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ORIGINAL ARTICLE

Do Children Play Differently in Nature Play Compared to Manufactured Play Spaces? A Quantitative Descriptive Study

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Abstract

The nature play movement has gained global attention, as early childhood spaces have been transforming from manufactured playgrounds to incorporating nature-based play spaces with a focus on natural elements and features. Despite the growing evidence base indicating that nature play is beneficial for children's health and development, there remains inconsistencies between early childhood organisations in describing the features and elements of a nature play space that make it successful for child-related health outcomes. As such, this study investigated the role of nature and manufactured play space features on observed play behaviours in seventeen children attending four socio-economically diverse South Australian early childhood centres. A quantitative descriptive approach was utilised, with observations measured using the Behaviour Mapping Schedule. A Wilcoxon singed rank nonparametric test showed that imaginative ($Z = -2.803$ $p = 0.005$) and cooperative play ($Z = -2.654$, $p = 0.008$) were more frequently observed in natural compared to manufactured play spaces. Physical and motor skill play, however, was more frequently observed in manufactured zones compared to nature ($Z = 1.966$ $p = 0.049$). These findings suggest that both manufactured and natural play zones afford important play behaviours, which may indicate a balanced approach to play spaces design to include a combination of both manufactured and nature play features and elements.

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Résumé
Le mouvement du jeu en pleine nature a attiré l'attention mondiale, car les espaces de la petite enfance ont évolué des terrains de jeux fabriqués vers l'intégration d'espaces de jeu basés sur la nature avec un accent sur les éléments naturels. Malgré la base de preuves croissante indiquant que le jeu en pleine nature est bénéfique pour la santé et le développement des enfants, il persiste des incohérences entre les organisations de la petite enfance concernant la description des caractéristiques et des éléments d'un espace de jeu en pleine nature qui le rendent efficace pour les résultats de santé liés à l'enfant. Ainsi, cette étude a examiné le rôle des caractéristiques des espaces de jeu naturels et fabriqués sur les comportements de jeu observés chez dix-sept enfants fréquentant quatre centres de la petite enfance d'Australie du Sud, diversifiés sur le plan socio-économique. Une approche descriptive quantitative a été utilisée, avec des observations mesurées à l'aide du Programme de Cartographie des Comportements. Un test non paramétrique de Wilcoxon Signé-Rang a montré que le jeu imaginatif (Z=-2,803, p=0,005) et le jeu coopératif (Z=-2,654, p=0,008) étaient plus fréquemment observés dans les espaces de jeu naturels par rapport aux espaces fabriqués. Cependant, le jeu physique et moteur était plus fréquent dans les zones fabriquées que dans la nature (Z=1,966, p=0,049). Ces résultats suggèrent que les zones de jeu fabriquées et naturelles offrent des comportements de jeu importants, ce qui peut indiquer une approche équilibrée dans la conception des espaces de jeu, incluant une combinaison de caractéristiques et d'éléments de jeu fabriqués et naturels.

Resumen
El movimiento del juego en la naturaleza ha captado la atención a nivel global, ya que los espacios de la primera infancia han ido transformándose de parques infantiles fabricados a la incorporación de espacios de juego basados en la naturaleza, con un enfoque en elementos y características naturales. A pesar de la creciente base de evidencia que indica que el juego en la naturaleza es beneficioso para la salud y el desarrollo de los niños, persisten inconsistencias entre las organizaciones de la primera infancia al describir las características y elementos de un espacio de juego en la naturaleza que lo hacen exitoso para los resultados relacionados con la salud infantil. Por tanto, este estudio investigó el papel de las características de espacios de juego naturales y fabricados en los comportamientos de juego observados en diecisiete niños que asistían a cuatro centros de la primera infancia en Australia del Sur, con diversidad socioeconómica. Se utilizó un enfoque descriptivo cuantitativo, con observaciones medidas mediante el Programa de Mapeo de Comportamientos. Una prueba no paramétrica de Wilcoxon Singed-Rank mostró que el juego imaginativo (Z=-2.803, p=0.005) y el juego cooperativo (Z=-2.654, p=0.008) se observaron con más frecuencia en espacios naturales en comparación con los espacios fabricados. Sin embargo, el juego físico y motor se observó con más frecuencia en zonas fabricadas en comparación con la naturaleza (Z=1.966, p=0.049). Estos hallazgos sugieren que tanto las zonas de juego fabricadas como las naturales ofrecen comportamientos

de juego importantes, lo que puede indicar un enfoque equilibrado en el diseño de espacios de juego para incluir una combinación de características y elementos de juego fabricados y naturales.

