	Schottelkorb et al. (2020)	23	4;0–10;0	NM	ADHD (n = 13), OCD (n = 3), GAD (n = 2), pica (n = 1), or ODD (n = 1)	CCPT	Social responsiveness		.01*
							Attention problems		.01*
							Aggressive behaviour		.03*
							Externalizing problems		.01*
(32)	Wong and Kwan (2010)	17	1;4–3;0	DSM-IV	All non-verbal, no co-morbid neurological or psychiatric disorders	1–2–3 PLAY	Vocalization directed to others		.005**
	Pilot						Reciprocal social interaction		.011*
							Requesting		.01**
							Language		.010**
							Social relationship to people		.007**
								Total stress	.004**

	References	Effect size	RoB						
			RS	AC	BO	IO	SR	Ot	on
(1)	Schreibman et al. (1991)	–	?	–	+	+	+	–	3b, 5
(2)	Nefdt et al. (2010)	0.95	–	?	+	+	+	–	3b

Table 1 (continued)

	References	Effect size	RoB						
			RS	AC	BO	IO	SR	Ot	on
		2.23							
		1.28							
		4.12							
(3)	Hardan et al. (2015)	1.06	+	+	+	+	+	−	3b
		.094							
		0.46							
		0.23							
		0.47							
		1.14							
		0.42							
		0.08							
		0.34							
		− 0.09							
		0.46							
		0.50							
		− 0.35							
		0.27							
		0.07							
		0.49							
(4)	Schreibman and Stahmer (2014)	0.22	?	?	?	+	+	−	1a, 3b
		0.49							
		0.11							
		–							
(5)	Mohammadzaheri et al. (2014)	–	?	?	+	+	+	−	3c
		–							
(6)	Mohammadzaheri et al. (2015)	–	?	?	+	+	+	−	3c
(7)	Gengoux et al. (2019)	–	+	+	+	+	+	−	2, 3b, 4
		–							
		–							
		–							
		–							
		–							
		–							
		–							
		–							
(8)	McDaniel et al. (2020)	0.69	+	+	+	+	+	−	2, 4

Table 1 (continued)

	References	Effect size	RoB						
			RS	AC	BO	IO	SR	Ot	on
(9)	Vernon et al., (2019a, 2019b)	− 1.39	+	+	+	+	+	−	4
	Pilot	0.61							
		0.52							
		0.69							
		0.47							
		0.62							
		0.55							
		0.75							
		0.24							
		0.31							
		0.21							
		0.24							
		0.55							
		0.00							
		− 0.02							
		0.23							
(10)	Barret et al. (2020)	1.00	+	+	+	+	+	−	2, 4
	Pilot	0.44							
		0.14							
		0.40							
		0.31							
(11)	Lawton and Kasari (2012)	1.85	+	+	+	+	+	+	
		2.02							
		1.85							
		2.02							
		1.24							
		1.41							
		–							
		–							
		–							
		–							
		–							
		–							
		–							
		–							
		–							
(12)	Goods et al. (2013)	0.81	+	+	+	+	+	+	

Table 1 (continued)

	References	Effect size	RoB						
			RS	AC	BO	IO	SR	Ot	on
		1.63							
		1.51							
		–							
		–							
(13)	Kasari et al. (2014)	0.21	+	+	+	+	+	–	3a
		0.14							
		0.30							
(14)	Kasari et al. (2015)	0.69	+	+	+	+	+	+	
		0.06							
		0.11							
		.06							
		–							
		–							
		–							
		–							
		–							
		–							
(15)	Gulsrud et al. (2016)	–	+	+	+	+	+	+	
		–							
		–							
		–							
(16)	Shire et al. (2016)	–	+	+	+	+	–	+	
		–							
(17)	Chang et al. (2016)	0.32	?	?	+	+	+	+	
		0.32							
		0.28							
		0.38							
		0.37							
		0.33							
		0.38							
		0.52							
		0.31							
		0.35							
		0.39							
		–							
		–							
		–							
		–							

Table 1 (continued)

