**A Systematic Review of Play-Based Interventions targeting the Social Communication Skills of Children with Autism Spectrum Disorder in Educational Contexts**

Social communication skills are a complex set of skills highlighted as difficult for children with Autism Spectrum Disorder (ASD) (Balasubramanian et al. 2019; Howlin 2000; Laugeson and Elingsen 2014). Social communication is an 'umbrella term', as described by Kossyvaki (2018, p.7), for both: (1) *social interaction*, defined as the reciprocal exchange of information (Dijkstra 2015; Shores 1987) as well as relational components including relationships and friendships (Burk 1996; Winstead and Derlegav 1986) acceptance and belonging (Duck and Montgomery 1991; Goffman 1963), and isolation and loneliness (Laursen and Harup 2002; Samp 2009), and; (2) *communication*, defined as an interactive process in which information is exchanged between partners through multiple means such as body language, speech, facial expressions and gestures (Gould 2009; Mehta 1987; Nilsen 1957; Rogoff 1990; Schlosser 2003). This inherent overlap between social interaction and communication is reflected within the literature (Conn 2016; Fuller and Kaiser 2019; Wetherby 2006; Wetherby et al. 2007) and has been adopted within the latest diagnostic criteria for ASD (DSM-V) (American Psychiatric Association 2013). As a result, this review will adopt an all-encompassing approach to social communication and include studies which target any aspect of social communication, in line with the above criteria.

Despite heterogeneity of ASD, challenges in social communication are experienced by all children across the spectrum (Anderson et al. 2014; Balasubramanian et al. 2019; Tager-Flusberg et al. 2001; APA 2013) throughout all stages of life (Plimley et al. 2007; Prizant and Fields-Meyer 2019; Tomaino et al. 2014; Volkmar et al. 2014) in areas including social-emotional reciprocity, non-verbal communication and in the development and understanding of relationships (APA 2013). Differences are apparent from early infancy and include difficulties initiating (Franchini et al. 2018; Mundy et al. 2016; Sasson and Touchstone 2014) and responding to joint attention (Chawarska et al. 2016 ; Sullivan et al. 2007) as well as differences in understanding non-verbal communication including eye contact (Muzammal and Jones 2017; Zwaigenbaum et al. 2013), imitation (Ornstein-Davis and Carter 2014; Rogers and Williams 2006), body language, gestures and facial expression (Chawarska et al. 2014; Wetherby 2006; Wetherby et al. 2004). Such differences often become more obvious among school-age children with ASD due to increased social demands (Bauminger-Zviely 2014; Einfeld et al. 2018; Loveland and Tuanali-Kotoski 2005) in particular surrounding peer relations and include reduced levels of peer interactions (Bauminger-Zviely 2014; Hansen et al. 2014; Wetherby et al., 2006) as well as quality (Bauminger et al. 2008; Kasari et al. 2011; Petrina et al. 2014) and quantity (Bauminger and Kasari 2000; Kuo et al. 2013) of friendships and peer relationships.

As a result of these social communication challenges, children with ASD often remain on the periphery of classroom social networks (Chamberlain et al. 2007; Kasari et al. 2011; Rotheram-Fuller et al. 2010). Difficulties persist throughout the school years and extend into adolescence as children with ASD attempt to navigate the complex social world and subtle social cues of the hidden curriculum (Jordan 2019; Myles and Simpson 2001). These include differences forming and maintaining friendships (Bauminger and Shulman 2003; Locke et al. 2010; Shea and Mesibov 2005) and, in turn, associated loneliness (Bauminger and Kasari 2000; Deckers, et al. 2017; Lasgaard et al. 2009), bullying and victimisation (Cappadocia et al. 2012; Symes and Humphrey 2012; Van Roekel et al. 2010). Although schools may be regarded as the prime context for relationships to flourish (Blatchford et al. 2015; Blatchford and Baines 2010; Juvonen 2018), without sufficient support, such settings may in fact further isolate children with ASD.

Evidence of greater risk of increased social difficulties as children with ASD progress through formal schooling (Bauminger-Zviely 2014) highlights the need for intervening early to support social communication development among children with ASD within educational contexts (Fuller and Kaiser 2019; Koegel et al. 2014). Additionally, increasing numbers of children with ASD are accessing inclusive education (National Council for Special Education 2016; European Agency for Special Needs and Inclusive Education 2018) and spend the majority of their time in educational settings (Callahan et al. 2008; Parsons et al. 2013). As a result, research now emphasizes the importance of enhancing social communication skills of children with ASD within naturalistic educational contexts (Boyd et al. 2019; Goldberg et al. 2019; Sutton et al. 2019) which may also support generalization (Carruthers et al. 2020; Ostmeyer and Scarpa 2012; Rao et al. 2008) and maintenance effects (Bellini et al. 2007; Neely et al. 2016; Rogers 2000). Highly controlled clinical interventions may fail to capture authentic interactions within children's everyday environment (Loveland 2001; Loveland and Tunali-Kotoski 2005) whereas a shift towards practice-based research (Barry et al. 2020; Boyd et al. 2019; Locke et al. 2019; Suhrheinrich et al. 2019) within a new 'era of translational research' (Boyd et al. 2019, p.595) in real-world educational settings allows for naturalistic peer interactions (Hume and Campbell 2019; Kent et al. 2020b; Wolfberg 2003) and, in turn, may close the research to practice gap (Kasari and Smith 2013; Guldberg 2017; Wood et al. 2015) and increase application to real-world contexts (Locke et al. 2015; 2019; Watkins et al. 2019a; Weisz et al. 2004).

One authentic context for social communication interactions embedded within the classroom is play (Balasubramanian et al. 2019; Reifel 2014; Shire et al. 2020). Described as the primary medium of social interaction in early childhood (Boucher 1999; Coehlo et al. 2017; Harper et al. 2008), play offers a naturalistic platform for social communication development and learning within educational contexts. It has therefore been used as a practice-based intervention in supporting social communication skills for children with ASD. However, despite its centrality in early childhood, play is a multifaceted construct (Eberle 2014; Sutton-Smith 2001) which has been construed in different ways including objective criteria such as active engagement and open-endedness (Christie and Johnson 1983; Garvey 1990; Rubin et al. 1983; Wolfberg 1995; 1999) as well as subjective qualities described as playfulness (Barnett 1990; Bundy 1997; Eberle 2014; Youell 2008). Types of play include object play, symbolic or pretend play and games with rules (Piaget 1952; Whitebread et al. 2012; Whitebread et al. 2017) as well as modern play types including digital play (Marsh et al. 2016). Others describe play in terms of social interaction with another, be it a peer, sibling or adult (Parten 1932; Vygotsky 1978). Finally, play can also be defined in terms of the extent to which an adult is involved: for example, as free (no adult involvement), guided (adult is involved but child leads the play) or structured (adult directs the play interaction) (Rubin et al. 1978; Weisberg et al. 2016; Wood 2014). As there is no single agreed-upon definition of play (Jensen et al. 2019; Zosh et al. 2018), for the purpose of this review all play-based approaches, self-identified by the relevant authors were accepted.

Researchers have emphasized the potential of play in supporting the social communication skills of pupils with ASD within educational contexts (Jordan 2003; Kossyvaki and Papoudi 2016; Manning and Wainwright 2010; Wolfberg et al. 2015) and called for a move away from clinical settings (Guldberg 2017; Papoudi and Kossyvaki 2018; Whalon et al. 2015). Across varying contexts, the relationship between play and multiple aspects of social interaction has been highlighted including turn-taking and sharing (Anderson-McNamee and Bailey 2010; Stanton-Chapman and Snell 2011), collaboration (Rowe et al. 2018; White 2012;

Yogman et al. 2018), negotiation (Bergen and Fromberg 2009; Hirsh-Pasek et al. 2009; Mraz et al. 2016), social reciprocity (Carrero et al. 2014; Wolfberg 1995) and theory of mind (Qu et al. 2015). Play also provides a natural context for the development of social relationships and has been described as children's 'natural means of making friends' (Gray 2011, p.457). Multiple researchers highlight the relationship between social play interactions and the development of friendships (Coehlo et al. 2017; Humphreys and Smith 1987; Scott and Panksepp 2003) and peer acceptance (Coehlo et al. 2017; Chang et al. 2016a; Flannery and Watson 1993). The relationship between play and communication skills has also been identified including joint attention (Lillard and Witherington 2004; Mateus et al. 2013; Quinn et al. 2018), joint engagement (Adamson et al. 2004; 2014; Moll et al. 2007; Perra and Gattis 2012) as well as gestures and body language (Carlson 2009; Cochet and Guidetti 2018; Qing 2011). While much of the literature has focused on the relationship between pretend play and social communication development (Farmer-Dougan and Kaszuba 1999; Fung and Cheng 2017; Lillard et al. 2013; Li et al. 2016; Uren and Stagnitti 2009; Vygtosky 1978), in recent years there has been increasing consensus towards the socially interactive nature of many different types of play and their contribution to social communication development (Pellegrini et al. 2002; Veiga et al. 2016; Whitebread et al. 2017).