Introduction

Early childhood is a crucial developmental period in a child's life, as it sets the foundations for future physical and cognitive capabilities (Hughes, 2010), executive functioning (Berk, 2017; Elias & Berk, 2002), lifelong learning behaviours (Gabbard, 2014), and overall health (Hughes, 2010), particularly from the ages of birth to five years, where important developmental millstones occur (Berk, 2017; Hughes, 2010). In Australia alone, one in five children under the age of five are considered developmentally vulnerable when they start school, and for children living in low socio-economic zones, the risks are even higher (South Australia Department for Education, 2021).

Whilst the causes of developmental vulnerabilities in children are multifactorial, evidence consistently highlights the positive impacts of engaging in activities such as play for children's health and development including, social skills, emotional regulation, motor function, and physical activity (PA) (Bowler et al., 2010; Coon et al., 2011; Dankiw et al., 2020; Mccormick, 2017; Sando, 2019). Children's play is driven by inner motivation and autonomy, meaning that the child decides what they want to do (Berk, 2017; United Nations International Children's Emergency Fund, 1990). The diverse nature of play leads to various presentations of behaviour in children, and researchers have developed approaches on how to categorise these behaviours (Berk, 2017). Such approaches involve classifying play based on physical and motor skill, cognitive, and social aspects (Hughes, 2010; Lillard, 2015). Although developmental psychologists hold differing approaches about how these stages are defined, they acknowledge the significance of play for child development.

Prominent psychologists like Piaget (Lillard, 2015), Vygotsky (1967), Smilansky (1968), and Parten (1932) offer insights into play classifications. Piaget highlights sensorimotor play aiding sensory understanding through object use (Hughes, 2010; Lillard, 2015). Functional play involves basic motor behaviours and builds physical skills (Rubin, 1977). Symbolic play uses objects to represent something else, enhancing creativity, imagination, and social skills (Hughes, 2010). Constructive play, like building, fosters creativity and fine motor skills (Fjørtoft, 2004; Kimberly & Keith, 2014; Zamani & Moore, 2013). Dramatic play enhances emotional regulation (Elias & Berk, 2002). Games with rules develop physical and problem-solving skills (Hughes, 2010; Lillard, 2015). Parten's levels of social interactions provide additional categories ranging from solitary to cooperative play and group play categories (Parten, 1932).

Socially engaging with others helps children to develop their language, cooperation, and negotiation skills, which may help in regulating emotions, behaviour and the development of complex thinking (Hughes, 2010; Rauf & Bakar, 2019; Tsao, 2002). Parten's social categories include: solitary (plays alone no reference to others), parallel (plays alongside other, uses available materials, with no influence on

others), associative (plays with others engaged in similar activity; communication and materials exchanged, no overall goal to activity), cooperative play (a group of children organise themselves with a specific goal in mind, i.e. team game, or drama role), and group composition (two or more children play alongside one another or in a group) (Hughes, 2010; Parten, 1932; Zamani & Moore, 2013).

Educational institutions and curriculum guidelines around the world also recognise the benefits of play (Australian Government Department of Education & Training, 2009; Yildirim & Özyilmaz Akamca, 2017). Within Australian early childhood settings, a 'learning through play' curriculum framework informs early childhood educator practice and delivery (Australian Government Department of Education & Training, 2009). This framework describes the importance of incorporating outdoor free play, with the addition of natural materials and features such as sand, mud, water, and trees (2009). The practice of incorporating natural elements and features within a play programme and play space has more recently been described as nature play (Lee et al., 2022). Nature play is a widely used term developed to describe children's play that takes place in a natural environment and/or involves interaction with natural elements and features (e.g. water and mud, rocks, hills, forests, and natural loose parts, such as sticks, pinecones, leaves, and grass) (Lee et al., 2022).

The concept of nature play has been gaining traction within educational settings, as early childhood settings and schools have been incorporating a more nature-based approach to outdoor play (Miller et al., 2022). Traditional playgrounds are transforming to include more natural features such as logs, trees, ponds, mud kitchens, and natural loose parts such as bark, rocks, and sand (Brown & Kaye, 2017; Dowdell et al., 2011). This nature-based approach to play space design is in response to research suggesting that nature play spaces facilitate important health and developmental benefits for children relating to PA, social and emotional outcomes (Brussoni et al., 2017; Dankiw et al., 2020). Research also suggests that children value nature play spaces. Studies have suggested that children enjoy outdoor open spaces where they can challenge themselves, take risks, explore, create, and manipulate objects (Burke, 2005; Norðdahl & Einarsdóttir, 2014). Children's fondness for nature play may be attributed to the unlimited affordances natural environments provide, compared to manufactured environments, which are created with a specific purpose in mind (climbing wall to climb, a slide for sliding down).

