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REVIEW ARTICLE



# Physical and sensory environment interventions to support children's social and emotional development in early childhood education and care settings: a systematic review

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## ABSTRACT

Interventions and programmes to support the development of preschool children's social and emotional skills are commonly used in early childhood education and care (ECEC) settings. Research suggests the physical and sensory ECEC environment can influence children's social and emotional development. The aim of this paper was to evaluate the effectiveness of physical and sensory ECEC environment interventions, delivered by ECEC educators, to support children's social and emotional development. Relevant studies were identified through a systematic search of PsycINFO, ERIC, Medline, and other sources; seven papers, published since 2000, were included in this review. The interventions used in ECEC settings, include: nature-based programmes, playground redevelopment, background music, indoor toy arrangement and sensory cushions. The results show the effectiveness of physical and sensory environment interventions is mixed, but shows promise. This paper outlines recommendations for future research and practice, including the need to further explore the characteristics of supportive sensory ECEC environments.

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## KEYWORDS

early childhood education and care; physical environment; sensory; social competence; emotional competence; child development

## Introduction

The preschool years are a critical period for children's social and emotional development that can shape a child's developmental trajectory across the life course. Currently, one in five Australian children are considered developmentally at risk or vulnerable at school entry, and this number is even higher for children living in the lowest socioeconomic areas, very remote areas and Indigenous children (Department of Education, Skills and Employment, 2022). If social and emotional skill development is delayed in early childhood there can be a subsequent impact on behaviour (Bornstein, Hahn, & Haynes, 2010) and academic outcomes in adolescence (Washbrook, Propper, & Sayal, 2013), and lifelong effects on an individual's mental health, education status, employment opportunities (Jones, Greenberg, & Crowley, 2015), physical health and vocational success (Moffitt et al., 2011) in adulthood. Consequently, there is a need for effective strategies to support social and emotional development in early childhood.

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Early childhood education and care (ECEC) provides a means of engaging with children and their families in the preschool years. In Organisation for Economic Co-operation and Development (OECD) countries, 96% of children attend ECEC (OECD, 2022), and the average time children spend in centre-based childcare varies from 15 h or more per week in Australia (Australian Bureau of Statistics, 2022) to 21 h per week in the United States (National Center for Education Statistics, 2016). Therefore, the ECEC sector plays a significant role in supporting children's development. As a result, social and emotional learning (SEL) programmes are a keen focus for the sector and provide an effective means of supporting children's social and emotional functioning in the preschool years (Blewitt et al., 2018; Sabey, Charlton, Pyle, Lignugaris-Kraft, & Ross, 2017).

More recently, the early childhood literature has highlighted a link between the physical ECEC environment and children's social and emotional development outcomes (Berti, Cigala, & Sharmahd, 2019; van Liempd, Oudgenoeg – Paz, & Leseman, 2020). The physical environment is characterized by the objects and materials that make up the learning environment. In Australia, the important role that high-quality physical environments play in children's development is acknowledged in the National Quality Framework that ECEC services are regulated against (Australian Children's Education and Care Quality Authority, 2022). Similarly, the regulatory authority for the early childhood sector in Singapore provides physical environment recommendations (Early Child Development Agency, 2020). Moreover, physical environment quality is captured through measures such as the Early Childhood Environment Rating Scale (ECERS-R) (Brunsek et al., 2017). The positive developmental benefits provided by nature-based education environments and programmes have been well documented (Dankiw, Tsiros, Baldock, & Kumar, 2020). At a community level, researchers have focused on the association between the neighbourhood-built environment and child development to inform urban design and optimize children's health and development outcomes (Villanueva et al., 2016). Hence, there is a growing body of literature that suggests the physical environment can support children's social and emotional functioning.

Children interact with the physical education environment and interpret it through the senses. The eight sensory systems include: visual, auditory, olfactory, gustatory, tactile, vestibular, proprioceptive and interoception (STAR Institute, 2022). Sensory stimuli from the environment is integrated in the central nervous system to form perception and behaviour (Ayres, 2005). A systematic review of hospital settings has combined physical and sensory environment factors, highlighting that sensory stimuli is a by-product of the physical environment (Bayramzadeh, Ahmadpour, & Aghaei, 2021). Hence, considering both physical and sensory environment factors together gives a comprehensive assessment of a child's education environment. The sensory environment is defined as any aspect of the ECEC setting that can be heard, seen, touched or smelt; including the visual layout of the classroom; noise, sounds or auditory input; sensory play materials, such as sand and playdough; smell, classroom chaos, nature play, furnishings and environment zones. The aforementioned sensory environment definition is adapted from Drahota et al. (2012) that evaluated the effectiveness of sensory environment interventions in hospital settings on adult's health related outcomes.