	References	Effect size	RoB						
			RS	AC	BO	IO	SR	Ot	on
		–							
		–							
		–							
		–							
		0.07							
		0.07							
		0.15							
(18)	Shire et al. (2017a, 2017b))	0.81	+	+	+	+	−	+	
		0.45							
		0.24							
		0.37							
		0.20							
		0.23							
		1.20							
		0.48							
		0.41							
		0.19							
		0.11							
		0.08							
		0.05							
		0.15							
(19)	Pajareya and Nopmaneejumruslers (2011)	–	+	+	+	+	+	-	2
		–							
		–							
(20)	Pajareya and Nopmaneejumruslers (2012)	–	+	+	−	+	+	−	2, 6
	Follow-up on	–							
		–							
(21)	Casenhiser et al. (2013)	1.02	+	+	+	+	+	−	1a, 1b, 3a, 7
		0.63							
		0.45							
		0.69							
		0.87							
		0.51							
		0.97							
		0.79							
		0.92							

Table 1 (continued)

	References	Effect size	RoB						
			RS	AC	BO	IO	SR	Ot	on
		0.86							
		.096							
		0.28							
		0.39							
(22)	Casenhiser et al. (2015)	.208	+	+	+	+	+	−	1a, 1b, 3a, 7
		0.123							
		.017							
		.165							
		.022							
		.012							
		.105							
(23)	Dawson et al. (2016)	–	+	?	+	+	+	+	
		–							
		–							
		–							
		–							
		–							
		–							
		–							
		–							
		–							
(24)	Rogers et al. (2019a, 2019b)	–	+	+	+	+	−	−	1c, 4, 7
		–							
		0.33							
		.05							
		.01							
(25)	Rogers et al. (2019a, 2019b)	.33	+	+	+	+	+	−	4
		–							
		–							
		–							
(26)	Solomon et al. (2014)	–	+	+	+	+	+	−	1c
		.14							
		0.7							
		0.14							
		0.5							
		.01							
		.09							

Table 1 (continued)

	References	Effect size	RoB						
			RS	AC	BO	IO	SR	Ot	on
		.02							
		.09							
		.30							
		0.15							
		0.20							
		0.10							
		0.10							
		.97							
		.02							
(27)	Mahoney and Solomon (2016)	–	+	+	+	+	+	–	1c
(28)	Ginn et al. (2017)	1.12	?	?	?	+	–	–	1b
		0.79							
		1.03							
		0.42							
		–							
		0.17							
		2.60							
		1.78							
		0.53							
(29)	Scudder et al. (2019)	–	?	?	?	+	+	–	3c
		–							
		–							
		2.18							
		–							
		–							
(30)	Owens et al. (2008)	–	?	–	–	+	+	–	8
		–							
		–							
		–							
		–							
		–							
(31)	Schottelkorb et al. (2020)	.47	+	+	?	+	+	–	1a, 2
		.40							
		.20							
		.34							
(32)	Wong and Kwan (2010)	–	?	?	?	+	+	–	9
	Pilot	–							
		–							

Table 1 (continued)

References	Effect size	RoB							
		RS	AC	BO	IO	SR	Ot	on	
	–								
	–								
	–								

NM not mentioned within the study, RoB is presented per category, *RS* random sequence generation, *AC* allocation concealment, *BO* blinding of outcome assessment, *IO* incomplete outcome data, *SR* selective reporting, *Or* other bias with? unclear risk of bias, – high risk of bias and + low risk of bias. Other bias on 1: Homogeneity, 1a: high income, 1b: Caucasian, 1c: high education. 2: Performance bias. 3: Selection bias, 3a: low income, 3b: delayed speech, 3c: IQ > 75, 4. Lack of power. 5: Stack effect of treatment. 6: No control group, 7: Attrition bias. 8: Control group not randomly assigned. 9: Use of unofficially translated questionnaires. Pilot: Due to small sample size of pilot study, mixed group x time analytical procedures were not conducted. Instead, the subdomain of pre-post analyses examined baseline to project completion, changes within treatment group are presented. *CO* class observation, *ESCS* early social communication scale, *PI* play interaction, *TCX* teacher–child interaction, *IJA* initiated joint attention, *IBR* initiated behaviour request, *SPACE* short play and communication evaluation

*Correlation is significant at the < .05, **Correlation is significant at the < .01, ***Correlation is significant at the < .001

Child-Centered Play Therapy, n = 1 RCT[31] and (9) 1–2–3 play project, n = 1 RCT [32]. An overview of all these studies is presented in Table 1. Descriptions of the nine play-based interventions are presented in Appendix I.

Outcome Variables

A wide range of specific outcome variables was found (Table 1); they were clustered in three levels and nine domains of functioning.