The theory of affordances was first introduced by Gibson (1986) and aims to describe how different environmental features, elements, and objects afford opportunities and possibilities for different types of interactions to take place (Gibson, 1986; Sandseter, 2009). Affordances are unique to the individual and unique to the environment, features, elements, and objects within that environment (Gibson, 1986), meaning that one child may engage with an element, such as a tree, differently to another child based on their own personal preferences or abilities. For example, one child of two years may interact with a tree by pulling off the bark, whereas a different child of six may attempt to climb the tree if the tree offers smooth low hanging branches. Similarly, if a rock is smooth and horizontal it may afford a child to sit on it, or if it is rough and tall it may afford a child to climb on it (Gibson, 1986).

Research evaluating outdoor play space design and its impact on observed behaviours in children suggests there is a relationship between the features/

components of outdoor play space design and the impacts on children's health and development (Morrissey et al., 2017; Tranter & Malone, 2004; Woolley & Lowe, 2013; Zamani, 2016). Studies to date have explored individual features of outdoor play spaces and their impacts on children's behaviour, such as loose parts (Houser et al., 2019) (bark, sticks, rocks, leaves, crates, buckets), natural elements (Brussoni et al., 2017; Kimberly & Keith, 2014) (water, dirt, sand), and manufactured elements such as playground equipment (Barton et al., 2015; Luchs & Fikus, 2018) and toys (Trawick-Smith et al., 2015). Similarly, the literature has also explored the impact of context in regard to topography (Fjørtoft, 2001, 2004; Gardner & Kuzich, 2018; O'Brien & Murray, 2007) (forest, bushlands, snow).

What is unknown and yet to be explored within the literature is, understanding how the Australian geographical context may impact children's outdoor play behaviours and engagement within an early childhood setting. Hence, this research investigated the role of play space features on observed play behaviours in children attending South Australian early childhood centres, by comparing nature play and manufactured zones. Specifically, this research aimed to describe where and how children play in outdoor early childhood settings. Findings from this study may inform the design of children's play spaces, providing descriptive information about play space elements that could be useful for facilitating developmental outcomes in children.

Methods

Study Design

A quantitative descriptive observational study was conducted in three–five-year-olds attending early childhood centres to address the following research questions, 1) what type/categories of play behaviours were observed and at what frequency, 2) where do children play within the outdoor play environment when they are given both nature play and manufactured play space opportunities, and 3) what are the differences in play behaviours between play locations (manufactured versus nature). Quantitative descriptive studies aim to describe patterns or differences within a context (in this case, early childhood outdoor play space environments), where no attempt is made to manipulate the individuals, conditions, or events but merely describe what is occurring (Baker, 2017). This was achieved by undertaking naturalistic observations of children at their early childhood centres during three separate playtime periods. This study design is ideal when the aims of a study are to describe what is occurring in a particular context, rather than to determine causation (Baker, 2017; Creswell, 2009). This research was informed by and reported using the Strengthening the Reporting of Observational Studies in Epidemiology Checklist (STROBE Checklist) (Cuschieri, 2019) (see Appendix 1).

Study Site

Early childhood centres were approached based on two selection criteria: 1) the outdoor play spaces had a mixture of both natural and manufactured elements (to ensure a diversity of play spaces and varying outdoor play opportunities and experiences) and 2) centres were located in differing socio-economic regions according to their Index of Relative Socio-Economic Decile Ranks (SEIFA) from five-year census data (Australian Bureau of Statistics, 2016). The lowest (more disadvantaged) 10% of areas are given a decile number of 1, up to the highest (less disadvantaged) 10% of areas which are given a decile number of 10 (Australian Bureau of Statistics, 2016). The study site recruitment process involved three steps. Firstly, a member of the research team contacted the directors of four early childhood centres to seek their willingness to participate. Secondly, each of the willing centres were visited to assess their outdoor play areas (later discussed with research team to ensure eligibility). Lastly, the eligible and willing centre directors were asked to sign a consent form.

Participants

Parents of children aged three-to-five years were recruited using flyers and information packs distributed at the participating Early Childhood Community Children's Centres in Adelaide, South Australia. The recruitment period lasted five months from July to November 2018. Parents or legal guardians provided informed written consent and completed a screening questionnaire to assist with determining their child's eligibility and to collect descriptive data including child age and gender. Children were included if they were within the desired age range and did not have any known or diagnosed special needs (e.g. physical, intellectual or developmental disability). Children were excluded if they had any diagnosed special needs or were outside the desired age range. The sample size was determined by referencing similar samples from previous observational studies with a focus on child play behaviours (Bourke & Sargisson, 2014; Swank et al., 2015; Tranter & Malone, 2004). Participation in the study was voluntary, and participants were able to withdraw at any time without any adverse consequences. All procedures were approved by the University of South Australia Human Research Ethics Committee (protocol number 201137).