Children integrate multiple sensory domains to process information from their surrounding environment through various cognitive processes (Miller, Nielsen, Schoen, & Brett-Green, 2009). Highly chaotic, noisy and crowded ECEC environments negatively affect child behaviour (Wachs, Gurkas, & Kontos, 2004) and educator's emotional responsiveness and teaching strategies (Jeon, Hur, & Buettner, 2016). Furthermore, a child's learning and development is enhanced when preschool teachers are aware of the child's individual learning style and unique sensory behaviours (Lersilp, Putthinoin, & Chaimaha, 2021). Elementary school children tend to preference, and are more sensitive to, a particular sensory pathway (such as auditory, visual or kinaesthetic input), and this has implications for the way children learn, receive new information and interact with the school environment (Mahdjoubi & Akplotsyi, 2012). Multiple theoretical models have focused on the influence the physical and sensory environment has on children's development and behaviour. The Theory of Affordance proposes that the environment is perceived through the senses and this guides action and behaviour in a continual and reciprocal fashion (Gibson, 2014). Optimal

Stimulation Hypothesis posits an inverted – U shaped relationship between the level of stimulation and behaviour or development; development is enhanced when an individual is exposed to an optimal level of stimulation (Wachs, 1977). Thus, given the behavioural and developmental implications, the sensory experiences a child is exposed to in the education environment needs to be thoroughly considered.

Fostering children's social and emotional skill growth is complex and multifaceted. The socioecological approach highlights the interplay between the many environmental and social factors that contribute to child development (Bronfenbrenner & Morris, 2006). A child's early social environment and caregiver relationships are pivotal in the development of self-regulation skills; regulation relies on others in the early years and lays the foundation for the development of one's own self-regulation skills (Sameroff, 2010). Parents and families play a fundamental role in children's early socialization experiences, and with many children attending ECEC (OECD, 2022), early childhood educators also contribute to the development of children's social and emotional competences through everyday interactions and positive emotional responsiveness (Denham, Bassett, & Zinsser, 2012). Currently, pre-service training does not always prepare educators with the skills needed to adequately address children's challenging behaviour (Hemmeter, Santos, & Ostrosky, 2008), and this can remain an issue for experienced educators (Quesenberry, Hemmeter, Ostrosky, & Hamann, 2014). The ECEC sector have placed a significant focus on SEL programmes to support children's social and emotional competency. However, there remains a need to broaden our focus, and also consider the implications a child's immediate physical and sensory environment can have on their acquisition of social and emotional skills.

To our knowledge, no systematic review has explored the ECEC interventions, programmes or experimental conditions that specifically focus on an aspect of the physical and/or sensory environment to support children's social and emotional development. Therefore, the overall aim of this study was to evaluate the success of physical and sensory ECEC environment interventions delivered by ECEC educators to support children's social and emotional development. The specific research questions that informed this review were:

- (1) What type of physical or sensory environment interventions have been evaluated in ECEC settings?
- (2) What measures have been used to capture children's social and emotional development subdomains?
- (3) Are physical or sensory ECEC environment interventions effective in supporting children's social and emotional development?
- (4) What recommendations can be made for future research and practice?

## Method

### *Eligibility criteria*

Interventions were included if they altered or modified any aspect of the physical or sensory ECEC environment (such as: sensory play, sensory play materials, noise, visual displays, outdoors, room design or redevelopment), and were published in English. To ensure current interventions were reviewed, eligible studies were published since the year 2000. The full list of inclusion and exclusion criteria is reported in [Table 1](#).

### *Search strategy*

The systematic literature search and the study selection process was preformed according to the Preferred Reporting for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Page et al., 2021). The systematic review protocol was registered on PROSPERO (registration number:

**Table 1.** Eligibility criteria

	Inclusion	Exclusion
Population	Children aged 3–6 years in a mainstream ECEC service. This may include children with a formal diagnosis of a neurodevelopmental disorder (e.g. ASD, ADHD, global development delay), development or communication delay or other mental health disorder who attended inclusive ECEC services.	Children under the age of 3 years
Intervention	An intervention that specifically states it focuses on an aspect of the physical or sensory ECEC environment, including any of the following: outdoors, sensory play, sensory play materials, visual displays, room design or redevelopment, noise, music; intervention delivery involves ECEC educators; the intervention is delivered to all children attending the ECEC setting	An intervention that specifically targets children with a neurodevelopmental disorder, developmental delay or other mental health condition; an intervention that is delivered solely by a third party where ECEC educators or professional staff are not involved in anyway
Eligible study designs	Experimental and quasi experimental study designs, including randomized controlled trials, non-randomized controlled trials and single group pre-post intervention studies	Qualitative studies
Comparator	No limits on comparison or control groups; studies that include no intervention or active control group will be included	
Outcomes	Any measure that captures children’s social and emotional development, including social competence, emotional competence, behaviour or self-regulation	
Setting	Centre-based, mainstream, inclusive ECEC centre, including kindergarten, preschool, nursery school, day care services; intervention takes place in the ECEC centre	Intervention takes place off site or outside the main learning centre; family day care

CRD42022299825). In September 2021, a systematic search of electronic databases was conducted using: Medline, Educational Resources Information Centre (ERIC) and PsycINFO. The comprehensive search strategy used for this review is featured in the supplementary information.