I. Primary dimensions of ASD: (1) social interaction, (2) communication and (3) restricted, repetitive behaviours or interests.
II. Everyday functioning: (4) daily functioning, (5) severity of problem behaviour and (6) play skills.
III. Parenting domains: (7) parental attunement, (8) frequency and quality of parent–child interactions, (9) level of parental stress (Table 2).

I The Effects of Play-Based Interventions on the Primary Dimensions of ASD Symptoms

Social Interaction

Social interaction was the most studied domain in 75% (24/32) of the RCTs. 87.5% of these (21/24)[7–14,16–21,24,26–28,30–32] showed significant improvements on a wide range of specific outcome variables (Table 2). Ten outcome variables showed large effect sizes (ES); six showed medium ES, and there were no small ES present (Table 2). Eight variables were evaluated without reported ES, but they showed significant improvements after play-based intervention. Three studies did not find significant results on social interaction[3,23,25] (Table 1). Most of the RCTs used self-contrived (video) observations (observations made by the research group), scored with adapted or pre-existing coding systems[11,16] or self-contrived coding systems with descriptions and percentages of inter-rater reliability[13,14,17].

Communication

Communication was the second most studied domain in 59% (19/32) of the RCTs. 84% of these (16/19)[2–5,7,9,10,12,13,,17,18,22–25,32] presented significant improvements on a wide range of specific outcome variables. Five variables showed large ES; 14 variables showed medium ES and there was one small ES present. Four variables showed no ES but did improve significantly after play-based intervention[14,21,22,32] (Table 2). Outcomes in

Table 2 Effectivity of play-based interventions in children with ASD and their parents based on our systematic literature review

Domain	Specified outcome	*p*			Effect size		
		from	–	*to*	*from*	–	*to*
Social interaction	Pointing	.005			2.02		
	Showing	.01	–	.025	1.85	–	2.02
	Initiated joint attention	.005	–	.05	0.14	–	1.85
	ADOS severity score	.001[t]			1.39		
	Improvement	.001	–	.037	1.06	–	1.14
	Social awareness	.02			1.03		
	Inattention to joint attention	.001			1.02		
	Social responsiveness	.03[t]	–	.05	0.33	–	1.00
	Initiated joint engagement	.001	–	.0019	0.32	–	0.81
	Involvement	.01			0.87		
	Enjoyment interaction	.05			0.63	–	0.79
	Attention to activity	.05			0.69		
	Joint engagement	.003	–	.01	0.21	–	0.69
	Severity	.003	–	.019	0.44	–	0.47
	Behaviour requests	.018			0.33		
	Cognition	.05			0.22		
	ASD symptoms[a,b]	.0001	–	.004	–		
	Emotional development	.007			–		
	Initiation	.001			–		
	Reciprocal social interaction	.011[z]			–		
	Social relationship	.007[z]			–		
	Requesting gestures	.01[H]	–	.01[z]	–		
	Engagement	.04[Z]			–		
	Reciprocal vocal contingency	.04			–		
Communication	Social communication	.001	–	.004	0.37	–	1.45
	Use of imitative words	.001			1.06		
	Functional verbal utterances	.001			0.95		
	Nonverbally prompt utterances	.002			0.94		
	Words produced	.000	–	.018	0.49	–	0.82
	Receptive language	.006[t]	–	.028	0.23	–	0.75
	Total utterances	.002	–	.026	0.64		
	Communication	.028[t]	–	.037	0.11	–	0.55
	Visual reception	.042[t]			0.47		
	Expressive language	.004	–	.022	0.46		
	Preschool language	.038[t]			0.45		
	Mean length of utterances	.01	–	.03[t]	0.44		
	Expressive communication	.000			0.22		
	Use of two words	.007			0.38		
	One-word request	.006			0.38		
	Use of three words	.007			0.37		
	Use of one word	.039			0.28		
	Overall language	.01[z]	–	.01	0.33		
	Obligator response	.021			–		
	Contingent response	.003			–		
	Communicative acts	.021			–		
	Vocalization directed	.005[z]			–		
Restricted, repetitive behaviours or interests	No significant results	–			–		
Daily functioning	Fine motor skills	.009[t]	–	.02[t]	0.62		
	Early learning (ELC)	.000[t]	–	.001	0.61		
	Visual receptiveness	.04[t]	–	.046	0.47		
	Mental age	.003[t]			–		
	Adaptive functioning	.05[z]	–	.011	–		
	Daily living skills	.013			–		
	Motor skills	.009			–		