Data Collection

Naturalistic play observations using a modified version of the Behaviour Mapping Schedule (Tranter & Malone, 2004) were conducted with children at the recruited community children's centres. The observations occurred from November 2019 to January 2020. The observations were completed over nine separate visits (three visits per centre). The Behaviour Mapping Schedule was used to systematically code the observed play behaviours of the children in real time, as well as the location of where the play

behaviour took place (nature play zone and manufactured zone). The tool consists of 23 behaviour codes categorised into five behaviour domains: *social interaction*, *social activity*, *cognitive activity*, *physical and motor skill activity,* and *other* (see Appendix 2). Inter- and intra-rater reliability of the Behaviour Mapping Schedule previously completed by the research team found the tool to have excellent intra-rater reliability [70% of behaviour codes had intraclass correlation coefficients (ICCs) > 0.75] and good inter-rater reliability (52% of ICCs ≥ 0.75) in three–five-year-olds (Dankiw et al., 2021). One member of the research team collected all the data and underwent training with a paediatric content expert prior to data collection to assist with interpreting the 23 behaviours codes. For each child, data were continuously recorded over a 20-min time period in 10 consecutive two-minute intervals (manually on paper-based data sheets, see Appendix 3) across three separate time points (up to 60 min in total), with some occurring on different days depending on the child's availability. During each two-minute interval multiple behaviours could be coded, but no single behaviour code was repeated. No notes were taken during the observations. To reduce the novelty of the researcher presence, familiarisation visits were completed over a one-week period at each location two weeks prior to data collection.

After consent was obtained from all centres, a mud map of their outdoor play space and its elements were sketched, and each element was labelled and then photographed. The map and photographs were shown to the research team where eligibility of each site was discussed against the selection criteria. The elements for each of the play spaces were then characterised as either belonging to a nature play zone or manufactured zone. The determination regarding the characterisation of the play space elements was based on previous literature which has investigated the impacts of play space design (nature and manufactured) on children's health, such as Storli and Hagen (2010) which described playground equipment (swings, slides) as being manufactured and Torka (2017) which described creek beds, trees, open grass areas, and rocks as being indicative of a nature play zone (Storli & Hagen, 2010; Torkar, 2017). As such, our choices were informed by current literature in this field. In the context of this study the nature play zones were defined by having natural features and elements, such as but not limited to, water and mud, rocks, hills, forests, and natural loose parts, such as sticks, pinecones, leaves, and grass. The manufactured zones were defined by having features and elements that are made from artificial materials, such as but not limited to, swings, slides, climbing equipment, plastic loose parts, toys, and sporting equipment.

Analysis

The steps taken during the analysis phase of the research are outlined in Table 1.

Results

Recruitment of the study sites yielded interest from four early childhood community centres. Despite our attempts, we were not successful in recruiting participants from the fourth site, resulting in the recruitment of participants from three study

Table 1 Data analysis procedure

Step	Description
Data Entry	Data were input into Microsoft Excel (version 2212, Microsoft Corporation) for each child during 20-min observation periods (one to three periods per child)
Data Reduction	Child-specific data were summarised by adding up counts for each variable (play behaviour, play location, play behaviour at location) per 20-min period before analysis
Research Questions 1 and 2	To address questions about play behaviours and play locations, percentages were calculated by dividing mean counts by total mean counts, considering one to three observation periods
Research Question 3	Total counts for each of the 23 play behaviour codes in manufactured versus nature play zones were computed per child with complete data (three time points)
Data Export	Summary data were exported to SPSS version 28 for subsequent analysis
Descriptive Statistics	Descriptive statistics (mean count, SD, percentage per time point) were examined for child play behaviours, play locations, and play behaviours in nature vs. manufactured zones
Wilcoxon signed rank tests	To compare the distribution of observations in nature versus manufactured zones (research question 3), Wilcoxon signed rank tests were conducted due to dependent*, continuous, and non-normally distributed data. Children with incomplete data (< three time points) were excluded from Wilcoxon signed rank tests to prevent bias from varying observation periods. The significance level was set at $\alpha \leq 0.05$ for Wilcoxon signed rank tests

Key: *A child could contribute to observations in nature play zones and manufactured zones

sites. Study site one (Centre A) was located in the Southern suburbs of Adelaide, South Australia, with a SEIFA in the ninth decile, whereas study site two (Centre C) was located in the North-Eastern suburbs with a SEIFA in the fifth decile, and study site three (Centre S) was located in the Western suburbs with a SEIFA in the second decile. Each of the three study sites exhibited similar elements and features within their outdoor play zones which were then categorised into one of two play zone types: nature play or manufactured (Table 2).