### **Selection process**

Across the three databases, a total of 2799 papers were returned once duplicates were removed. The title and abstract of a random 10% sample of papers were reviewed by two authors (AT and CB) against the inclusion and exclusion criteria. There was a 98.3% agreement between authors, with 100% agreement after discussion. After the title and abstract of the remaining papers were reviewed, a total of 198 papers were read in full. From here, 194 papers were excluded for various reasons reported in [Figure 1](#). There were four remaining papers that met the inclusion criteria. Three papers were found by forward and backward citation searching and going through the search results of another review by the same authors; to make a total of 7 studies included in this review.

### **Quality assessment**

The Effective Public Health Practice Project (EPHPP) was used to assess the methodological quality of the included studies (Effective Public Health Practice Project, [n.d.](#)). This tool was developed to assess the quality of quantitative studies. Two studies included in this review had a mixed methods study design (Agostini, Minelli, & Mandolesi, [2018](#); Brussoni, Ishikawa, Brunelle, & Herrington, [2017](#)). Given that we were only interested in the quantitative aspect of the studies, the EPHPP was used to assess the methodological quality of these papers. The EPHPP is a list of eight items, including selection bias, study design, confounders, blinding, data collection methods, withdrawals and drop-outs, intervention integrity and analysis. The rating given to each item was combined to give a global rating of

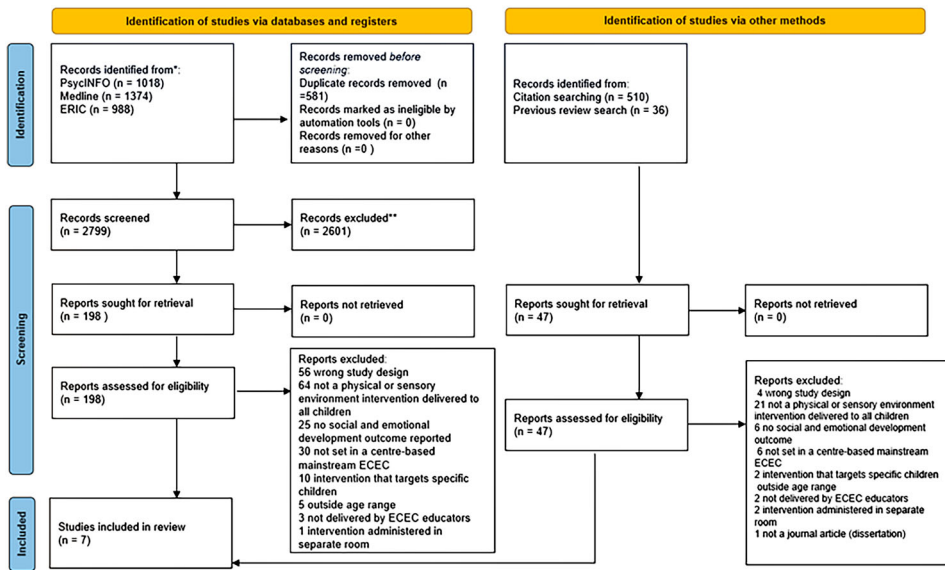


Figure 1. PRISMA flow diagram (Page et al., 2021).

strong, moderate or weak for each study. Two authors (AT and YS) appraised 29% of the included studies and any discrepancies were discussed; the remaining papers were evaluated independently. The overall quality assessment for each study is reported in the last column of Table 2.

## Results

### Study selection

The selection of included studies is presented in Figure 1. One paper was excluded as the intervention was delivered in a different room separate to the ECEC classroom (Saarikallio, Tervaniemi, Yrtti, & Huutilainen, 2019); 64 studies were excluded from the database search because they did not include a physical or sensory environment intervention delivered to all children, five of these studies were movement-based interventions (Burkart, Roberts, Davidson, & Alhassan, 2018; Duman & Ozkur, 2019; Keown, Franke, & Triggs, 2020; Urena, Fernandez, Cardenas, Madinabeitia, & Alarcon, 2020; Webster, Wadsworth, & Robinson, 2015) and four were mindfulness interventions (Lee et al., 2020; Moreno-Gomez & Cejudo, 2019; Razza, Bergen-Cico, & Raymond, 2015; Viglas & Perlman, 2018). Movement and mindfulness interventions may include sensory components in the form of proprioception and interoception, respectively. However, these studies were excluded as their respective authors did not discuss the sensory modalities that may be associated with the intervention, therefore, inclusion on these grounds would involve inference that may not be the intention of the original study.

### Study characteristics

Table 2 includes a summary of the details of each study included in this review. Four included studies were from the United States (Cordiano et al., 2019; Love & Burns, 2006; Morrier, McGee, & Daly, 2009; Seifert & Metz, 2017), one from Canada (Brussoni et al., 2017), one from Italy (Agostini et al., 2018), and one from Romania (Jucan & Simion, 2015). A total number of 248 children were included across the seven studies. Five studies relied on a quasi-experimental study design (Cordiano et al., 2019; Jucan & Simion, 2015; Love & Burns, 2006; Morrier et al., 2009; Seifert & Metz, 2017), two of these

Table 2. Summary of results.