Table 2 (continued)

Domain	Specified outcome	*p*			Effect size		
		from	–	*to*	*from*	–	*to*
Problem behaviour severity	Intensity	.001	–	.05	1.12	–	1.42
	Problem behaviour	.05			0.87		
	Disruptive behaviour	.02			0.79		
	Attention problems	.01			–		
	Aggressive behaviour	.03			–		
	Externalizing problems	.01			–		
Play skills	Object engagement	.01			1.41		
	Supported engagement	.05			1.24		
	Functional play improvement	.001	–	.004	0.39	–	1.20
	Simple play time	.001			0.52		
	Improvement of play	.001			0.48		
	Simple play improvement	.01			0.35		
	Functional play time	.027			0.31		
	Symbolic play	–			0.30		
	Highest play level achieved	.01			0.11		
	Types of functional play	.02			0.06		
	Spontaneous play	.04[H]			–		
	Engagement	.05[H]			–		
	Play types	.04[H]			–		
Parental attunement	Positive following	.001			2.60		
	Negative leading	.001			1.78		
	Language opportunities	.000			2.23		
	Observed confidence	.001			1.28		
	Responsivity	.01			0.99		
	Co-regulation	.01			0.96		
	Joining in activities	.001			0.92		
	Reciprocity	.001			0.86		
	Positive affect	.01			0.79		
	Expression of enjoyment	.05			0.79		
	Environment arrangement	.008			–		
	Mirrored pacing	.01			–		
	Prompting	.01			–		
	Communication	.01			–		
	Responsiveness to child	.0001			–		
	Affect/animation	.001			–		
	Achievement-orientated	.001			–		
Parent–child interaction	Pride skills	.001			2.18		
	Negative skills	.001			–		
	Parent–child interaction	.045	–	.05	–		
Parental stress	Difficult child	.05			0.57		
	Stress	.004[z]	–	.05	0.35		

[a]Measured with parental self–reported questionnaires on ASD symptoms like the CARS/GARS.

[b]Measured with structured clinical observation instruments such as the ADOS-2/T

[t]Statistical analysis was performed with a T test

[H]Statistical analysis was performed with the Kruskal–Wallis test

[Z]Statistical analysis was performed with the Wilcoxon signed-rank test. In all other cases an ANOVA/F-test was used

communication were either obtained through self-contrived video observations or through parental self-reports like the Vineland Adaptive Behaviour Scale (VABS) (Van Duijn et al., 2009). One RCT[13], using the Reynell Developmental Language Scales (RDLS), compared a play-based intervention to a parent-only psychoeducational intervention and found an overall increase of receptive and expressive language in both treatment groups. Four studies found no significant changes in communication variables[14,26,28,30].

Restricted, Repetitive Behaviours or Interests

Restricted, repetitive behaviours or interests were scarcely reported: one RCT[23] evaluated the effect on restricted, repetitive behaviours or interests but showed no significant improvements after play-based intervention compared to community service[23]. Restricted, repetitive behaviours or interests was measured by parent self-reporting on The Repetitive Behaviour Scale. Another RCT[27] included data using the restricted, repetitive behaviours or interests Scale of the Autism Diagnostic Observation Scale (ADOS). This showed no significant post-intervention improvement on restricted, repetitive behaviours or interests.

II The Effect of Play-based Interventions on Everyday Functioning

Daily Functioning

Daily functioning was studied in 25% (8/32) of the RCTs. Other RCTs did used instruments which could have provided information on daily functioning, but these studies did not report those scores because they focused on other domains. 75% of these RCTs (6/8)[9,17,21,23–25] presented significant improvement after play-based intervention. No large ES were found; three variables showed medium ES, and no small ES were present. Five variables were reported without ES but did show significant improvement after play-based intervention (Table 2). Daily functioning was mostly assessed with the VABS or the Functional Emotional Development Questionnaire (FEDQ) (Hess, 2013). The MESL[1], an observation instrument for professionals, was also used.

Severity of Problem Behaviour

The severity of problem behaviour was studied in 19% (7/32) of the RCTs. 83% (6/7)[6,26,28–31] presented significant improvement on a range of specific outcome variables. Two variables showed large ES, one showed a medium ES, and there were no small ES found. Three variables showed no ES, but significantly improved after play-based intervention (Table 2). Outcomes on problem behaviour severity were mostly obtained through parental self-reporting such as the Eyberg Child Behaviour Inventory (ECBI) or the Child Behaviour Rating Scale (CBRS) (Abrahamse et al., 2015).