Recruitment of participants yielded interest from 19 parents on behalf of their children. Of these, two children were withdrawn from the study due to them leaving the centre, resulting in 17 children participating. There were eight children attending Centre A (47.1%), three at Centre C (17.6%), and six at Centre S (35.3%). The median age of participants was four years (inter quartile range (IQR) = 1, minimum = 3, maximum = 5). There were seven children aged three years (41.2%) of which three were male and four were female, nine children aged four years (52.9%) of which four were male and five were females, and one child aged five years (5.9%) who was male. The median age of females and males was four years, respectively. The gender of children was eight males (47.06%) and nine females (52.94%). Most children completed all three timepoints ($n = 13$, 76.5%), however, one child (5.9%) completed one timepoint, and three children (17.6%) completed two timepoints due to being absent on the day(s) of data collection. A total of 964 observation minutes were recorded across all 17 children.

Table 2 Examples of grouping elements and features with play zone characteristics

	Nature play zone	Manufactured play zone
Example of features/elements	Rocks	Swings
	Trees and tree stumps	Slides
	Logs	Manufactured climbing equipment
	Grass (including artificial grass)	Manufactured playground
	Dirt	Artificial structure
	Wooden structures	Chairs
	Natural structures	Couches
	Sand pit area	Bench
	Vegetation	Toys
	Bark	Tables and chairs
	Dirt	Paved path
	Garden with vegetables/flowers	Concreate path
	Plants in pots	

Table 3 presents the mean count and percentage of all play behaviours per observational period ($n=17$). Social interactions were frequently observed, accounting for 32% of overall play (not including solitary play) with the majority of the social interactions being parallel play (7%) and cooperative play (7%), and group play involving two children (7%). The social interactions of children were frequently recorded as verbal interactions (12%), rather than observing others (6%) or being self-focused (4%). In terms of cognitive activity, close interaction with the natural environment was more frequently observed (10%) compared to other behaviours. For physical and motor skill activities, playing with free equipment was most observed (7%). Other behaviours such as moving between locations were commonly observed (7%) compared to other behaviours in the same domain.

Table 4 presents the mean count and SD per timepoints completed and percentage across children ($n=17$) in nature versus manufactured play zones. Children were observed more frequently in the nature play zone (59%) compared to the manufactured play zone (41%).

Table 5 shows that cooperative play ($Z=$-2.654, $p=0.008$), close interaction with the natural environment ($Z=$-2.833, $p=0.005$), exploring environment ($Z=$-3.082, $p=0.002$), and imaginative play ($Z=$-2.803 $p=0.005$) were more frequently observed in the nature play zone compared to the manufactured play zone. Playing on/with fixed structures ($Z=1.966$ $p=0.049$) were more frequently observed in the manufactured play zone compared to the nature play zone. There were no other statistically significant differences in the frequency of play behaviours observed in nature play zones compared to manufactured zones.

Figure 1 highlights that for children who completed three timepoints ($n=13$), cognitive play behaviours were more frequently observed in nature play zones (17.2%) compared to manufactured zones (3.5%). Similarly, social interactions were more frequently observed in nature play (20%) compared to manufactured zones (15.6%). However, social activities were more frequently observed in manufactured (12.2%) compared with nature play zones (10.3%), whereas physical and motor skill play behaviours were comparable for both nature play (5%) and manufactured

Table 3 Play behaviour frequency per timepoint completed (n = 17)

Behaviour domain	Behaviour code	Mean count (SD)	% Behaviour	% Domain
Social interaction	Solitary play	2.3 (2.0)	4.4	36.5
	Parallel play	3.5 (2.5)	6.6	
	Associative play	2.7 (1.5)	4.7	
	Cooperative play	3.9 (2.9)	6.8	
	2 people	4.1 (2.5)	7.3	
	3–6 people	2.3 (1.5)	4.1	
	7 + people	1.3 (2.0)	2.6	
Social activity	Self-focused	2.1 (1.8)	3.8	21.7
	Observing participant	0.0 (0.3)	0.1	
	Observing others	3.2 (2.0)	6.0	
	Verbally interacting	6.8 (2.9)	11.8	
Cognitive activity	Constructing activity	0.7 (1.0)	1.4	21.3
	Close interaction with natural environment	5.8 (1.8)	10.3	
	Exploring environment	3.1 (2.2)	5.4	
	Imaginative activity	2.5 (2.1)	4.2	
Physical and motor skill activity	Playing with free equipment	3.7 (2.0)	6.7	10.3
	Playing on or in fixed structure	1.8 (1.2)	3.2	
	Participating in structured team game	0.2 (0.5)	0.4	
Other	Inside physical environment	0.7 (1.7)	1.3	9
	Moving between locations	3.7 (1.4)	6.7	
	Changing activity	0.4 (0.6)	0.7	
	Other (Enthusiastic play)	0.1 (0.2)	0.2	
	Other (Crying or injured)	0.1 (0.1)	0.1	