### The Current Study

Previous reviews of the play of children with ASD have focused on the use of interventions to improve play skills (Jung and Sainato 2013; Kent et al. 2020a; Kossyvaki and Papoudi 2016; Kuhaneck et al. 2019; Lang et al. 2011; Lory et al. 2018) or on the promotion of playful engagement among children with ASD (Godin et al. 2019) or therapeutic approaches such as Lego therapy (Lindsay et al. 2017). Fewer reviews have focused on play as a means to develop the social communication skills of children with ASD (Mpella and Evaggelinou 2018; Gibson et al. 2020) and none have examined play-based interventions for social communication skills in educational contexts. For example, Gibson et al.'s scoping review of early play-based interventions for supporting social communication development of children with ASD, aged two-seven years, found support for play in contributing to social developmental outcomes across multiple contexts. Our study contributes to the review literature on play-based interventions for the social communication skills of children with ASD (aged 3 to 13 years) by addressing an important gap on evidence synthesis of research conducted within the primary school classroom. The aim of this systematic review was to identify and synthesize research on play-based interventions for the social communication skills of children with ASD in educational contexts. The review was guided by four research questions: (1) What practice-based research has examined the impact of play-based interventions on the social communication skill development of children with ASD in educational contexts?; (2) What are the characteristics of play-based interventions that target social communication skills of children with ASD in educational contexts; (3) What is the quality of research on play-based interventions for the social communication skills of children with ASD in educational contexts?; and (4) What recommendations can be drawn from a review of the existing literature for future practice-based research in the field of autism, play and social communication development?

## Methods

### Protocol and Registration

The planning, organization and implementation of this systematic review was based on the Preferred Items for Systematic Reviews and MetaAnalysis (PRISMA) guidelines (Moher et al. 2009) and PRISMA-P statement (Shamseer et al. 2015). The review was pre-registered with the Open Science Framework (link removed for blind review) to ensure transparency and reproducibility (Munafó et al. 2017; Sullivan et al. 2019) and reduce the risk of publication bias (Van t'Veer and Giner-Sorrola 2016).

**Eligibility Criteria and Study Selection**

Studies were included if they met the following criteria: (1) the study reported empirical research (single-case or group research) examining the impact of play-based interventions on social communication skills; (2) play (self-defined by authors and included recognisable characteristics as outlined previously in this review ) was identified as the independent variable and primary intervention; any additional strategies used in the intervention were supplementary and incorporated within the play session; (3) at least one outcome measure targeted social communication skills; (4) the article was published in a peer-reviewed journal between the years 2000 and 2020; (5) participants included children, of primary-school age, between three and thirteen years; (6) the sample population included at least one participant with a diagnosis of ASD; (7) data on dependent variables could be isolated for participants with and without ASD; and (8) the study was conducted, at least partially, within educational contexts. Studies were excluded based on the following criteria: (1) the article was written in a language other than English; (2) the study design was a case study (3) the play intervention was a form of play therapy; (4) participants included children outside of the pre-defined age range (3-13 years) who could not be isolated from the overall sample with regard to the effect of the intervention; and (5) play was used as part of a multi-component intervention approach alongside strategies including peer training sessions (e.g. Brock et al. 2018; Hu et al. 2018; Kamps et al. 2014; Katz and Girolametto 2013; Kuhn et al. 2008; Laushey and Heflin 2000; Lee et al. 2007; Maich et al. 2018; Thiemann-Bourque 2012; Whitaker 2004), direct teaching sessions (e.g. Szumski et al. 2016; 2019) or other naturalistic classroom activities including snack or toilet (e.g. Bauminger-Zviely et al. 2020; Boyd et al. 2018; Dykstra et al. 2012) or play was used as the context for the implementation of alternative interventions (e.g. Garfinkle and Schwartz 2002; Harper et al. 2008; Owen-DeShryver et al. 2008; Simut et al. 2016). Single-case studies were excluded in order to reduce the risk of bias (Schünemann et al. 2013). Studies based on therapeutic interventions such as play therapy, Lego therapy and drama therapy were excluded given that these approaches are based on the therapeutic properties of play (Association for Play Therapy 2020; Drews and Schaeffer 2016) and extend beyond the definition of play in this review and have been systematically examined within other literature (Hillman 2018; Lindsay et al. 2017).

**Systematic Search Procedures**

The search string was informed by key words and subject terms within sample seminal research in the field (Barber et al. 2016; Boyd et al. 2018; Chester et al. 2019; Dykstra et al. 2012; Hu et al. 2018; Kasari et al. 2012; Katz and Girolametto 2013; Stagnitti et al. 2012; Vousden et al. 2019; Watkins et al. 2019b; Wolfberg et al. 2015; Wong 2013; Yang et al. 2003), extensive pilot searching alongside subject librarian consultations, and exploration of the thesaurus function across relevant databases**.** The final comprehensive search was conducted on January 9th 2020 across multiple academic databases including; PsychInfo, CINAHL, Education Research Complete and ERIC. Searches across databases were based on the following identical search string; ('Autism

Spectrum Disorders' OR 'ASD' OR Autis*) AND Play AND ('Social Skills' OR 'Social Interaction' OR 'Social Communication' OR 'Social Competence') AND (Education OR School* OR Class*). This process resulted in the return of 911 citations. Complementary backward chaining was also conducted given that database searching is not exhaustive (Evans and Benefield 2001). The reference lists of the seminal articles identified (and listed) above were searched for eligible studies alongside the examination of the bibliographies of previous systematic reviews in the area (Alagendran et al. 2019; Cornell et al. 2018; Gibson et al. 2020; Godin et al. 2019; Jung and Sainato 2013; Kent et al. 2020a; Kossyvaki and Papoudi 2016; Kuhaneck et al. 2019; Lai et al. 2018; Lang et al. 2011; Lindsay et al. 2017; Lory et al. 2018; Mpella and Evaggelinou 2018; Pyle et al. 2017). Overall, this process yielded an additional 130 citations resulting in a total of 1041 articles for potential inclusion. Finally, searches were re-run on November 10th 2020 to ensure all recently published material were included and the review was as current as possible, as recommended within the Cochrane guidelines (Lefebvre et al. 2020). This resulted in the inclusion of one additional full-text study based on eligibility criteria (Bauminger-Zviely et al. 2020). Following title and abstract screening, 88 studies were identified by the first author as meeting eligibility criteria. The full text of each article was then screened against the inclusion criteria which resulted in the identification of 29 full-text studies involving the use of play-based interventions to target the social communication skills of children, aged three-thirteen, with ASD within educational contexts. However, play was the primary independent variable in only nine of these interventions. As a result, the authors segregated these studies into: (a) those that were multi-component interventions (i.e. play was one of several independent variables but was not the primary intervention variable) (n=29) and (b) those that strictly met criteria for this review (n=9). Figure 1 displays the results of each stage of the screening process.

[Insert Figure 1 top]

**Inter-rater Reliability**

Inter-rater coding was conducted throughout abstract and full-text screening stages. The first author screened all articles for inclusion. The second author blindly and independently screened 10% of the sample at the abstract stage and 20% at the full-text stage. Inter-rater agreement for inclusion was 84% when screening at the abstract stage and 100% when screening full-texts in the final stage of the study search. Disagreements were resolved through discussions related to the inclusion and exclusion criteria.