Play Skills

Play skills were studied in 19% (5/32) of the RCTs; all used the same play-based intervention (JASPER). These five studies[12,13,14,17,18] present data showing significant improvements in a range of specific outcome variables. Eight variables were presented with large ES; three other variables were reported using a measure that does not give ES but they all also showed significant improvement (Table 2). Three of the RCTs reported mixed outcomes on play skills, finding significant effects on symbolic but not functional play[14,17], or on functional but not symbolic play[13]. One study established that higher pre-intervention mental age was related to greater effects on symbolic play[14]. All the RCTs used video and other observations of semi-structured play moments to evaluate the effect of the play-based interventions.

III The Effect of Play-Based Interventions on Parenting Domains

Parental Attunement

Parental attunement was studied in 31% (9/32) of the RCTs. 90% of these RCTs (8/9) presented significant progress on a large range of outcome variables [1,2,15,16,21,24,26,28]. Ten variables showed large ES, but no medium or small ES were reported. Nine variables were presented without ES but did show significant improvement in parental attunement after play-based intervention (Table 2). One study did not find any significant results on increased social bids from the parent towards the child[10]. A range of instruments was used, varying from clinical, semi- or fully structured observation tools like the Dyadic Parent–Child Interaction Coding System (Eyberg & Robinson, 1981) (DPICS-III), to self-contrived video observation schedules and fidelity scales specifically developed for the play-based intervention itself, like the Milton & Ethel Harris Research Initiative (MEHRIT) fidelity scale[21,22].

Parent–Child Interaction

The frequency and quality of parent–child interaction was studied in 13% (4/32) of the RCTs. All four RCTs presented significant improvements on three specific outcome variables: (1) the frequency of praise a parent made increased (pride skills, ES 2.18)[29] and the (2) frequency of negative talk towards the child with ASD decreased (p 0.001) [29], both were measured with the DPICS-III. An overall positive significant effect was found on (3) the quality of the parent's interaction towards the child (p 0.045[19,20]–0.05[26]), measured on a semi-structured clinical observation tool, the Functional Emotional Assessment Scale (FEAS) (Greenspan et al., 2003).

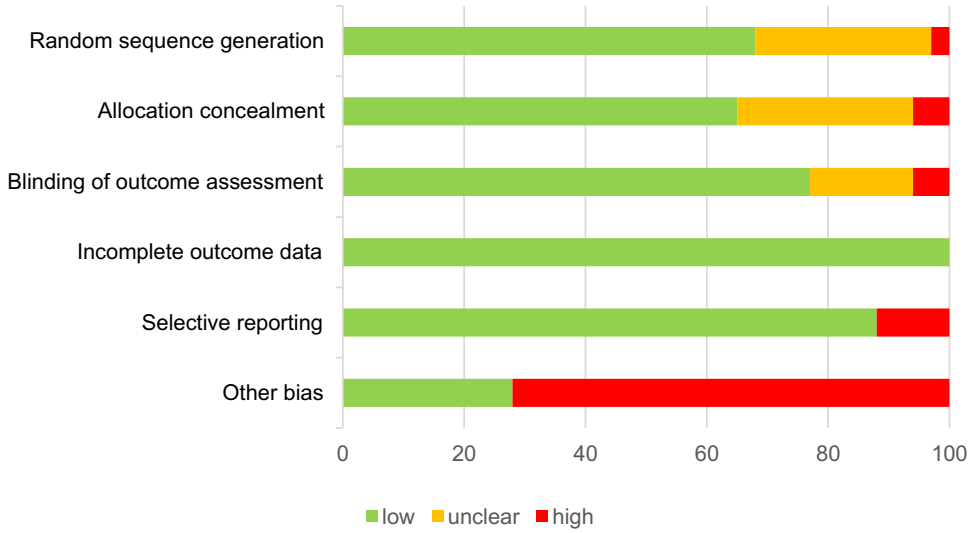

Fig. 2 Risk of bias assessment graph in percentages, overview on the 32 RCTs on play-based interventions for children with ASD. Other biases included: Homogeneity of study population[4,21,22,24,26–28,31]; Lack of power[7–10,24,25]; Performance bias[7,8,10,19,20,31]; Selection bias[1,3–7,13,21,22,29]; Attrition bias[22,24] Stack effect of outcome effects[1]; No control group[20]; No random assignment to control group[30]; Unofficial translated questionnaires[32]