Key: SD = standard deviation

Due to rounding, the total of percentages may not add to 100%

Table 4 Play location frequency per timepoint completed (n = 17)

Play location zone	Mean count	SD	% Location
Nature play zone	6.0	2.7	58.9
Manufactured zone	4.2	2.8	41.0

KEY: SD = standard deviation

* Due to rounding, the total of percentages may not add to 100%

Table 5 Frequency of play behaviours observed in nature play zone versus manufactured zone per timepoint completed (n = 13)

Domain	Behaviour	Nature Play			Manufactured			Nature play VS manufactured	
		Mean count (SD)	% Behaviour	% Domain	Mean count (SD)	% Behaviour	% Domain	Z score	P value
Social interaction	Solitary play	2.8 (2.5)	1.6	20	5.2 (5.3)	3.1	15.6	1.427	0.154
	Parallel play	5.9 (4.0)	3.5		6.0 (5.6)	3.6		-0.175	0.861
	Associative play	4.3 (3.8)	2.5		4.6 (4.6)	2.7		0.140	0.889
	Cooperative play	7.6 (6.5)	4.5		1.9 (3.5)	1.1		-2.654	0.008*
	2 people	6.7 (4.6)	4.0		3.6 (4.2)	2.1		-1.648	0.099
	3–6 people	4.7 (5.3)	2.8		3.5 (3.2)	2.0		-0.210	0.834
	7 + people	2.0 (3.5)	1.1		1.6 (2.3)	1.0		0.170	0.865
Social activity	Self-focused	2.2 (2.7)	1.3	10.3	4.9 (4.8)	2.9	12.2	1.841	0.066
	Observing participant	0.0 (0.2)	0.0		0.3 (1.1)	0.1		0.447	0.655
	Observing others	3.9 (2.2)	2.3		7.3 (5.6)	4.3		1.532	0.126
	Verbally interacting	11.3 (8.3)	6.7		8.3 (5.7)	4.9		-0.867	0.386
Cognitive	Constructing activity	0.8 (2.2)	0.5	17.2	2.0 (3.3)	1.2	3.5	0.763	0.445
	Close interaction with natural environment	13.4 (6.5)	7.9		3.1 (2.7)	1.8		-2.833	0.005*
	Exploring environment	8.9 (7.0)	5.2		0.38 (0.6)	0.2		-3.082	0.002*
	Imaginative activity	6.2 (6.1)	3.6		0.54 (0.7)	0.3		-2.803	0.005*
Physical and motor skill	Playing with free equipment	6.5 (4.8)	3.8	5	4.4 (3.5)	2.6	4.9	-1.218	0.223
	Playing on or in fixed structure	1.6 (2.5)	0.9		3.9 (3.1)	2.3		1.966	0.049*

Table 5 (continued)

Domain	Behaviour	Nature Play			Manufactured			Nature play VS manufactured	
		Mean count (SD)	% Behaviour	% Domain	Mean count (SD)	% Behaviour	% Domain	Z score	P value
	Participating in structured team game	0.5 (1.3)	0.3		0.0 (0.2)	0.0		-1.069	0.285
Other	Inside physical environment	0.0 (0.2)	0.0	3.3	2.7 (5.8)	1.6	6.2	2.154	0.031
	Moving between locations	5.3 (3.4)	3.1		6.3 (3.9)	3.7		0.595	0.552
	Changing activity	0.2 (0.4)	0.1		1.23 (2.2)	0.7		1.549	0.121
	Enthusiastic play	0.3 (0.7)	0.1		0.1 (0.5)	0.0		-0.557	0.564
	Crying or injured	0.0 (0.0)	0.0		0.3 (0.6)	0.2		1.890	0.059

Key: SD = standard deviation, * = statistical significance ($p < 0.05$)

Due to rounding, the total of percentages may not add to 100%

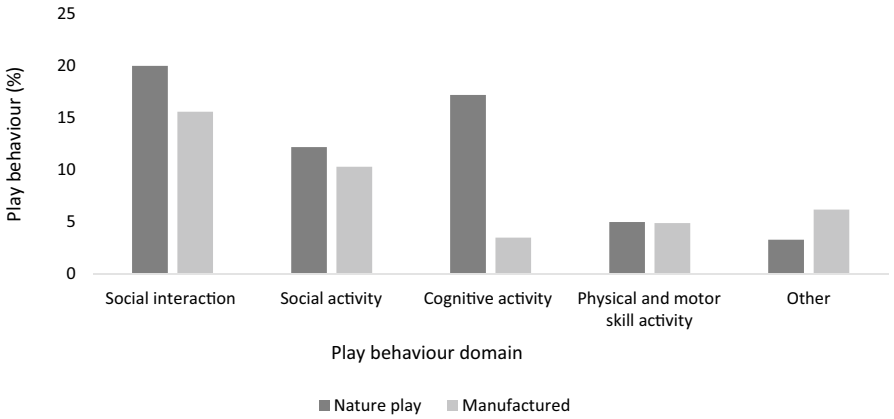

Fig. 1 Percentage of play behaviours observed in nature play versus manufactured per play domain (n = 13)

(4.9%) zones. Other play behaviours were more frequently observed in manufactured zones (6.2%) compared to nature play zones (3.3%).