**Data Extraction and Narrative Synthesis**

Data were extracted by the first author for the purpose of narrative synthesis. Studies included in this review were summarized in terms of: (1) participant characteristics including number, gender, age and diagnostic information; (2) research designs including design and types of methods used; and (3) intervention characteristics including components, frequency, intensity, duration, intervention setting, intervention agent, type of play, social communication outcomes and findings (three-point system outlined in the following section). Data were extracted and reported in tabular form and a narrative synthesis of the extracted data was conducted to address the four research questions underpinning this systematic review. The second author blindly

and independently extracted data from two of the nine selected texts (corresponding to 20% of the sample) according to identical characteristics. Inter-rater reliability was calculated and demonstrated 97% agreement and discrepancies were solved through discussions.

**Study Findings**

A three-point classification system was used to indicate the type of findings from each study: positive, mixed or negative. A similar approach has been implemented across other systematic reviews where diversity of study designs has meant that it is difficult to compare study results (Gunning et al. 2019; Tupou et al. 2019; Verschuur et al. 2014). Single-case design studies were classified as positive if all participants demonstrated an increase across all social communication dependent variables, mixed if only some participants increased performance across social communication dependent variables and negative if no participant demonstrated an increase in any social communication dependent variables. Findings from group designs were classified as positive if statistically significant results were reported across all social communication dependent variables, mixed if statistically significant results were reported across some but not all social communication dependent variables and negative if no statistically significant results were reported across any social communication dependent variable.

**Quality Appraisal**

The quality of each study was assessed according to the Evaluative Method for Determining Evidence Based Practice in Autism (Reichow et al. 2008). This appraisal tool was selected given its specific reference to research within the field of autism, widespread use across other systematic reviews in the field (Ke et al. 2018; Kossyvaki and Papoudi 2016; Watkins et al. 2015) and reports of validity within the literature (Cicchetti 2011; Wendt and Miller 2012). Furthermore, the framework distinguishes between single-case and group research and was, thus, deemed suitable for the diverse range of research designs included in this review.

Single-case and group research studies were evaluated according to specific primary and secondary quality indicators including: participant characteristics, clarity with which the independent variable was described, inter-observer agreement, fidelity, generalization and/or maintenance, and social validity. Studies subsequently received a quality rating of high, acceptable or unacceptable. Following this process, studies were categorized as strong, adequate, or weak research. The first author independently evaluated all full-text reviews. The second author blindly and independently rated two of the nine selected texts (corresponding to 20% of sample) according to identical primary and secondary quality indicators. Inter-rater reliability was calculated and demonstrated 92% agreement. Discrepancies were solved through discussion as well as reference to the original documentation. The empirical strength of each study was categorized as promising or established based on the outcome of the quality rating process.

## Results

Overall, a total of 29 full-text play-based interventions were identified following application of inclusion and exclusion criteria. However, only nine of these studies strictly met all eligibility criteria proposed within this

review, specifically in relation to the use of play as the independent variable or primary intervention in improving social communication skills of children with ASD in educational settings. The remaining 20 articles used play as part of a multi-component social intervention package involving strategies outside of scheduled play sessions such as peer training, direct teaching and pre-teaching (see Table 1). As it was difficult to isolate the impact of play on social communication outcomes in these studies, they are excluded from the data extraction and narrative synthesis reported below.

[Insert Table 1]

Data on participant characteristics, study design, and intervention characteristics were extracted from the nine eligible studies for inclusion and are first reported in tabular form (see Table 2). Data are further examined in narrative synthesis here.

[Insert Table 2]

**Participant Characteristics**

Overall, 107 children with ASD received treatment interventions within included studies with an additional 43 children with ASD included in wait-list control groups (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012). The vast majority of research samples were comprised of male participants with a total of 103 male and 16 female participants included across studies, with the exception of Goods et al. (2013) and Lawton and Kasari (2012) who did not report sample participants' gender. Overall, the age range of participants was three to almost thirteen years with a mean age of approximately 6.21 years (this is approximate as some studies did not specify age in months). This does not include participants within Thomas and Smith's (2004) study given that information was only provided in relation to age range as opposed to mean. All participants had a professional diagnosis of ASD with some studies reporting IQ levels (Beadle-Brown et al. 2018; Ben-Sasson et al. 2012; Loncola and Craig-Unkefer 2005), mental age scores (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012) or severity of ASD (Loncola and Craig-Unkefer 2005; Watkins et al. 2019b). Five of the studies excluded respondents with co-occurring needs (Beadle-Brown et al. 2018; Ben-Sasson et al. 2012; Lawton and Kasari 2012; Loncola and Craig-Unkefer 2005) however it is unclear if the remaining interventions included children with co-occurring needs.

**Play-Based Intervention Characteristics**

Play-based interventions were employed as the independent variable across all nine full-text studies. Play-based interventions varied in their presentation across studies in terms of social partners, types of play used and level of child autonomy and adult involvement. This is unsurprising based on the multi-faceted nature of play. Given the focus on social communication outcomes, all studies involved social play, ranging from play with a single peer (Ben-Sasson et al. 2012; Loncola and Craig-Unkefer 2005; Watkins et al. 2019b) to play in peer groups (Beadle-Brown et al. 2018; Vincent et al. 2018) and play with adults (Lawton and Kasari 2012; Thomas and Smith 2004) as well as the combination of both adult and peer play (Chang et al. 2016b) with the exception of

Goods et al. (2013) whereby it is unclear whether adult play was combined with peer play. Furthermore, studies varied in their approach to peer play with some interventions employing peers with ASD (Beadle-Brown et al. 2018; Ben-Sasson et al. 2012; Loncola and Craig-Unkefer 2005) and others utilizing typically developing peers (Chang et al. 2016b; Vincent et al. 2018; Watkins et al. 2019b). The majority of play sessions involved a semi-structured or guided play approach and balance between adult and child agency (Beadle-Brown et al. 2018; Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Loncola and Craig-Unkefer 2005; Vincent et al. 2018; Watkins et al. 2019b) whilst others focused on adult-led structured play (Ben-Sasson et al. 2012; Thomas and Smith 2004). Although Watkins et al. (2019b) described their play intervention as structured, it involved minimal adult direction and was very much child-led and has consequently been classified as a semi-structured or guided play approach within this review. Finally, the majority of studies adopted an individualized approach to play whereby play types were often selected based on the developmental level of the child (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012) as well as the incorporation of interests and preferences within object play (Thomas and Smith 2004; Watkins et al. 2019b) or game play (Vincent et al. 2018). Chang et al. (2016b) implemented multiple types of play (cause and effect or object play, functional and symbolic play) with a similar approach adopted across other play-based interventions (Goods et al. 2013; Lawton and Kasari 2012). Although Goods et al. (2013) or Lawton and Kasari (2012) do not specify types of play employed, reference is made to previous publications which clearly indicate types of play used (object, functional and symbolic play) which have been recorded in Table 2. The remaining studies focused specifically on symbolic or imaginative play (Beadle-Brown et al. 2018; Loncola and Craig-Unkefer 2005) and digital play (Ben-Sasson et al. 2012).

Play-based intervention programs were employed across all nine full-text articles included within this review, for example JASPER (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012), as well as individualized adapted interventions (Watkins et al. 2019b). Despite heterogeneity in approaches to play, none of the nine studies explicitly discussed or stated the theory of play which underpinned the intervention. However, upon examination of theoretical underpinnings based on intervention components, the majority of studies were based on naturalistic behavioral approaches (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Thomas and Smith 2004; Vincent et al. 2018). These approaches combine behaviourist and developmental principles within a natural context (Bruinsma et al., 2020; Frost et al., 2020; Tiede & Walton, 2019), in this case through play interactions. Naturalistic behavioral approaches also combine traditional behaviorist components including adult modelling (Ben-Sasson et al. 2012; Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Loncola and Craig-Unkefer 2005; Thomas and Smith 2004; Vincent et al. 2018), imitation (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Thomas and Smith 2004), prompting (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Vincent et al. 2018), positive reinforcement (Goods et al. 2013; Vincent et al. 2018) and visual supports (Thomas and Smith 2004) with developmental approaches including individualized strategies and support (Beadle-Brown et al. 2018; Chang et al. 2016b; Goods et al. 2013), incorporation of interests and preferences (Goods et al. 2013; Lawton and Kasari 2012) and environmental arrangement (Chang et al. 2016b; Goods et al 2013; Lawton and Kasari 2012; Vincent et al. 2018). Watkins et al. (2019b) also drew on such developmental approaches involving individualization of play sessions and use of children's interests. Finally, Beadle-Brown et al. (2018) were child-led throughout the intervention which incorporated immersive environments, multiple stimuli and scenario based learning whilst

Loncola and Craig-Unkefer (2005) employed a social cognitive approach involving instruction of social behaviors, rehearsal or repeated practice, feedback and reinforcement of social behaviors as well as skill maintenance and generalization.