First author Year Country	Main study aims	Design Sample Setting Intervention length	Main intervention <i>Physical/sensory environment intervention Control</i>	Main outcome measures <i>Social and emotional development outcome measure</i>	Main findings <i>Social and emotional development findings</i>	Study quality (EPHPP)
Agostini 2018 Italy	To explore teachers' perceptions and ratings of children's developmental trajectories over 2 school years in two different kindergarten settings	Design: mixed methods study (two group, pre and post-test) Sample: 20 teachers, evaluating 93 children aged 3–5 (M = 46.95 months, SD = 6.73) Setting: traditional kindergarten; outdoor education (OE) kindergarten. Intervention Length: 2 years	<i>Outdoor education kindergarten with teachers that had undertaken intensive training in Outdoor Education Approach</i> Traditional kindergarten	Kuno Beller Developmental Tables (quantitative measure) includes 8 developmental areas Domain of Body Function, Awareness of the Surrounding Environment, <i>Social and Emotional Development</i> , Play, Language, Cognitive Development, Gross and Fine Motor Skills. Outdoor Activities/Trips Diary (qualitative data instrument)	Children in the OE group showed significantly higher mean scores at T1 and T2 compared to the Traditional Group in the following developmental areas: Domain of Body Function [F(1, 91) = 6.99, $p = 0.010$ ], Play [F(1, 91) = 18.27, $p = 0.000$ ], Language [F(1, 91) = 19.15, $p = 0.000$ ], Cognitive Development [F(1, 91) = 32.23, $p = 0.000$ ], Fine Motor Skills [F(1, 91) = 16.49, $p = 0.000$ ], <i>Social and Emotional Development</i> [F(1, 91) = 14.83, $p = 0.000$ ]. Children in the OE group showed significantly higher mean scores at T1 only compared to the Traditional Group in the following developmental areas: Awareness of Surrounding Environment [F(1, 90) = 8.98, $p = 0.004$ ] and Gross Motor Skills [F(1, 90) = 5.49, $p = 0.021$ ]	Moderate
Brussoni 2017 Canada	To investigate the effects of the Seven Cs design intervention in childcare centres on children's play, social behaviours, mental health and physical activity	Design: mixed methods study (one group, pre and post-test design) Sample: 48 children, 2–5 years (M = 4.28 years, SD = 0.63) Setting: 2 childcare centres Intervention Length: 2 weeks	Seven Cs design intervention to promote access to nature and risky outdoor play opportunities <i>Nature based outdoor design intervention</i> No control	Qualitative: Play sessions (Video & Spatial behavioural maps) Quantitative: accelerometers; seven Cs rating; <i>Play observations video coding; Questionnaires: Children's sociometric status, Strengths and Difficulties Questionnaire (SDQ), Preschool Social Behaviour Scale -Teacher Form (PSBS-T)</i> .	Seven Cs score: Centre A increased from 44 to 97; Centre B increased from 35 to 125. Accelerometers: decrease in physical activity from T1 to T2 (M decrease = 1.32 min, SE = 0.37, $p < 0.001$ ). <i>Play observations – Unadjusted intervention effects:</i> <i>Play with natural materials:</i> OR = 43.20, 95% CI = 12.40–188.80, $p < 0.001$ . <i>Antisocial behaviour:</i> OR = 0.54, 95% CI = 0.00–0.02, $P < 0.05$ ; <i>Teacher-child interaction:</i> OR = 0.40 95% CI = 0.23–0.72, $P < 0.01$ ; <i>Solitary play, Channel surfing, Gender-segregated play, Risky play, Prosocial behaviour and Lack of engagement in play: no significant increase from T1 to T2.</i> <i>SDQ peer problems scale: Wilcoxon signed rank tests for paired samples</i>	Strong