Discussion

Whilst research exploring where and how children interact within outdoor play environments is well established, research exploring the concept of nature play and how children interact with it in an Australian early childhood context is limited. The emergence of nature play within early childhood settings has prompted investigations by researchers around the world such as the USA, Canada, Scandinavia, and Scotland, who have found that nature play is beneficial for children's health and development (Dankiw et al., 2020). However, what is unknown is how the South Australian geographical context may impact children's interactions with nature play, given the unique features and elements present in children's outdoor play spaces in early childhood settings. The purpose of this study was to address this knowledge gap by investigating where and how young children play in the outdoor play environment when they are exposed to nature play and manufactured outdoor play space features. The findings suggest that both nature play and manufactured play spaces provide children with affordances to engage in a range of play behaviours relating to social, physical and motor skill, cognitive, and other play activities. Our findings also indicate that children may prefer to play in nature zones compared to manufactured zones. Furthermore, when children are in nature play zones, they exhibit more cognitive and imaginative play behaviours compared to manufactured zones. Certain behaviours in the social and physical play domains also differed whereby cooperative play behaviours (social) were more frequent in nature play zones, whilst physical/motor skill play (playing on/in fixed structures) were observed in manufactured zones.

Overall, children were observed engaging in a range of play behaviours (research question one) that were in line with the age range and developmental status of the children (Fromberg, 2012). Social behaviours were a dominate component of playtime for children, with common examples including play in pairs/groups, peer-to-peer verbal interactions, sharing toys whilst playing alongside other children (parallel play) and cooperative play towards a common goal. Children engaged in physical motor skill activities such as playing with free equipment and using fine motor skills to pick up and use toys (Lillard, 2015). Children were also observed playing on or in fixed structures and moving between locations, using their gross-motor skills to climb monkey bars, run and walk (Lillard, 2015). Age-appropriate cognitive play behaviours, such as imaginative play, were also observed (Hughes, 2010; Zamani, 2016).

Children played in both nature play and manufactured zones, with slightly more observations (by 18%) within nature play areas (research question two). This finding may indicate that children have a preference for nature play zones, whilst still valuing manufactured play spaces. Previous research has also found that children have affections towards both nature and manufactured play spaces (Cosco et al., 2010; Ernst, 2018; Zamani, 2017). Zamani (2017) interviewed 22 children aged four–five years and found that the loose materials found in natural play environments (dirt, rocks, mud) sparked a number of dramatic play behaviours to occur where the children could challenge themselves, take risks, explore, create, and manipulate objects (Zamani, 2017). In addition, the interviews also revealed that the children valued manufactured features and elements such as play structures (slides, swings, gazebos, rockers) as they provided them with functional play opportunities (Zamani, 2017). The findings of this study and that of others suggest that including a combination of both natural and manufactured components may be important in designing engaging play spaces for children (Cosco et al., 2010). Another factor that may also be valuable to consider is what natural or manufactured features and elements are needed to facilitate play behaviours that are important for children's health and development, such as imaginative play.

When comparing play behaviours in nature versus manufactured spaces (research question three), we found significantly higher frequencies of cognitive play—most notably, imaginative play. Social interaction in the form of cooperative play was also more common in nature play zones. Engaging in imaginative play behaviours offers children valuable learning opportunities (Lillard, 2015; Zamani, 2016); as it encourages creative problem-solving and helps them make sense of the world around them by interacting with their peers (Hughes, 2010; Zamani & Moore, 2013). This dynamic interaction fosters the development of both language and social skills (Fromberg, 2012; Hughes, 2010). This finding is consistent with prior research, which found that young children's imaginative and social group play improved after interactions with nature and within nature play environments (Dowdell et al., 2011; Johnstone et al., 2022; Luchs & Fikus, 2013). This finding may be attributed to the expanded affordances that a nature play space may provide for children, in the form of natural features, elements and objects which can be used in multiple ways, such as loose parts, trees, logs, water and sand (Herrington & Brussoni, 2015). Manufactured play spaces on the other hand are created with features, elements and objects

designed for use in a particular way, such as a climbing wall to climb or a slide for sliding down (Storli & Hagen, 2010).