Parental Stress

The level of parental stress was assessed in 16% (5/32)[14,26,28,29,32] of the RCTs. No large ES were found, but 40% (2/5) of the RCTs presented medium ES on two specific variables: (1) the degree to which parents experience their child as troublesome (ES 0.57)[29], and (2) the decline of parental stress[29,32]. No small ES were present. Three RCTs reported contradictory results: one compared a play-based intervention to community treatment and found a significant decrease of parental stress in both groups, but with no difference between the two groups[26]. A second RCT compared a play-based intervention to a parent psycho-education group and described high levels of parental stress in both groups, with no significant declines in either after intervention[14]. The third RCT presented a steeper reduction of parental stress compared to a waiting list group, although this difference was not significant[28]. All RCTs that evaluated the effect of play-based interventions on parental stress used a self-rated questionnaire, the Parental Stress Index (PSI) (Lee et al., 2016).

Risk of Bias Assessment

After RoB assessment, 14% (n = 3) of the studies with significant effects (n = 21) on social interaction showed low RoB[11,12,14], 10% (2/21) showed an unclear risk of RoB[9,17], and 76% (16/21) showed high RoB[7,8,10,13,16,18–21,24,26–28,30–32]. The high RoBs were found most often in the category 'other biases': (1) performance bias[7,8,10,19,20,31] and (2) selection bias[7,8,13,21]. RoB assessment on studies on communication revealed that 6% (n = 1)[12] of the studies with significant effects (n = 16) showed a low RoB, 25% (4/16)[5,9,17,23] showed an unclear RoB, and 69% (11/16)[2,–4,7,10,18,22–25,32] showed a high RoB. The two most common RoBs were in the category 'other biases': (1) selection bias[2,3,4,7,22,] and (2) lack of power[7,10,24,25]. The study on restricted, repetitive behaviours or interests [23] was classified with an unclear RoB regarding allocation concealment, because of a lack of clarity about the randomization process and whether participants and/or investigators could have foreseen treatment assignment. None of the studies with significant effects on enhanced daily functioning (n = 6) were classified with a low RoB, 50% (3/6) had an unclear RoB[7,17,23] and 50% (3/6)[21,24,25] had a high RoB. The two most common high RoBs were: (1) selection bias[21,24] and (2) attrition bias[21,24]. All of the studies with significant effects on problem behaviour severity showed a high RoB[6,26,28,29,30,31]. The most common high RoBs were homogeneity of study population [26,28,31] and selection bias[6,29]. One RCT did not report on problem behaviour severity but used the Child Behaviour Checklist (CBCL) to address this research domain[25]. This RCT was therefore classified with a high RoB due to selective reporting. 40% (n = 2) of the studies on play skills with significant effects (n = 5) were classified with a low RoB[12,14], 20% (1/5)[17] with unclear RoB and 40% (2/5) with a high RoB due to selection bias by only including parents with low incomes[13] and selective reporting (Table 1, Appendix II)[18]. After RoB assessment, 11% of the studies (n = 1)[15] on parental attunement that showed significant effects (n = 8) had a low RoB, while 88% (7/8) [1,2,16,21,24,26,28] had a high RoB. The most common high RoBs were homogeneity of study population[21,24,26,28] and selection bias[1,2,21,29]. All of the studies that showed significant effects on the frequency and quality of parent–child interaction were classified with a high RoB, mostly due to performance bias[19,20], or lack of blinding of outcome assessment[20]. The one study with a significant effect on parental stress had a high RoB, due unclear RoB in 3/5 RoB categories and because they used

unofficial translations of questionnaires (English into Chinese) that might have been culturally sensitive (Appendix II). A RoB assessment per RCT is presented in Table 1, an overall RoB assessment is presented in Fig. 2, and a review on the individual RoB assessment per RCT is presented in Appendix II.

Discussion

Our aim was to evaluate the effectivity of play-based interventions in children with ASD and their parents, by performing a systematic review based on the PRISMA guidelines and a RoB assessment (Higgins & Green, 2008; Higgins et al., 2011; Page et al., 2021). We selected 32 RCTs evaluating nine different play-based interventions in a total of 1206 children with ASD. The overall results are mixed, and significant positive outcomes might be due to several sources of bias.