Cordiano 2019 United States	To compare if a traditional and nature based pre-primary programme in the same school can equally prepare children for kindergarten	Design: quasi-experimental study; longitudinal cohort study (two group pre and post) Sample: 26 pre-primary children Setting: pre-primary division of an independent school; 12 children in the nature-based programme and 14 children in the traditional programme Intervention Length: school year	Nature-based: children spent 90% of their day outdoors in the forest. <i>Nature-based education</i> Traditional pre-primary programme	Teacher and parent rated measure: Pretend play rating; Teacher rated measure: Kindergarten readiness measure. Student rated measure: Children's Attitudes Toward School (CATS); Children's Attitudes Toward Nature (CATN). <i>Teacher and parent rated measures: Penn Interactive Peer Play Scale (PIPPS); Preschool and Kindergarten Behaviour Scales, Second Edition (PKBS-2).</i>	showed a decrease from T1 to T2 (Median T1 = 2.3, T2 = 2.0; z = -2.10, p = 0.036). <i>PSBS depression score decreased from T1 to T2 (Median T1 = 6.0, T2 = 3.0; z = -2.24, p = 0.03).</i> Pretend play and kindergarten readiness (teacher composite) showed effect of school was not significant Nature appreciation and school enjoyment (child results): the main effect of schools was not significant. <i>PIPPS (teacher composite scores): play interaction: the effect of school was not significant. Play distribution: the outdoor group showed higher levels across time points (p &lt; .001). Play disconnection: The effect of school was significant (p &lt; .01).</i> <i>PKBS-2 (teacher composite): social skills: effect of school was not significant; problem behaviours: The effect of school was significant, the outdoor group showed higher levels of problem behaviours (p &lt; .05)</i>	Strong
Jucan 2015 Romania	To establish a link between the development of preschool children's social and emotional skills and music listening while undertaking specific educational activities	Design: quasi experimental study; cohort (one group, pre and post-test) Sample: 21 preschool children Setting: 1 Romanian kindergarten Intervention Length: 5 weeks	<i>Preschool children participated in a series of learning activities that were accompanied by music listening for 30 min every day for a series of five weeks</i> No control	'YES, YOU CAN!' rating scale measures: trust, perseverance, organization, understanding, emotional strength; measured at pre and post intervention	Trust: pre-test M = 1.92, post-test M = 2.46, post-test score was 'greatly strengthened' for 4.76% of children. Perseverance: pre-test M = 1.92, post-test M = 2.48, post-test score was 'greatly strengthened' for 4.76% of children. Organization: pre-test M = 1.92, post-test M = 2.54, post-test score was 'greatly strengthened' for 8.34% of children. Understanding: pre-test M = 1.92, post-test M = 2.33, post-test score was 'greatly strengthened' for 6.67% of children. Emotional strength: pre-test M = 1.90, post-test M = 2.57, post-test score was 'greatly strengthened' for 9.52% of children	Moderate
Love 2006 United States	To examine how carefully selected music might facilitate children's social constructive and sociodramatic play by	Design: quasi experimental study; observational study with three different experimental conditions	<i>One teacher facilitated play in the block area that was set up with blocks, toy and props. A video camera recorded play for</i>	Video recording was analysed in 3-minute time intervals to record the number of occurrences for each of the following: movement into and out of	Movement into and out of the block area for no, slower and faster music conditions F (2, 21) = 4.52, p < .05 (M = 1.70, 1.34, 1.25, SD = 0.35, 0.22,	Strong

(Continued)



Table 2. Continued.

First author Year Country	Main study aims	Design Sample Setting Intervention length	Main intervention <i>Physical/sensory environment intervention Control</i>	Main outcome measures <i>Social and emotional development outcome measure</i>	Main findings <i>Social and emotional development findings</i>	Study quality (EPHPP)
	influencing cognitive performance, attention, and engagement	Sample: 20 children (10 male, 10 female), mean age = 49.4 months (range = 38–61 months) Setting: 1 private university nursery school Intervention Length: 5 weeks, 24 observation days	<i>approximately 1 h per day. Orchestral and acoustic piano music was carefully selected for rhythm and tempo. For 8 days each slower tempo, faster tempo and no music was played</i> No control	the block area, social group play, dramatic play themes	0.33) Social group play: more intervals of social play between dyads with slower music played than when no music played $F(2, 21) = 4.41, p < .05$ . No difference between faster and slower music. Mean duration of dyad play in the block area for faster music ( $M = 32.61, SD = 14.19$ ), slower music ( $M = 37.86 \text{ min}, SD = 8.31 \text{ min}$ ) no music ( $M = 22.50, SD = 7.68$ ). Dramatic play was only observed on 9 out of 24 days, no statistical analysis	
Morrier 2009 United States	To examine how various environmental arrangements effect social behaviours in an inclusive preschool	Design: quasi experimental study; observational study with three different experimental conditions Sample: 15 children, aged 3–6 years, ( $M = 4$ years, 4 months), 7 children with autism, 8 typically developing children Setting: Inclusive preschool Intervention Length: 5 weeks	Three experimental conditions: conventional classroom package; systematic materials package, including sensory and logistical considerations; enhanced materials package with frequent item rotation.	Positive social behaviours: sharing, cooperative play, child interactions, initiations to teachers. Negative social behaviours: negative affect, disputes over toy possession, tattling, verbal hostility, physical aggression.	Positive social behaviours (interactions, cooperative play, sharing) were significantly higher during the enhanced materials package than the conventional materials package ( $P < 0.01$ ). Enhanced materials package was associated with significantly more initiations to teachers than the conventional materials package ( $P < 0.01$ ). Mean frequency of negative social behaviours was highest during the conventional materials package and lowest during the systematic or enhanced materials package.	Strong
Seifert 2017 United States	To test the effect of inflatable wobble cushions during circle time on children's engagement.	Design: quasi experimental study; cohort study (two group pre and post-test) Sample: 4 preschool classrooms; 25 participants Setting: Independent Nursery School Intervention Length: 4 weeks	Wiggles cushions used at circle time in two preschool classrooms in one-week phases (one week without wobble cushions, one week with cushions, alternating for 4 weeks). Wobble cushions used on the floor during circle time Two control classrooms using their usual seating throughout the study.	Child Behaviour Rating Scale, five subscales included: Affect, Attention, Involvement-Distractibility, Joint Attention, and Persistence. Affect: the child's general emotional state; Joint attention: child initiated adult interactions	Engagement: between subject effect $F(5, 19) = 0.296, p = 0.208$ , within-subject effect $F(15, 9) = 6.719, p = .003$ ; Within-subject effect subscales: Attention: $F = 5.824, p = 0.002$ ; Involvement-distractibility $F = 1.580, p = 0.208$ ; Persistence: $F = 3.394, p = 0.026$ Affect: $F = 1.207, P = 0.319$ ; Joint attention: $F = 1.687, p = 0.186$ .	Strong

