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Children, play, and the built environment

What can we learn from co-creation and embodied cognitive science?

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CoC
Playful
Minds

Children, play, and the built environment

WHAT CAN WE LEARN FROM CO-CREATION
AND EMBODIED COGNITIVE SCIENCE?

Children, play, and the built environment

What can we learn from co-creation and embodied cognitive science?

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children**





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Preface

Billund is the Capital of Children. Here children learn through play and are creative world citizens. This is the vision. We are making the vision alive. By projects co-created with children, by facilitating child-centered processes and design-collaborative affordances for, with and around children, and by creating and sharing a sound knowledgebase on how to promote children's play, creativity, and learning.

As a Living Lab for co-creating cities and built environment with children we are proud to present this third Research Journal on how to promote play, playful learning, and creativity for and with children in the built environment. The research has been conducted by several researchers from Department of Architecture, Design and Media Technology from Aalborg University. They have approached the task from two perspectives: co-creation and embodied cognitive science.

Building and creating spatial and urban places with children is a complex but also fun and creative process, that not only brings new perspectives and understanding of how to create better and more child friendly urban spaces and cities, but also promote new learning opportunities and informal learning communities for the children and professionals involved in the process.

We are constantly searching for ethical ways and practice-based learnings on how to promote children's positions as agents in matters of their concerns and in their near communities, spaces, and places. Creating cities and built environment with children is not a simple task, but a wonderful opportunity to make a better world together across generations and professions.

This Research Journal sets the stage concerning available research-based knowledge on why and how to design and create better and more child friendly built environment and urban spaces, promoting play and a more holistic development for children – with children.

The Research Journal provides theoretical understandings and practical examples and recommendations for researchers and for practitioners. It highlights opportunities for developing stronger research on the topics as well as how designer-child collaboration and co-creation potentially can influence and enable place-makers to engage children and their perspectives in future urban planning and building.

We wish to thank the research team from Aalborg University for a solid and inspiring collaboration. The result is this Research Journal, which we hope will inspire everyone with an interest in designing and creating built spaces with and for children.

Billund, August 2020

Karin Møller Villumsen
Director of Research Lab
CoC Playful Minds



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Executive Summary

The emphasis on creating cities and buildings that take children's needs and perspectives seriously has seen a marked increase internationally. Manifested through agendas such as child-friendly environments and the rise of participatory design approaches involving adolescents and children, it highlights a shift in viewing children as active rather than passive agents in the design and creation of spaces. In parallel, the growing concerns on the built environment's impact on children's physical and mental health have contributed to the resurgence of interest in play and playful learning as a key factor in children's holistic and healthy development.

The outcome of the research project is a state-of-the-art, systematic literature review that focuses on understanding how children's play, playful learning, and creativity can be promoted and enhanced in the built environment through research-based design and the "co-creation" of urban spaces and architecture. The research – initiated and funded by CoC Playful Minds – was conducted and conceptualized by architectural and urban design researchers from the Department of Architecture, Design and Media Technology at Aalborg University.

In line with CoC Playful Minds' vision and strategies for the urban and architectural development of the city of Billund (Denmark) as the Capital of Children, this research project is a first step toward the generation of a sound knowledge base on how to better design child-friendly environments and spaces that encourage children's play, learning through play, and children's holistic development. Moreover, it considers how processes of co-creation can

assist in the pursuit of more child-friendly built environments. Accordingly, the aim of the research project was to critically explore existing scholarship on children, play, playful learning, and creativity in the built environment (i.e., architectural and urban spaces) in order to identify the state-of-the-art in research as well as examples of practice internationally.

Theoretically, the systematic literature review was conducted from two perspectives: (1) the co-creation lens and (2) the embodied cognitive science lens. The former, co-creation lens, examined existing scholarship in urban design/architecture on the co-production or co-design of spaces with children/adolescents. Here, co-creation arises in the "realm of collaboration" where different stakeholders enter together into a collaborative design process. The latter, embodied cognitive science lens, investigated existing knowledge on how the design of built spaces affects and possibly enhances children's play, learning through play, and creative skills. Here, embodied cognitive science is understood as the interdisciplinary field of research focusing on the mechanisms of human cognition, perception, emotions, memory, imagination, and experience – among others. Given its significance to this research, play is defined as a child-initiated, actively engaging, and joyful activity. The role of play is twofold: it is a sensemaking and learning process as well as a child's way of creatively transforming and engaging with the world.