With respect to the primary symptoms of ASD in this review, over half the RCT studies showed significantly improved social interaction after play-based intervention. It is not certain whether the results are only due to play-based interventions, since shorter treatment duration or lower intensity in the control groups might have affected the group comparisons[1,2,21,22,31]. More so, in studies that showed no significant results on social interaction, the same evaluation instruments were used as in the studies that presented significant improvement. In addition, a minority of the 32 RCTs did not show significant results for social interaction; in one RCT [25] their absence might be due to the lack of power. In others, this might have been due to the choice of comparison groups (play-based intervention versus community service or waiting list)[23,27,28].

Play-based interventions appear to be effective in enhancing communication in children with ASD. However, one third of the studies on communication used small sample sizes[1,2,4,10,24] and the specific outcomes in these studies differed considerably. Half of the study samples in the RCTs on communication consisted of children with delayed speech[2,3,32] and mainly with Caucasian parents[28,31] with higher education levels[25,27] and/or higher than average incomes[19,20].

Restricted, repetitive behaviours or interests was much less well studied in the ASD symptom domain than social interaction or communication and showed no significant results. The absence of these evaluations may be due to the choice of population studied, mainly studies were of children with low IQ (total intelligence score 50–70)[5,6]. Other RCTs used instruments which could have provided information on restricted, repetitive behaviours or interests, but they did not report these scores because their focus lay elsewhere.

Mixed results were also present in the domain of everyday functioning of the child with ASD. Although the majority of the RCTs on daily functioning and problem behaviour severity showed significant positive results after play-based intervention, it is difficult to generalize since a large proportion of the study population comprised Caucasian parents, with higher incomes and higher education levels than average[19,25,27,28,31]. The play skills of children with ASD were shown to improve significantly after play-based intervention, but this was only studied in RCTs with JASPER. All but one RCT (which had mixed results, specifically targeted low- resource parents, and had high attrition rates before the start of the intervention)[14] showed significant improvements. Improved play skills can be considered an important finding, since aberrant play development, which is commonly seen in ASD, is associated with social problems. This shows that children with ASD do seem to be able to develop their play skills through play-based interventions like JASPER.

The effect of play-based interventions on parenting-related domains of functioning also varied. Play-based interventions seemed to be effective for parental attunement and for increasing parent–child interaction. Representativeness of findings may be limited, since the study populations mainly included Caucasian parents with higher education levels and/or higher incomes than the average population[19,24,26–28]. Also, some studies only included children with delayed speech[7,8], or excluded children with developmental delays[19,20]. Other studies on parent–child interaction were not blinded in their outcome assessments[21,22], which may have biased outcomes. A minority of the RCTs on parental stress showed significant positive results, while the lack of significant results could not be explained by the instruments used. RoB could also not explain the differences in outcomes.

Even though this systematic review shows that play-based interventions can be effective for children with ASD and their parents which is in line with previous studies, even allowing for bias, (Tachibana et al., 2017; Parsons et al., 2017; Bernard-opitz, 2002; Field et al., 2001; Goods et al., 2013; Kasari et al., 2006; Quirmbach et al., 2008; Shire et al., 2017a, 2017b; Kasari et al., 2014; Kasari et al., 2010; Kasari et al., 2015; Chang et al., 2016; Kamps et al., 2015; Kretzmann et al., 2015; Wong, 2013) we still need to know more about the working mechanisms that may have led to these specific findings.

Despite the fact that we have not made a substantive analysis of the play-based interventions covered by the RCTs, one hypothesis for the main contributing factor to a positive outcome might be that the activity of parent and child playing together stimulates the child's social behaviour—this seems to be the common factor in most RCTs. Stimulation of parent–child activity may well enhance the mutual contact

within a natural and pleasant activity like play. This could further enhance basic skills in social interaction and communication. Learning more about the specific mechanisms that underlie the effects of play-based interventions and that stimulate parent–child play, enhanced joyfulness, or other aspects of a motivational learning environment, will help to improve the effects and the design of tailor-made interventions for children with difficulties in specific domains of functioning, like those with ASD. Where previous studies showed that interventions focussing on the child were more effective than interventions mediated by parents, peers or teachers, the majority of studies within this review focus on the parent–child dyad (Kent et al., 2020).