**Characteristics of the Educational Contexts for Play-Based Interventions**

All nine studies conducted play-based interventions within educational settings, as stipulated within the eligibility criteria. Three of the nine studies were carried out within special schools (Beadle-Brown et al. 2018; Goods et al. 2013; Watkins et al. 2019b) with the remaining interventions conducted within mainstream schools (Lawton and Kasari 2012; Loncola and Craig-Unkefer 2005; Vincent et al. 2018; Thomas and Smith 2004) and special classes (Ben-Sasson et al. 2012; Chang et al. 2016b; Lawton and Kasari 2012). Four of the interventions were conducted within authentic classroom play areas (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Watkins et al. 2019b) whilst the remaining four studies were implemented outside of the classroom context within an area of the school hallway (Beadle-Brown et al. 2018; Loncola and Craig-Unkefer 2005), isolated quiet room (Ben-Sasson et al. 2012) or playground recess (Vincent et al. 2018) with the exception of Thomas and Smith's study (2004) whereby the context of the intervention is not specified. Selected studies were carried out across a limited range of geographical locations including the USA (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Loncola and Craig-Unkefer 2005; Vincent et al. 2018; Watkins et al. 2019b) UK (Beadle-Brown et al. 2018; Thomas and Smith 2004) and Israel (Ben-Sasson et al. 2012). Although all studies were conducted within educational settings, only two of the nine included interventions employed existing school teachers or paraprofessionals as interventionists (Chang et al. 2016b; Lawton and Kasari 2012). The remaining studies involved members of the research team (Ben-Sasson et al. 2012; Thomas and Smith 2004; Watkins et al. 2019b) or trained independent interventionists (Beadle-Brown et al. 2018; Goods et al. 2013; Loncola and Craig-Unkefer 2005; Vincent et al. 2018).

**Intervention Characteristics regarding Frequency, Intensity and Duration**

Play-based interventions ranged from daily intervention techniques (Chang et al. 2016b; Lawton and Kasari 2012; Thomas and Smith 2004; Vincent et al. 2018; Watkins et al. 2019b) to weekly (Beadle-Brown et al. 2018), two-times weekly (Goods et al. 2013) three-times weekly (Loncola and Craig-Unkefer 2005) or twice-monthly (Ben-Sasson et al. 2012). Interventions also varied in terms of the intensity of intervention sessions from five-ten minutes (Ben-Sasson et al. 2012; Thomas and Smith 2004; Watkins et al. 2019b) to 15-20 minutes (Chang et al. 2016b; Loncola and Craig-Unkefer 2005; Vincent et al. 2018) and 30-45 minutes (Beadle-Brown et al. 2018; Goods et al. 2013; Lawton and Kasari 2012). The average intensity of intervention was 21 minutes with the exception of Ben-Sasson et al. (2012) who did not specify intervention intensity. The duration of intervention periods also varied widely from a minimum of two weeks (Thomas and Smith 2004) to a maximum of 34 weeks (Vincent et al. 2018).

**Type of Social Communication Outcomes Targeted**

All nine full-text reviews targeted social communication outcomes, as stipulated within eligibility criteria. The majority of studies provided a clear operational definition of target outcomes based on the measurement of social initiations (Loncola and Craig-Unkefer 2005; Vincent et al. 2018; Watkins et al., 2019b) and responses

(Loncola and Craig-Unkefer 2005; Watkins et al., 2019b) by target participants with ASD towards peers or adults within play. Ben-Sasson et al. (2012) also examined the frequency of positive and negative social interactions alongside social responsive scales whilst other studies focused specifically on initiations of joint attention behaviors (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012). However, social communication outcomes were less clear within some studies (Beadle-Brown et al. 2018; Thomas and Smith 2004) in particular when dependent measures were based on generic social communication subscales (Beadle-Brown et al. 2018) and social interaction (Thomas and Smith 2004).

Given that social communication skills did not have to be the exclusive outcome, eight of the nine included studies incorporated additional outcome measures. These included evaluation of teacher implementation of play-based interventions (Chang et al. 2016b; Lawton and Kasari 2012), impact of play-based interventions on additional areas of development including: language skills (Chang et al. 2016b; Loncola and Craig-Unkefer, 2005), play behaviors (Beadle-Brown et al. 2018; Chang et al. 2016b; Goods et al. 2013; Thomas and Smith 2004; Watkins et al. 2019b), cognitive skills (Chang et al 2016b) as well as the effect of interventionist support during play-based interventions (Loncola and Craig-Unkefer 2005), and impact of the level of social communication deficits on intervention outcomes (Ben-Sasson et al. 2012).

**Study Findings**

Results of studies were classified as positive, mixed or negative as outlined in the method section. Two single-case design studies reported an increase in all social and communication outcomes across all participants and were thus, classified as providing positive findings (Thomas and Smith 2004; Watkins et al. 2019b) with a further group research study also exhibiting significant findings across all social communication dependent variables (Chang et al. 2016b). The remainder of study outcomes were classified as mixed due to demonstration of positive results across some but not all participants (Beadle-Brown et al. 2018; Ben-Sasson et al. 2012; Loncola and Craig-Unkefer 2005; Vincent et al. 2018) or across some but not all social communication dependent variables (Goods et al. 2013; Lawton and Kasari 2012).

**Study Quality**

The quality of included articles was examined using Reichow et al.'s (2008) evaluative framework however studies were not excluded based on evaluations of rigor. Given the limited research in this area, each of these studies was valuable in contributing to the evidence base.However, the majority of studies were classified as weak based on primary and secondary quality indicators (Beadle-Brown et al. 2018; Ben-Sasson et al. 2012; Goods et al. 2013; Lawton and Kasari 2012; Thomas and Smith 2004) with the remainder classified as adequate (Chang et al. 2016b; Loncola and Craig-Unkefer 2005; Vincent et al. 2018; Watkins et al. 2019b). Following implementation of Reichow et al.'s (2008) criteria, play-based interventions are regarded as a promising evidence based practice given identification of at least three single-subject or at least two group experimental designs of at least adequate research report strength, conducted by at least two different research teams in at least two different locations, involving a total sample size of at least nine different participants across studies.

**Generalization, Maintenance and Social Validity**

According to Reichow et al.'s (2008) criteria, two of the included full-texts collected data on generalization of social communication outcomes within free play sessions (Chang et al. 2016b) and as part of a formal generalization assessment (Goods et al. 2013). A further three studies implemented generalization measures (Lawton and Kasari 2012; Thomas and Smith 2004; Watkins et al. 2019b) however these were implemented throughout the intervention as opposed to upon its completion, as stipulated within Reichow's (2008) criteria. Watkins et al. (2019b) measured generalization of social communication skills to novel peer partners. In addition, Thomas and Smith (2004) incorporated generalization measures to ascertain the generalization of play behaviors to free play contexts and Lawton and Kasari (2012) examined teachers' generalization of JASPER strategies within the classroom. Three of the included studies also completed maintenance measures following the termination of the intervention. Watkins et al. (2019b) conducted follow-up sessions six-weeks post-intervention whilst Chang et al. (2016b) conducted a one-month follow-up assessment and Beadle-Brown et al. (2018) conducted three follow-up sessions up to 12 months' post-intervention. Watkins et al. (2019b) was the only study to explicitly collect data in relation to social validity based on: classroom teacher evaluations, comparisons with typically developing peers and observer ratings. However, using Reichow et al.'s (2008) criteria for social validity, a further five studies included at least four out of seven social validity measures (Ben-Sasson et al. 2013; Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Vincent et al. 2018; Watkins et al. 2019b). These related to socially important outcomes, comparisons conducted between individuals with and without disabilities, clinically significant target behavior, consumer satisfaction with the results, implementation in natural contexts and by those who typically come into contact with participants as well as time and cost effectiveness (ends justified the means) of the intervention. Finally, treatment or procedural fidelity was reported by the majority of included studies using pre-defined checklists and criteria with statistical tests all reaching 80% or over, as stipulated within Reichow et al's (2008) criteria (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Loncola and Craig-Unkefer 2005; Vincent et al. 2018; Watkins et al. 2019b). Table 3 presents a summary of results based on Reichow et al's (2008) criteria for generalization, maintenance, social validity and fidelity.