studies included a control group (Cordiano et al., 2019; Seifert & Metz, 2017), and three were single group studies without a control group (Jucan & Simion, 2015; Love & Burns, 2006; Morrier et al., 2009). Two studies used a mixed methods study design (Agostini et al., 2018; Brussoni et al., 2017).

Overall, the methodological quality of the included studies was strong (Table 2). Five studies had a strong global quality rating (Brussoni et al., 2017; Cordiano et al., 2019; Love & Burns, 2006; Morrier et al., 2009; Seifert & Metz, 2017). Jucan and Simion (2015) recorded a moderate quality rating due to a weak data collection methods rating as the reliability and validity of the outcome measurement tool was not reported. Agostini et al. (2018) also recorded a moderate quality rating due to the withdrawal and drop-out category; the teachers evaluated 230 child participants on four occasions over the duration of the study. There was a total sample of 93 children at the end of the study with complete evaluations; the withdrawal rate of 60% yielded a moderate quality rating.

### ***What type of physical or sensory environment interventions have been evaluated in ECEC settings?***

Three studies evaluated outdoor physical environment interventions. Two studies compared children's developmental outcomes in a traditional preschool and a nature-based preschool setting (Agostini et al., 2018; Cordiano et al., 2019). One study involved children in the nature-based programme spending 90% of their day outside in all weather conditions (Cordiano et al., 2019), and the other study included an outdoor education kindergarten where the teachers were trained in outdoor education, and outdoor activities were embedded in the daily routine (Agostini et al., 2018). A third study assessed child development outcomes at pre and post implementation of a playground redevelopment in two early childhood centres (Brussoni et al., 2017). This study used the Seven C's design intervention to guide the playground redevelopment and enhance the child's access to natural and risky play affordances (Brussoni et al., 2017).

One intervention focused on the indoor physical environment (Morrier et al., 2009) to determine if three different environmental toy arrangements affected the social behaviour of children with and without autism in an inclusive preschool over a five-week period. The three experimental toy conditions in the free play area were as follows: (1) Conventional Materials Package, included 20 culturally and developmentally appropriate toys most frequently recommended by a survey of preschool teachers; (2) Systematic Materials Package, involved weekly rotation of half the toys in the free play area with consideration for children's sensory needs and toy preferences, and hobby boxes that were made up of toys, based on children's interest from previous observations, to encourage engagement; and (3) the Enhanced Materials Package was the same as the Systematic Materials Package, however, the toys were rotated twice weekly (Morrier et al., 2009). The number of toys available in the classroom remained constant in all three conditions.

Three studies evaluated sensory environment interventions (Jucan & Simion, 2015; Love & Burns, 2006; Seifert & Metz, 2017). One study evaluated the effectiveness of inflatable wobble cushions during circle time on children's engagement. The cushions offered vestibular input, deep pressure, and the small nubs on one side of the cushion offered additional tactile input (Seifert & Metz, 2017). In Love and Burns (2006), children's social play interactions in the block area of the nursery school room were observed during three different background music conditions: fast tempo, slow tempo and a no music condition. In another study, children participated in learning activities that were accompanied by background music (Jucan & Simion, 2015).

### ***What measures have been used to capture children's social and emotional development subdomains?***

The seven included studies use a variety of outcome measurement tools, including observations, scales and questionnaires or a combination of both (Table 2.) The interrater reliability was reported for the studies that coded observational data (Brussoni et al., 2017; Love & Burns, 2006; Morrier et al.,

2009). The scales and questionnaires used in the included studies were child measurement tools (Agostini et al., 2018; Brussoni et al., 2017; Cordiano et al., 2019; Jucan & Simion, 2015; Seifert & Metz, 2017). Social competence was the most commonly reported social and emotional development domain and behavioural self-regulation was only reported in one study (Seifert & Metz, 2017) (Table 3). No two studies used the same outcome measurement tool owing to the substantial number of tools available to quantify children's social and emotional development.