Our report synthesizes the key collection of academic literature and vocabulary associated with "children in the city" and "play in the built environment" to develop a systematic understanding of: (1) the different components

associated with designer-child collaboration in the built environment as well as (2) a variety of novel approaches and methods for conceptualizing and investigating children's interactions with the built environment.

Methodologically, the systematic literature review was performed, first, by identifying a total of 83 keywords associated with the overall topic. These keywords were categorized across seven overall descriptors (co-creation, embodied cognitive science, built environment, children, play, learning, creativity) and combined in two databases (Scopus and Web of Science). Iterative testing and searching returned a total of 2333 peer-reviewed academic journal articles; this was reduced to 159 papers, after duplicates were removed and two rounds of relevance assessment performed. The 159 papers were further screened for relevant empirical cases, to analyze empirical evidence of collaborative design with children and develop a critical commentary on practice. A total of 20 cases were identified for analysis of which five (three from Australia, one from the USA, and one from UK) are put forward as exemplary cases, worthy of particular note for research and practice. Each of the five represents a unique set of practices demonstrative of "good" or "better" practice in the collaborative involvement of children in the design and creation of the built environment.

Based on the critical reading and analysis of the 159 academic papers and 20 cases, we present a series of findings that unpack the relationship between children and the built environment from the complimentary perspectives of embodied cognitive science and co-creation. Through these lenses, we posit a number of research gaps and suggestions for future investigation on the themes presented.

A key finding to emerge from the embodied cognitive science lens is that learning and play in the built environment are embodied, multi-sensory, affective, and movement-based activities. Accordingly, play and learning do not occur in isolation or exclusively in "formal play

spaces" like schools, kindergartens, or playgrounds. Instead, they are structured by all of the environments in which children live – including, what we term "informal play spaces" such as neighborhood spaces, public spaces, or city streets/squares/plazas as well as by the people they interact with such as their peers, parents, or other people around them. From an embodied cognitive science perspective, children can be best thought of as agents that actively explore and creatively engage with the built environment. In this process, play becomes a means of co-producing spaces, places, and children's own knowledge and understanding of the world around them. Therefore, the built environment can act as a pedagogical space in two ways: through children's agency and spontaneous interactions with the spatial setting as well as through carefully planned play and playful learning experiences. This also opens up the potential of placemaking through play: by transforming unexpected places in the city, such as a bus stop or a vacant lot. Through "learning landscapes" or design interventions, opportunities can be provided not only for meaningful play and playful learning, but also for children and caregivers to come together.

A second key finding also from this lens, is that the way children interact with the built environment is always relational and depends on children's skillful bodily and cognitive abilities. Accordingly, the idea of affordances is formulated to describe the environment in terms of possibilities for action – that is, what a child can do in any environment. This means that the same aspects of the built environment will provide and invite different play opportunities depending on, for example, children's age, gender, body size and bodily action capabilities, or background. Notably, children's capacity to perceive affordances for play in the built environment is not simply a passive response to predesigned play environments. Instead, it is an active engagement and often a creative transformation – through play – of the existing potentials and possibilities that the built environment offers. As a set of reviewed studies

showed, this is evidenced in the capacity of children to identify play opportunities even in spaces not specifically designed for children's movement and exploration – namely informal play spaces. In addition, there is growing support that children have a preference for open-ended and non-standardized play spaces, which allow for variation and modification, thus creating opportunities for children with a range of bodily action capabilities and for more creative play. We therefore recommend that the future task of professional practice – architects, urban designers, and planners – is to understand how to articulate and carefully design the built environment as a rich "landscape of affordances" for play.

From the latter co-creation lens, it was established that only a small, but emerging, body of literature has set out to empirically investigate co-creative design processes and practices with children. The research identified that very little conceptual consistency on the practice of co-creation involving children currently exists. Thus, determining what co-creation with children in the built environment is remains a complex procedure. We put forward that defining the co-creation strategy is of vital importance to the success of any initiative involving children. Here, careful consideration should be given to three key aspects: (1) the scale of child involvement, (2) the specificity of the purpose or outcome of the project, and (3) the duration of children's active involvement in the process. Clarity of purpose and intention is vital in communicating what is to be co-created. This transparency recognizes that complexities to involving children in built processes exist and realistic expectations as to what can be achieved need not be ignored. Here, recognizing the duration of children's active involvement in the process can enable actors to understand the importance of entrenched rather than fleeting engagement with children in collaborative design processes.