[Insert Table 3]

**Recommendations for Future Practice-Based Research in the Field of Autism, Play and Social Communication Development**

This review identified nine promising research studies on play-based interventions in supporting social communication skills of children with ASD within education contexts, a field very much in its infancy. There are several implications for future research in this area. Firstly, future research should explicitly report participant characteristics including IQ, functioning levels and presence of co-occurring needs in order to ascertain if results can generalize across all students with ASD given the heterogeneity of the spectrum, as recommended within similar reviews (Gibson et al. 2017; 2020; Hansen et al. 2017; Kent et al. 2020a; Kossyvaki and Papoudi 2016). Secondly, although all studies were conducted within educational contexts, future practice-based research may benefit from examining play-based interventions as part of classroom practice as opposed to isolated educational settings, as recommended within previous systematic reviews in the field (Bellini et al. 2007; Hansen et al. 2017; Jung and Sainato 2013; Kent et al. 2020a) and broader research

literature (Kasari and Smith 2013; Koegel et al. 2012; Laugeson et al. 2014; Mazurik-Charles and Stefanour 2010). Given the diversity and heterogeneity of the classroom environment, this will also enable researchers to identify the influence of contextual variables such as inclusive classroom practices (Woodman et al. 2016), teacher support (Pintrich et al. 1993) and activity types (Vitiello et al. 2012) on social communication outcomes (Gibson et al. 2017; Hume et al. 2019; Kent et al. 2020a). Furthermore, further research is needed to examine the role of educators as interventionists in play-based interventions, as previously recommended (Bellini et al. 2007; Hansen et al. 2017; Kossyvaki and Papoudi 2016). In addition, future research should incorporate measures of generalization and maintenance, in line with previous reviews in the field (Brady et al. 2020; Gunning et al. 2019; Hansen et al. 2017; Kent et al. 2020a). This is especially important given the reported generalization (Carruthers et al. 2020; Ostmeyer and Scarpa 2012; Rao et al. 2008) and maintenance (Bellini et al. 2007; Neely et al. 2016; Rogers 2000) benefits of practice-based research (Bellini et al. 2007; Gresham et al. 2001; Neely et al. 2016). Thirdly, future research should consider seeking input from teachers, peers and also children with ASD, as reflected within broader participatory research recommendations (den Houting et al. 2020; Fletcher-Watson et al. 2019; Jivraj et al. 2014; Lau and Stille 2014) and, consequently, add to the social validity of this evidence base. Fourthly, given that the vast majority of play-based interventions included in this review were based on predominately male samples across the UK and USA, future research may consider including more geographical and gender representative samples, as identified within other systematic reviews in the field (Gibson et al. 2020; Kossyvaki and Papoudi, 2016; Stiller and Mößle, 2018). Fifthly, using Reichow et al.'s (2008) quality criteria, the vast majority of studies in this review were classified as weak or adequate. This finding supports recommendations by Gibson et al. (2020) in their recent scoping review of play-based interventions to support social communication development of children, aged two-seven, with ASD in which they highlighted the need for increased rigor in research on play-based interventions for the social communicative development of children with ASD. Finally, given the multi-faceted nature of both play and social communication, future research should provide an account of the theoretical approaches underpinning the play interventions, as recommended within similar reviews (Gibson et al. 2020; Ke et al. 2018; Lindsay et al. 2017).

## Discussion

The present review aimed to identify practice-based research on play-based interventions for the social communication skills of children with ASD in educational contexts. The relationship between play and social communication development within early childhood education is widely recognized (Barnett 2018; Beazidou and Botsoglou 2016; Hirsh-Pasek et al. 2009). However, this is an emerging field for children with ASD, as reflected by the results of this review whereby a total of just nine studies were identified, with seven of these studies conducted in the last eight years.

### Research on Play-based Interventions for the Social Communication Skills of Children with ASD in Educational Settings

Play-based interventions varied widely in terms of intervention characteristics, for example, in types and contexts of play, social communication measures, settings, intensity, frequency, duration and intervention

agents. There were, however, commonalities across studies including the selection of types of play and materials based on children's developmental level or interests (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Thomas and Smith 2004; Vincent et al. 2018; Watkins et al. 2019b), in line with research recommendations (Jordan 2003; Kasari et al. 2006; Kossyvaki and Papoudi 2016; Papoudi and Kossyvaki 2018). Guided play appeared to form a key part of play-based interventions with the majority of studies involving adult involvement and child autonomy (Beadle-Brown et al. 2018; Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Vincent et al. 2018), reflecting broader recommendations in terms of the provision of support during play for children with ASD (Kok et al. 2002; Papoudi and Kossyvaki 2018; Sherratt and Peter 2002; Wolfberg et al. 2012). This also aligns with increasing emphasis on the importance of guided play in educational contexts in order to support learning and development (Weisberg et al. 2013; 2016; Yu et al. 2018; Zosh et al. 2017; 2018). The majority of studies incorporated authentic peers within play-based interventions (Beadle-Brown et al. 2018; Ben-Sasson et al. 2012; Chang et al. 2016b; Loncola and Craig-Unkefer 2005; Vincent et al. 2018; Watkins et al. 2019b), a key benefit of conducting research within educational contexts (Hume and Campbell 2019; Kent et al. 2020b; Wolfberg 2003). These included both typically developing peers (Chang et al. 2016b; Vincent et al. 2018; Watkins et al. 2019b) and peers with ASD (Beadle-Brown et al. 2018; Ben-Sasson et al. 2012; Loncola and Craig-Unkefer 2005), with the selection of peers often dependent on the nature of the educational setting.

Although play-based interventions across all studies involved a social element, they varied greatly in terms of the varieties of play employed from object play (Thomas and Smith 2004; Watkins et al. 2019b) and game play (Vincent et al. 2018) to symbolic or imaginative play (Beadle-Brown et al. 2018; Loncola and Craig-Unkefer 2005) and digital play (Ben-Sasson et al. 2012) highlighting the potential value of all types of play in supporting social communication outcomes (Pellegrini et al. 2002; Veiga et al. 2016; Whitebread et al. 2017).

Commonalities were evident across targeted social communication outcomes specifically frequency of social initiations and responses (Loncola and Craig-Unkefer 2005; Vincent et al. 2018; Watkins et al. 2019b) alongside joint attention and engagement (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012). This is surprising given the vast array of social communication skills associated with play for typically developing children including turn-taking and sharing (Anderson-McNamee and Bailey 2010; Stanton-Chapman and Snell 2011), collaboration (Rowe et al. 2018; White 2012; Yogman et al. 2018), negotiation (Bergen and Fromberg 2009; Hirsh-Pasek et al. 2009; Mraz et al. 2016) theory of mind (Qu et al. 2015) and relational components such as friendships (Coehlo et al. 2017; Humphreys and Smith 1987; Scott and Panksepp 2003) and peer acceptance (Coehlo et al. 2017; Chang et al. 2016a; Flannery and Watson 1993) as well as communication outcomes such as gestures and body language (Carlson 2009; Cochet and Guidetti 2018; Qing 2011), all skills in which children with ASD may benefit from assistance and support.

Finally, the majority of studies consisted of naturalistic behavioral approaches (e.g. Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Thomas and Smith 2004; Vincent et al. 2018) similar to findings reported in other systematic reviews in the field (Gibson et al. 2020; Kossyvaki and Papoudi 2016). This is unsurprising given the current shift within the literature towards an integrated approach to learning involving both behaviorist and developmental approaches for children with ASD (Frost et al. 2020; Hume et al. 2021; Schreibman et al. 2015). However, with the exception of Loncola and Craig-Unkefer (2005), philosophies were

inferred in this review from the strategies and approaches used thus highlighting the need to report on theoretical underpinnings going forward within future research, as recommended by Vivanti et al. (2017).