### ***Are physical or sensory ECEC environment interventions effective in supporting children's social and emotional development?***

Three studies reported on the effectiveness of outdoor environment interventions (Agostini et al., 2018; Brussoni et al., 2017; Cordiano et al., 2019). A high-quality study found that after an outdoor playground redevelopment to enhance natural and risky play opportunities, there was a significant decrease in peer problems and depression symptoms (Brussoni et al., 2017). In the two childcare centres that received the intervention, children's antisocial behaviour decreased, but the effect was larger in the centre where children displayed greater levels of antisocial behaviour prior to the intervention. Moreover, when an outdoor preschool programme, led by teachers that had undertaken outdoor education training, was compared to a traditional preschool programme, in which teachers had similar years of traditional education experience, the children in the outdoor programme showed significantly higher overall social and emotional development scores than the children in the traditional group at the beginning of the study. However, by the end of the two year study the children showed similar levels of teacher rated social and emotional development (Agostini et al., 2018). In contrast, another study that compared a nature-based preschool programme and a traditional preschool programme found that in the nature-based group there was significantly higher levels of play disruption and disconnection measured by teachers with the same instrument at the beginning, middle and end of the school year (Cordiano et al., 2019). Furthermore, teacher-rated problem behaviours, measured at the beginning and end of the study, with a 76-item behaviour scale, were significantly higher in the outdoor group (Cordiano et al., 2019). While there were higher rates of challenging behaviour in the nature-based group, the rates were still within the normal range. In this study the traditional and nature-based preschool group finished the year with equal levels of social and emotional functioning and preparedness for kindergarten (Cordiano et al., 2019). The following methodological factors may have contributed to the seemingly opposing findings reported in these studies: (1) parents self-selected the type of preschool programme their children attend, leading to the potential for selection bias as differences between groups may exist (Agostini et al., 2018; Cordiano et al., 2019); (2) children's development measures were not assessed at baseline due to study constraints, and it is not possible to establish if there were any pre-existing differences between preschool groups (Agostini et al., 2018); (3) in one study, there were higher rates of challenging behaviours in the nature-based group, however, the authors described the traditional kindergarten as exceptionally high quality, therefore it may not have acted as a true control group (Cordiano et al., 2019); (4) the teachers running the outdoor programme in one study had undergone specific outdoor education training (Agostini et al., 2018); whereas, Cordiano et al. (2019) evaluated a

**Table 3.** Social and emotional development domains captured.

Study (First author)	Overall social & emotional development	Social competence	Emotional competence	Behavioural self-regulation	Behaviour
Agostini	X				
Brussoni		X	X		X
Cordiano		X			X
Jucan	X				
Love		X			
Morrier		X			
Seifert		X	X	X	

new outdoor programme, and additional teacher training was not reported, and this may influence the disruptive and challenging behaviours reported in the nature based group. Hence, when interpreting the results of these studies, the individual study designs need to be considered.

In Morrier et al. (2009), children who participated in the Enhanced Material Package condition showed significantly higher levels of positive social behaviours compared to the Systematic and Conventional Materials Package conditions. Overall, the frequency of negative social behaviours was lower in the Systematic and Enhanced Materials Package arrangements compared to the Conventional Materials Package condition.

Three sensory interventions were shown to be effective in supporting children's social and emotional development (Jucan & Simion, 2015; Love & Burns, 2006; Seifert & Metz, 2017). There was no significant difference in engagement during circle time between the wiggle cushion classroom and the control classroom (Seifert & Metz, 2017). However, there was a statistically significant effect within the experimental group, over the course of the 4-week study, in overall engagement scores. In contrast, the control group showed no significant change over the duration of the study. Furthermore, over the course of five weeks, background music was effective in supporting children's social and emotional skill development and social play (Jucan & Simion, 2015; Love & Burns, 2006). In Love and Burns (2006) play observations took place in a block area that had been modified to include additional play materials with an educator present to facilitate play activities, and when slower tempo background music played there were more intervals of social play than when no background music played; however, no difference was found between the faster and slower tempo music condition (Love & Burns, 2006). Additionally, in a moderate quality study, background music supported social and emotional skill development in a single group pre and post study design (Jucan & Simion, 2015).

## Discussion

This review focused on educator implemented physical and sensory environment interventions for all children attending ECEC services. The findings suggest the physical and sensory environment supported children's wellbeing across multiple social and emotional development domains, however, the results were mixed. The included studies focused predominantly on social competence and only one study measured children's behavioural self-regulation. There is a need to further evaluate environmental interventions, programmes or tools that educators can use to support all social and emotional development domains.

There were only seven studies that evaluated physical and sensory environment interventions that targeted all children attending ECEC services, implemented by educators, that emerged from this systematic search. The paucity of research on this topic suggests there is a need to expand our understanding of environmental interventions in the early years sector. There is a large body of evidence that has evaluated the sensory environment in other settings, such as hospitals (Drahota et al., 2012) and dentistry services (Cermak et al., 2015). In addition, there are also many examples of sensory spaces being routinely used in other populations to address behaviour, social skills and general wellbeing (Cameron et al., 2020). Sensory environment interventions for children and youth with behavioural problems (Wan Yunus, Liu, Bissett, & Penkala, 2015), and sensory integration difficulties, including autism spectrum disorder (autism) (Bodison & Parham, 2018; Dargue, Adams, & Simpson, 2022) have been thoroughly considered. Sensory interventions are routinely used in elementary schools for children with autism (Case-Smith, Weaver, & Fristad, 2015; Dargue et al., 2022). However, the average age a child is diagnosed with autism is five years (van 't Hof et al., 2020), and the age of school entry in Australia is commonly five years (OECD, 2020). Therefore, ECEC settings differ to schools, in that children with autism are less likely to have a formal diagnosis in the preschool years, so there is an enhanced need for universal sensory environment interventions, strategies and awareness that support all children; particularly those that are

more sensitive to sensory stimuli, such as children with a neurodevelopmental disorder, sensory integration difficulties, sensory processing challenges and sensory processing sensitivity.