Physical and gross-motor skill behaviours in the form of playing on or in fixed structures were more frequently observed in manufactured compared to nature play zones (research question three). This finding highlights a difference in the types of play behaviours exhibited by children when they are engaging with different play space elements and features. Manufactured zones may be more conducive to physical and gross-motor skill activities, whilst nature play zones seem to facilitate sociodramatic play and imaginative interactions among children which is also consistent with previous findings (Cosco et al., 2010; Kimberly & Keith, 2014; Zamani, 2016). To enhance future nature play spaces, it may be beneficial to include play space features that cater to various age groups and abilities. These features should provide physical challenges that encourage children to utilise their gross-motor skills effectively and provide diverse affordances to promote other types of play to occur.

The theory of affordances suggests that providing children with a range of play space features may promote diverse interactions to occur (Gibson, 1986). Therefore, incorporating a variety of features within a play space, such as natural and manufactured, may help cater to individual child needs whilst facilitating different kinds of play interactions. Research has investigated how play space features may have an impact on children's behaviours. Cosco and colleagues found that natural soft ground surface materials, such as sand afforded less PA and moderate to vigorous physical activity (MVPA) than other surfaces such as asphalt and concrete in two American pre-school outdoor play spaces located in North Carolina (Cosco et al., 2010). Similarly, Larrea et al. found that Spanish pre-school aged children engaged in more social group play when they were given access to flat smooth ground surfaces, such as asphalt compared to natural surfaces such as sand or dirt (Larrea et al., 2019). Sandseter and colleagues found that the presence of a sandbox afforded more constructive play in the outdoor play space of a Norwegian early childhood centre (Sandseter et al., 2022). Hence, findings from the present study and that of others suggest that whilst providing children with flat smooth surfaces may encourage social group play and PA, other features of the outdoor play environment should also be considered to afford other behaviours to take place, such as sand for constructive and imaginative play. Therefore, it may be critical to consider a hybrid approach to outdoor play design by including a range of manufactured and natural features.

Designing and creating play spaces for children that are engaging is an important step towards facilitating children to play. Another important step is to understand what features and elements are needed to promote health and developmental outcomes. The findings from the current study and that of Cosco (2010) and Zamani (2016) recommend integrating both nature play and manufactured features and elements in children's play spaces to encourage diverse play behaviours. The implications of these findings can serve as a foundation for evidence-based play space design, ensuring that play spaces are universally designed to foster a wide array of play behaviours and developmental outcomes for children. The findings can guide collaboration between play space designers/architects, educators, children, and child development experts to create play spaces that address various developmental aspects and provide enriching experiences for children.

It is also worth considering the importance of involving children's perspectives in future research and play space design through qualitative exploration. Incorporating the voices of children within the design process could help capture their preferences for specific nature or manufactured play space elements. Previous research has highlighted the importance of involving children in the design process as it aids in developing play spaces that are inclusive and engaging (Birbeck et al., 2009; Merewether, 2015). This participatory approach not only ensures that children's preferences are considered, but also contributes to creating play spaces that meaningfully engage and resonate with children.

Limitations and Strengths

Whilst the research followed the gold-standard approach for reporting observational studies (STROBE checklist) (Cuschieri, 2019), it still has some limitations. The relatively small sample size captured in this study should be considered a limitation as it impacts the generalisability of the findings. The descriptive methodology employed in this study does not lend to establishing causality. However, it does serve as an initial step in generating new knowledge in identifying trends and informing hypotheses which can then be tested using robust research designs in the future, such as randomised controlled trials. To address potential observer bias in interpreting observed behaviours, training with a paediatric content expert was conducted before data collection. To mitigate the impacts of seasonal variations on children's observed behaviours, data were collected during spring and summer, as these seasons offer regular access to outdoor play spaces compared to cooler months. The familiarity of the researcher with the participants may have influenced the children's typical play behaviours during data collection. To minimise the novelty effect and participants' reactivity, a one-week familiarity period was implemented at each study site two weeks before data collection.

Conclusion

The findings suggest that nature play spaces afforded more imaginative and cooperative play compared to manufactured zones. Therefore, it may be key for play space design architects to include nature play characteristics that include features and elements such as rocks, trees, vegetation, sand pits, open grass areas and natural structures. There was a tendency for children to show a preference towards nature play over manufactured zones, although the latter were still shown to provide opportunities for physical and motor skill play activities. Therefore, when designing play spaces, it may be important to incorporate a mixture of both nature play and manufactured features and elements to afford a range of play behaviours. Stakeholders such as children, educators, parents, play space architects, government agencies, and policymakers may use these findings to creature context-specific guidelines around hybrid play spaces for children which include both natural and manufactured features.

Declarations

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