**Implications for Practice in the field of Autism, Play and Social Communication Development**

Given that this review focused on examining play-based interventions for social communication of children with ASD in educational contexts, findings can offer unique practical implications. Although findings are not conclusive, they demonstrate promising evidence for the potential of play for social communication of children with ASD that extend beyond the clinical context and offer support to those currently implementing play within the classroom, of particular importance given the international promotion of play-based curricular (Aistear, High/Scope, Reggio Emilia, Te Whãriki, Enriched Curriculum/Years Foundation) and increasing endorsement of play within education for children with ASD (Jordan 2003; Kossyvaki and Papoudi 2016; Manning and Wainwright 2010; Papoudi and Kossyvaki 2018; Wolfberg et al. 2015). However, given the diversity of interventions included, it proves difficult to evaluate how best to use play to support social communication skills of children with ASD in terms of intervention setting, intensity, frequency, duration and intervention agents. There are however commonalities across included play-based interventions which may offer guidance for practitioners in the field including consideration of the child's developmental level and interests (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Thomas and Smith 2004; Vincent et al. 2018; Watkins et al. 2019b), use of guided play or adult support and involvement during play (Beadle-Brown et al. 2018; Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Vincent et al. 2018) and involvement of authentic peers (Beadle-Brown et al. 2018; Ben-Sasson et al. 2012; Chang et al. 2016b; Loncola and Craig-Unkefer 2005; Vincent et al. 2018; Watkins et al. 2019b) as well as the potential value of naturalistic developmental approaches (Chang et al. 2016b; Goods et al. 2013; Lawton and Kasari 2012; Thomas and Smith 2004; Vincent et al. 2018). Further research involving practitioners is very much warranted in order to fully determine the feasibility and effectiveness of practitioner-implemented play-based interventions within educational contexts and work towards bridging the gap between research and practice (Kasari and Smith 2013; Guldberg 2017; Hume et al. 2021; Wood et al. 2015).

**Limitations**

This review offers a unique and timely insight into current practice-based evidence surrounding the impact of play on the social communication outcomes of children with ASD within educational contexts. There are, however, several limitations which need to be acknowledged. Firstly, a diverse range of study types were included involving both single-case and group research which restricted subsequent analysis to narrative synthesis as opposed to meta-analysis. Although this allowed for an overview of relevant studies to be synthesized, it prevented effective comparisons to be drawn between research thus, the extent to which play-based interventions impacted social communication skills is unknown. Secondly, studies were only included if they met strict eligibility criteria. As a result, it is possible that meaningful papers were excluded that did not fit these specific criteria. Whilst every effort was made to conduct searches across multiple database and types, including the implementation of hand searching and updated follow-up searches, this search was not exhaustive and it is not possible to ensure all relevant studies were included. Thirdly, quality appraisal was conducted based

on strict interpretation of criteria outlined by Reichow et al. (2008). This was selected following careful consideration of quality frameworks given the diverse range of single-case and group research included in this review. However, appraisal ratings were based on the level of detail outlined within studies and it is possible details may have been omitted which subsequently may have influenced appraisal ratings. In addition, such studies may have received alternative ratings if different appraisal tools were selected.

**Conclusion**

Overall, this review identified the emerging evidence base of practice-based research that has examined the potential of play-based interventions in supporting the social communication outcomes of children with ASD within educational contexts. To the best of our knowledge, this is the first systematic review to investigate the impact of play on the social communication skills of children with ASD in naturalistic educational contexts. As a result, this review significantly contributes to the emerging literature surrounding practice-based research in supporting the social communication development of children with ASD (Barry et al. 2020; Boyd et al. 2019; Locke et al. 2019) and, in particular, provides support for the potential of play-based interventions in contributing to the social communication skills of children with ASD within educational contexts as part of a new 'era of translational research' (Boyd et al. 2019, p.595). This is important given the increasing numbers of children with ASD accessing inclusive education (European Agency for Special Needs and Inclusive Education 2018; National Council for Special Education 2016) and associated demands and expectations of formal schooling (Bauminger-Zviely 2014; Einfeld et al. 2018; Loveland and Tuanali-Kotoski 2005). However, as highlighted by the limited number of studies in this review, there is insufficient evidence to draw conclusions regarding the mechanisms by which play-based interventions might be especially beneficial for the social communication skills of children with ASD in educational contexts. Further rigorous research is warranted to expand on this emerging evidence base.

**Ethics Approval**

Declarations

This is a review study. As a result, no ethical approval is required. However, the planning, organisation and implementation of this systematic review was based on the Preferred Items for Systematic Reviews and MetaAnalysis (PRISMA) guidelines (Moher et al.2009) and PRISMA-P statement (Shamsheer et al. 2015). The review was also pre-registered with the Open Science Framework (link removed for blind review).

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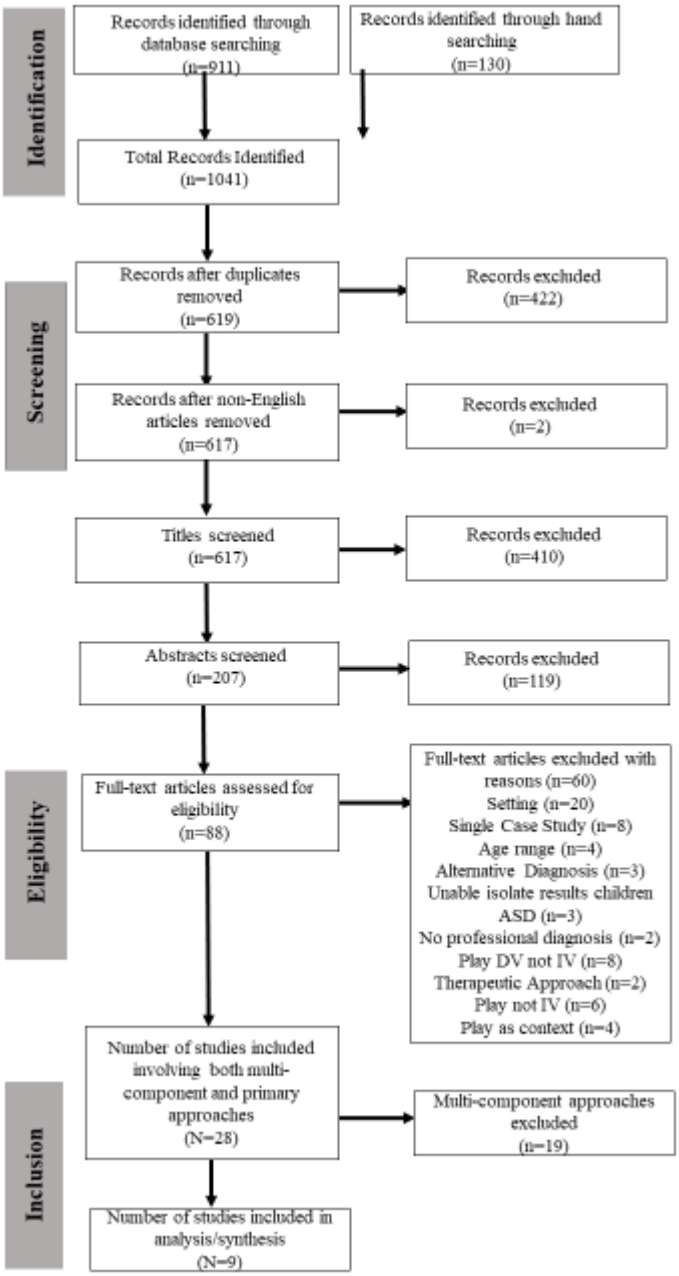
## Figure Captions