Future Research

Our systematic review showed that RCTs on play-based interventions used many different instruments, leading to a large number of outcome measures. Future research could profit from using standardized evaluation instruments, which would enhance any meta-analyses in further specifying the mechanisms and effects of play-based interventions in children with ASD and their parents. Suggestions for future research on this topic include: (1) using a standard instrument that measures ASD symptoms, such as the ADOS-2; (2) using an instrument that measures daily functioning including problem behaviour, such as the Vineland; (3) using a standardized play observation that measures progress in play skills, e.g. JASPER (Kasari et al., 2014); (4) using a standardized instrument that indicates the parent–child relationship, such as the FEAS (Greenspan et al., 2003); and (5) using a questionnaire that provides insight into parental stress, such as the Parental Stress Index (Haskett et al., 2006). With regard to parental stress, we would advise to use additional physical stress parameters such as cortisol, to reach objective stress evaluation like was done by Radin et al., 2019.

Opensource data can offer an opportunity to increase the generalizability of the effect of play-based interventions. Reanalysis of available data could have been used to reduce some of the main biases presented in this review (lack of power, homogeneity of study population, selection bias). If studies need to be duplicated, we would suggest: (1) to look carefully at the representation within the study populations, so that there is an equal distribution in background, origin, co-morbidity, and ASD problems and (2) Introducing more equality in the duration and/or intensity of the treatment groups, which would help prevent performance bias.

Based on our findings, it seems to be crucial for future research to seek for better understanding of the impact of the stimulation of interactive activity in play-based interventions for children with ASD and their parents. If we can identify the active elements, we can tailor interventions specifically to the needs of individual parent–child dyads to ensure that the development of the children and their parents' health run as smoothly as possible.

Limitations

There are several limitations to this review. First, in order to obtain an accurate overview of studies evaluating the effect of play-based interventions in children with ASD and their parents, it was decided to cover a long period of time in our literature search. During this period of time, different classification systems have been used with regard to ASD. This should be taken into account with respect to the findings of this review. For example, it changed over time whether or not ADHD was diagnosed in addition to ASD. Therefore, for each included study it is reported which classification system was used and if it was allowed to add comorbidity. In the overall analysis of the results and the RoB, differences in classification systems were not taken into account to be able to perform an overarching analysis regarding the main question of effectiveness of play-based interventions. We choose to describe the results on three levels and nine domains of functioning, being the primary aim of this review, in order to give the relevant information for evaluation. In addition, since we chose to include only RCTs, many studies fell outside our scope. Choosing only RCTs allowed us to compare results of study designs with the highest level of evidence and most reduction in bias, to be able to make adequate comparisons in effect sizes between the different play interventions.

Conclusions

Although the results were mixed, this review does suggest there is evidence that play-based interventions can be effective for children with ASD, taken the risk of bias mainly due to homogeneity of study population, lack of power and performance bias into account. Previous literature showed that children with ASD have an aberrant play development and play-based interventions specifically target this deficiency. Our review endorses the findings of Kent et al. (2020) that children with ASD can enhance their social interaction, communication and play skills through play-based interventions. In addition, play-based interventions can enhance daily functioning, decrease the severity of problem behaviour in children with ASD, and enhance parental attunement and improve the parent–child relationship. These findings are all beneficial to the child's development. Also, a more positive parent–child interaction is associated with fewer behaviour problems and somatic complaints in the child (Rigter & van Hintum, 2010), while fewer problems with

the child can help reduce parental' stress (Smith et al., 2014; Zaidman-Zait et al., 2014).

In summary, the results from this systematic review suggest that play-based interventions can lead to improvement in two core symptoms for children with ASD: social interaction and communication. Play-based interventions seem to also enhance everyday function, decrease the severity of problem behaviour and improves play skills. The majority of parents can become better attuned to the needs of their child with ASD and the parent–child relationship seems to improve. Implementing play-based interventions in the treatment of children with ASD could therefore be considered, taken the risk of bias within these studies into account. As this study shows that play-based interventions can influence behaviour of children and parents, it can therefore positively influence the bi-directional interaction of parents and their child (Zaidman-Zait et al., 2014).

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10803-021-05357-2.

Author contributions LD, IAB, HS and WAE contributed to the study conception and design. Study selection and data extraction were performed by LD and LAK, risk of bias analysis was performed by LD and CT. The first draft of the manuscript was written by LD and authors IAB, HS and WAE commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding Funding was provided by Korczak Foundation for Autism and Related Disorders (Grant No. 250.000EU).

Declarations

Conflict of interest All authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Note. Those references prefixed by a number denote the 32 RCTs included in this review.

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