It would be beneficial to evaluate the sensory interventions that are commonly used in the ECEC sector, such as sensory play materials, music, visual displays, and sensory play spaces or zones. There are many dimensions that make up the child's sensory experience, including sound, sight, smell, touch, movement and interoception. Preschool based movement programmes have been shown to improve children's self-regulation and behaviour (Burkart et al., 2018; Duman & Ozkur, 2019; Keown et al., 2020; Urena et al., 2020; Webster et al., 2015), and the interoception sense can be captured in some aspects of mindfulness programmes such as full body scanning and breathing exercises. However, the comprehensive search that was undertaken for this review did not find any studies that referenced the sensory aspects of movement or mindfulness programmes. Highlighting that while the sensory environment may be routinely integrated into practice, there are currently limited sensory ECEC environment interventions, implemented by educators, that are documented and evaluated in peer reviewed literature.

There is an opportunity to build and evaluate a multi-faceted ECEC physical and sensory environment intervention and best practice framework. Educators and children are co-contributors in the ECEC space; there is evidence to suggest educator wellbeing is affected by physical education environment conditions (Kwon et al., 2021) and environmental chaos (Jeon et al., 2016) – a sensory environment factor. In addition, a change in physical environment layout can give children different opportunities for play and encourage social interaction (Brussoni et al., 2017; Morrier et al., 2009). Careful consideration of ECEC environments is needed to ensure the play activities that emerge from the environmental conditions are aligned with early childhood pedagogy and curriculum. Hence, the involvement of educators in all facets of ECEC service set-up and design is vital. Future research is encouraged to include the perspectives of educators to inform the development of a physical and sensory environment intervention for the ECEC sector.

Two outdoor environment programmes reviewed here had a mixed influence on children's social and emotional growth (Agostini et al., 2018; Cordiano et al., 2019); however, Johnstone et al. (2022)'s systematic review that looked specifically at nature-based ECEC, showed an overall positive association with children's social and emotional development. Despite this, wavers for outdoor play space requirements have been granted, commonly in CBD areas, to allow the development of ECEC services with limited access to the outdoor environment or imitation natural elements (Morrissey & Moore, 2021). The current disparity between outdoor ECEC environment research and current practice is a necessary consideration for ECEC policy makers, regulators and a direction for future research.

### **Limitations**

A limitation of this paper is that the low number of included studies, participants and methodologies makes it difficult to draw firm conclusions on the effectiveness of physical and sensory environment programmes. It is, however, reflective of the current body of literature on this topic to date. Highlighting that this is a new and emerging field of research for the ECEC sector, and further consideration of the ECEC environment is needed. Furthermore, this review was particularly interested in interventions that were delivered by educators to all children attending mainstream ECEC services, rather than targeted interventions for specific children. While social and emotional learning programmes are routinely used in ECEC, this review only included social and emotional programmes if they included a physical or sensory environment element. As a result, a small number of studies met the inclusion criteria.

It is logistically and ethically complex to implement and evaluate environmental interventions that randomly allocate children to different environmental conditions, particularly those with a longitudinal study design, as parents wish to choose their child's kindergarten programme. As a result, there is a distinct lack of randomized controlled trials on this topic. Potentially, a wait list-

controlled study design may be a way of randomizing participants to short term environmental intervention studies while accounting for confounding variables.

### ***What recommendations can be made for future research and practice?***

Given the paucity of research on this topic, it would be premature to make extensive conclusions about an optimal physical and sensory environment configuration in ECEC settings. However, ECEC providers are encouraged to consider the physical environment layout, available play materials, sensory stimuli, and the play behaviours and social interactions it affords. There are several recommendations for future research. Firstly, there is a need to consider educator perspectives in this area of research and evaluate already existing physical and sensory environment conditions educators routinely use in practice, such as lighting, noise, room layout and visual displays to determine their impact on children's social and emotional wellbeing. Secondly, future programme evaluation is encouraged to investigate all social and emotional development domains to allow for comparison across studies. Finally, enhancing the methodological rigour in future research is necessary, such as the inclusion of randomized controlled trials and larger sample sizes. Considering the above approaches will expand the current evidence base and provide further recommendations for policy and practice.

## **Conclusion**

This review offers an overview of the current and available environment interventions that are used to support children's social and emotional wellbeing in the ECEC sector. The effectiveness of these programmes and methodological rigour of the included studies is mixed, and the findings highlights that considering the environment as an intervention that affects children's social and emotional skills is a broad and complex topic. However, it is imperative that the education environment is considered in ECEC practice to provide supportive environments that allow all children to develop and thrive in the preschool years.

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