*Figure 1*. Prisma flow diagram

**Figures**


Identification
Records identified through database searching (n=911)
Records identified through hand searching (n=130)
Total Records Identified (n=1041)
Screening
Records after duplicates removed (n=619)
Records excluded (n=422)
Records after non-English articles removed (n=617)
Records excluded (n=2)
Titles screened (n=617)
Records excluded (n=410)
Abstracts screened (n=207)
Records excluded (n=119)
Eligibility
Full-text articles assessed for eligibility (n=88)
Full-text articles excluded with reasons (n=60)
Setting (n=20)
Single Case Study (n=8)
Age range (n=4)
Alternative Diagnosis (n=3)
Unable isolate results children ASD (n=3)
No professional diagnosis (n=2)
Play DV not IV (n=8)
Therapeutic Approach (n=2)
Play not IV (n=6)
Play as context (n=4)
Inclusion
Number of studies included involving both multi-component and primary approaches (N=28)
Multi-component approaches excluded (n=19)
Number of studies included in analysis/synthesis (N=9)

## Tables

Table 1 Studies with a play-based component for social communication skills of children with ASD in education

| Reference | Sample 3-13 years | Professional Diagnosis ASD | Play Independent Variable | Intervention components | Social Communication Outcomes | Educational Setting |
|---|---|---|---|---|---|---|
| **Bauminger-Zviely et al. (2020)** | Y | Y | N | Preschool Peer Social Intervention: Experiential learning activity + practice sessions in small mixed peer groups during play, snack, joint activity crafts. Techniques involved role play, doll play, audio-visual stimuli and play | Y | Y |
| **Beadle-Brown et al. (2018)** | Y | Y | Y | Imagining Autism: Children engage with drama practitioners in participatory play within multisensory 'pods' | Y | Y |
| **Ben-Sasson et al. (2012)** | Y | Y | Y | Collaborative Puzzle Game: Comparison of conditions (Free play and Enforced collaboration) involving collaborative puzzle game on diamond touch interface | Y | Y |
| **Boyd et al. (2018)** | Y | Y | N | ASAP: 1-1 and group sessions involving play + naturalistic classroom activities e.g. snack, toilet | Y | Y |
| **Brock et al. (2018)** | Y | Y | N | Peer-Mediated Intervention: Pivotal response training + recess play sessions | Y | Y |
| **Chang et al. (2016b)** | Y | Y | Y | JASPER: Trained teachers implement at pre-existing play centres and promote social interaction and strategies | Y | Y |
| **Dykstra et al. (2012)** | Y | Y | N | ASAP: 1-1 and group sessions involving play + naturalistic classroom activities e.g. snack, toilet | Y | Y |
| **Goods et al. (2013)** | Y | Y | Y | JASPER: Play routines used to target communication skills. Strategies include expanding play within routines, all conducted within play session | Y | Y |
| **Hu et al. (2018)** | Y | Y | N | Peer-Mediated Lego Play: Lego play + peer-training in naturalistic strategies to engage children with ASD | Y | Y |
| **Kamps et al. (2014)** | Y | Y | N | Peer-Mediated Intervention: Peer training + direct instruction + written text cues + play | Y | Y |
| **Kasari et al. (2016)** | Y | Y | N | Compared SKILLS and ENGAGE: SKILLS involved didactic groups for children with ASD from different classes and grades to teach social skills. ENGAGE involved interest based groups consisting of multiple activities including free play, games, conversational exercises, storytelling and music for children with ASD and typically developing classmates | Y | Y |
| **Katz and Girolametto (2013)** | Y | Y | N | Peer-Mediated Intervention: Peer training sessions + play sessions | Y | Y |
| **Kuhn et al. (2008)** | Y | Y | N | Peer-Mediated Intervention: Peer training + pivotal response training + play sessions | Y | Y |
| **Laushey and Heflin (2000)** | Y | Y | N | Stay Play Talk: Peer training buddy skills + free play sessions | Y | Y |
| **Lawton and Kasari (2012)** | Y | Y | Y | JASPER: Teacher implementation of JASPER following training; Social communication outcomes embedded within play routines | Y | Y |

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| **Lee et al. (2007)** | Y | Y | N | Peer-Mediated Intervention: Peer training sessions + play sessions | Y | Y |
| **Licciardello et al. (2008)** | Y | Y | N | Intervention Package: Pre-teaching target children and peers how to engage in play + playground play session including use of reinforcement and prompting | Y | Y |
| **Loncola and Craig-Unkefer (2005)** | Y | Y | Y | Plan-Play-Report: Play-based session involving brief planning/discussion with interventionist | Y | Y |
| **Maich et al. (2018)** | Y | Y | N | Stay Play Talk: Peer training buddy skills + structured play sessions | Y | Y |
| **Mpella et al. (2019)** | Y | Y | N | Theatrical Play Intervention Package: Physical education + theatrical play including use of modelling, shaping and reinforcement | Y | Y |
| **Radley et al. (2014)** | Y | Y | Y | Superheroes Social Skills Programme: Video modelling + adult modelling +role play + social games +reinforcement | Y | Y |
| **Szumski et al. (2016)** | Y | Y | N | Play Time/Social Time: Structured Play session including the use of reinforcement and prompting + direct teaching session (social skills lesson) | Y | Y |
| **Szumski et al. (2019)** | Y | Y | N | Play Time/Social Time and I Can Problem Solve: PTST involved structured play + direct teaching. ICPS involved activities including play, games, stories, role play in whole class group. | Y | Y |
| **Thiemann-Bourque (2012)** | Y | Y | N | Modified Stay Play Talk based on AAC Instruction: Peer training buddy skills + structured play sessions | Y | Y |
| **Thomas and Smith (2004)** | Y | Y | Y | Tabletop Identiplay: Table divided in two with clear area for child's toys and adult's toys. Adult lays out toys, implements according to script and models, imitates child | Y | Y |
| **Vincent et al. (2018)** | Y | Y | Y | FRIENDS Playground Program: Structured play-based activities implemented during recess | Y | Y |
| **Watkins et al. (2019)** | Y | Y | Y | Individualized peer/child play intervention session facilitated by interventionist | Y | Y |
| **Whitaker (2004)** | Y | Y | N | Peer Mediated Intervention: Peer training session + play sessions | Y | Y |
| **Wong (2013)** | Y | Y | N | JASPER Intervention: Teacher training symbolic play x 4 weeks and implemented within classroom play sessions then training joint attention activities x 4 weeks and implemented across multiple activity types or vice versa | Y | Y |

Table 2 Characteristics of included play-based intervention studies

| Author, Year, Country | Sample Characteristics | | | | Research Design | | Name | Components | Frequency, Intensity, Duration | Interventionist | Educational Setting/Context | Play Type | Social Communication Outcomes | Results |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Age (as reported by authors in years and/or months) | Gender | Professional Diagnosis | Methodology | Strength | | | | | | | | |
| **Beadle-Brown et al. (2018) UK** | 22 | 7.33-12.92 years M=9.16 years | 18 Male; 4 Female | ASD | AB Single Case Design | Weak | Imagining Autism | Children engaged with drama practitioners in participatory play within multisensory 'pods'. Encountered range of stimuli including puppetry, light, sound, costume, masks, digital media and responsive technology. Engaged in five imaginary themes-forest, outer space, arctic, underwater, city | Weekly; 45 minute; 10 weeks | Trained Drama Practitioner | Special School (x3); School hall | Social Play Peer Groups (3-4 children with ASD); Guided Play (Child-led + Adult Involvement); Imaginative/ Dramatic | Communication Subscale ADOS; Socialisation Subscale VABS (Interpersonal Relationships, Play, Coping Skills); Communication Subscale VABS (Receptive, Expressive, Written combination) | Mixed (No statistically significant differences in communication scores from pre to post intervention according to ADOS;<br><br>Statistically significant difference in scores from baseline to intervention in socialisation and communication domain of VABS) |
| **Ben-Sasson et al. (2012) Israel** | 12 (6 dyads) | 8-11 years M=9.28 years | 12 Male | ASD | Within Subjects Design | Weak | Collaborative Puzzle Game | Individual training session followed by experimental session. Children paired in dyads and engaged in 3 puzzle games for free play mode and 3 puzzle games for enforced collaboration mode. FP mode involved two players independently moving puzzle pieces to match completed puzzle piece on digital table. EC mode forced partners to move puzzle pieces together during joint activity | 2 experimental sessions one month apart; Duration varied for each dyad depending on time taken to complete | Researcher | Mainstream Public School; Special Class; Quiet room within School | Social Play (Child with ASD + Peer with ASD); Structured Play (Adult-led); Digital Play on Diamond Touch Interface; Puzzle Game | Friendship Observation Scale: Frequency of Positive and Negative Social Interactions; Social Responsiveness Scale: Parent reported measure social cognition, social awareness, social communication, social motivation | Mixed (Children demonstrated significant difference between EC and FP mode in positive social interaction;<br><br>No significant difference between modes regarding negative social interaction) |
| **Chang, et al. (2016b) USA** | 66 (38 intervention; 28 waitlist control) | 3-5 years M=50.26 months | 59 Male; 7 Female | ASD | Randomised Wait-List Control | Adequate | JASPER | Classrooms randomised to JASPER intervention or | Daily; 15 minute; | Trained Class Teacher and Paraprofessionals (N=13) | 6 Mainstream Public Schools; | Social Play (Child with ASD + 2-4 Typically | Percentage of engagement with peers and teachers during | Positive (Children in intervention group |

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| | | | | | | | | continue usual ABA preschool curriculum. Teachers underwent training and implemented JASPER at pre-existing play centres using appropriate toy selection to promote peer to peer interaction. Teachers actively interacted with children and researchers coached teachers | 8 weeks, total 40 sessions | | Pre-school Autism Special Classroom Play Centre | Developing Peers or 1-1 Interaction with Teacher (depending on ability levels); Guided Play (Child-led + Adult Involvement); Play type based on developmental level; simple (cause and effect), combination (object), pre-symbolic (functional) or symbolic | play interactions; Frequency of spontaneous initiation of joint attention behaviors (verbal and non-verbal) during play interactions; Frequency of initiated behavior regulation during play interactions | demonstrated significantly more time in child initiated joint engagement with teachers and peers during play sessions as opposed to control group;<br><br>Total number of spontaneous initiated joint attention and initiated behaviour regulation was also greater among children in intervention group) |
| **Goods, et al. (2013) USA** | 15 (7 intervention; 8 waitlist control) | 3-5 years M=51.71 | NS | ASD | Randomised Wait-List Control | Weak | JASPER | JASPER; Treatment group withdrawn from same classroom as control. Opportunities were embedded within play routines based on developmental level and interests of child to target social communication skills | Twice weekly; 30 minute 12 weeks, total 24 sessions | Graduate Student Educational Psychology | Private Autism Special Preschool; Children withdrawn | Social Play (Adult + Child) Guided Play (Child-led + Adult Involvement); Play type based on developmental level; object play, functional play or symbolic play | Frequency of spontaneous initiations of Joint Attention and Request Behaviors; Duration of Engagement State in Classroom Play Interactions | Mixed (Treatment group demonstrated significant decrease in time spent unengaged;<br><br>Significant increase in frequency of request gestures;<br><br>No significant difference in initiations of joint attention and request behaviors) |
| **Lawton and Kasari (2012) USA** | 16 (9 Intervention Group; 7 Waitlist Control) | 3-5 years M=44.51 months | NS | ASD | Randomised Waitlist Control Trial | Weak | JASPER | JASPER: Teachers from intervention group received training from interventionist in JASPER within classroom context twice weekly; Teachers implemented JASPER daily within play routines; set up environment, follow child's toy choice, initiate child's play actions, prompt play | Daily, 20 minute JASPER session, 6 week intervention | Trained Classroom Teacher | 16 Public Preschools; 8 inclusive classrooms and 3 self-contained classrooms Classroom Play area | Social Play (Adult + Child); Guided Play (Child-led + Adult Involvement); Play type based on developmental level; object play, functional play or symbolic play | Frequency of initiations of Joint Attention; Duration of Engagement States in Classroom Play Interactions | Mixed (Children in JASPER Treatment group used significantly more joint attention initiations during class observations in comparison to control. However, mean total of joint attention initiations were not different between treatment and control; |

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| | | | | | | | | actions, establish play routine, wait for communication, contingent language, prompts for joint attention and modelling | | | | | | Treatment group demonstrated significant decrease in object engagement and significant increase in supported engagement states) |
| **Loncola and Craig-Unkefer (2005) USA** | 6 | 6.01-8.00 years M=6.71 years | 5 Male; 1 Female | ASD | Multiple Baseline Design | Adequate | Plan-Play-Report | Plan-Play-Report: 5-minute play organiser session with interventionist and peer dyad. Plan according to designated play theme, label toys and includes role-play and modelling if necessary; 10-minute play session minimal involvement of interventionist; 5-minute review session where interventionist re-enters play and discusses play with peer dyad | Three times weekly; 20 minute; Varied across participant dyads | Trained researcher | Public Mainstream School; Self-contained classrooms; Sectioned off area hallway | Social Play (Child with ASD + Peer with ASD); Guided Play (Child-led + Adult Involvement); Symbolic Play | Frequency of comments, requests and verbal others directed towards peers | Mixed (Increase in peer directed comments across all children;<br><br>Increase in peer directed requests and verbal others across some not all children) |
| **Thomas and Smith (2004) UK** | 3 | 3.4-4.1 years M=NS | 2 Male; 1 Female | ASD | AB Single Case Design | Weak | Tabletop Identiplay | Table divided in two with clear area for child's toys and adult's toys; child and interventionist face to face on chairs with two identical sets of toys. Adult lays out toys, implements according to script, models and imitates child | Daily; 5 minute; 2 weeks, total 10 sessions | Researcher | Mainstream Pre-School; NS | Social Play (Adult + Child); Structured Play (Adult - led); Object play | Time engaged in social interactions; Frequency Eye contact; Frequency Verbal Communication | Positive (Children demonstrated increase in frequency of eye contact and verbal communication) |
| **Vincent et al. (2018) USA** | 6 (6 children ASD and 1 child EBD) | 5-9 years M=7.14 years | 4 Male; 2 Female | ASD | Multiple Baseline across Participants Design | Adequate | FRIEND Playground Program | Multiple structured play activities provided on playground for children with ASD and typically developing peers. This was | Daily 20-minute recess session; 30-34 weeks throughout school year | Trained researcher | Mainstream Elementary School; Playground | Social Play (Child ASD + Typically Developing Peers); Guided Play (Child-led + Adult Involvement); | Duration of engagement with peers; Frequency of Social Initiations | Mixed (All children demonstrated increase in time spent engaged with peers during recess;<br><br>Some children increased |

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| | | | | | | | | guided by trained researcher who facilitated sessions using strategies including following the child's lead, facilitating interactions between students, supporting with prompts and providing reinforcement | | | | Games with Rules | | number of social initiations) |
| **Watkins, et al.(2019b) USA** | 4 | 54-74 months M=62.5 months | 3 Male; 1 Female | ASD | Multiple Baseline Design | Adequate | Individualized Play Intervention | Individualized play intervention. 4 children paired with typically developing peers from classroom. Participants and peers engaged in mutually appealing play activity within the classroom facilitated by researchers | Daily; 10-minute; Varied across participants, total 43 sessions | Researcher | Private Special School; Inclusive Pre-School Classroom Play Area | Social Play (Child with ASD + Typically Developing Peer); Guided Play (Child-led+ Adult Involvement) Object Play | Frequency of social initiations and responses to peers during interactive play | Positive (Increase in initiations and responses to peers across all participants from baseline to intervention.<br><br>Increase in average duration of interactive play with peers from baseline to intervention across all participants) |

NS=Not Specified

Table 3 Generalization, maintenance, social validity and fidelity results (Reichow et al. 2008)

| ***Author*** | ***Assessments*** | | | |
|---|---|---|---|---|
| | **Generalisation** | **Maintenance** | **Social Validity** | **Treatment and/or Procedural Fidelity** |
| *Beadle-Brown et al. (2018)* | N | Y | Y | N |
| *Ben-Sasson et al. (2012)* | N | N | Y | N |
| *Chang et al. (2016b)* | Y | Y | Y | Y |
| *Goods, et al.(2013)* | Y | N | Y | Y |
| *Lawton and Kasari (2012)* | N | N | Y | Y |
| *Loncola and Craig-Unkefer (2005)* | N | N | N | Y |
| *Thomas and Smith (2004)* | N | N | N | N |
| *Vincent et al. (2018)* | N | N | Y | Y |
| *Watkins et al. (2019b)* | N | Y | Y | Y |