In addition to this, the review resolutely highlighted the methodological value of spatial workshops involving play to facilitate conversations and establish successful co-creation processes with children. Moreover, the strength of collaborative partnerships between one or more – built environment orientated – organizations proved vital to the success of every registered project. Both demonstrate the need to "bridge" the collaborative design process with some form of built environment expertise. The spatial skillsets of these stakeholders act as a critical "translation tool" for children's ideas to be interpreted by adults and children alike.

As a final point, the co-creation lens also revealed some important issues concerning the relationship between the physical design of the built environment and co-creative processes with children. These issues relate to the actual level of influence children have in the design process as well as the extent to which children can be involved in physical design interventions. With respect of the former, the literature highlighted that the involvement of children can sometimes be for appearance sake and political interest only. In these instances, children's voices were not actually heard or appropriately considered in the final design, but tokenistic gestures. Regarding the latter issue, consideration of the multi-layered, highly complex domain the built environment represents was not a common feature of the literature reviewed. Ultimately, the application of co-creation processes in the built environment remained detached from property and land development processes, the multiple stakeholder groups typically involved, the relations between them, and the conflicts that can ensue from differing interests, opinions, and expressions of power.

Our report presents a seminal study that, for the first time, links children, play, playful learning, and creativity with the built environment, co-creation, and embodied cognitive science. At present, this field is not yet well established, representing an emerging area of scholarship

The future task of professional practice – architects, urban designers, and planners – is to understand how to articulate and carefully design the built environment as a rich “landscape of affordances” for play.

and academic interest. While existing research on the subject holds value, connections between co-creation and embodied cognitive science in the built environment are in their infancy, thus there is a need for further testing to corroborate the outcomes of the review with additional empirical research belonging to a number of specific areas.

In light of our analysis, we recommend further empirical studies be conducted across six identified knowledge gaps, each which represents critical subjects for practice and research going forward.

Informal play spaces and the spectrum of play.

Across the literature, we identified a predominate focus on “formal play spaces” and free play as the golden standard. Studies that explored what we term “informal play spaces” were less common as were projects that placed an emphasis on different types of play. We advocate that better consideration should be given to the different contexts of children's lives, including both formal and informal play spaces, different types of play (i.e., free play, guided play, or games) as well as intergenerational needs – recognizing the positive role of adults/caregivers in children's play and playful learning.

Affordances for play in the built environment.

Despite the prominence of the affordance-based approach to play in built spaces, there is a need for better understanding of *how* and *why* particular affordances in a play environment invite or solicit playful activities for a particular child. In addition, we identified a scarcity of evidence on how children with different bodily and cognitive abilities engage with the same play affordances. We, therefore, recommend that more knowledge is required on how to design for neurodiversity and accessibility in play spaces.

The emotional aspect of play for learning and social development. Recent developments in neuroscience show that emotional processes involving the body are central to cognitive processes such as learning, memory,

decision-making, and creativity. Additionally, it has been hypothesized that play may have an important role in children's brain development via an emotional route, with implications for individuals' social behavior in later life. However, our review showed that the emotional aspect of play in the built environment is a topic which was largely overlooked. Further theoretical understanding and empirical testing are needed in this area to explore the relationship between emotional processes, children's development, and play affordances in the built environment.

Defining the co-creation strategy. Our research identified very little conceptual consistency on the practice of co-creation involving children. Common across the literature was an over-extension of the degree to which children have been involved in the process. Thus, stronger consensus on the definition and practice of co-creation is needed. We suggest that the framework presented in this report be tested empirically in a bid to move toward a more robust and rigorous appreciation of the concept and its constituent parts.

Consideration of built environment realities.

Present across the literature was an ignorance of the complex regulatory reality of built/development processes. Moreover, the “collaborative” component of the word can imply an equal involvement of all stakeholders in all parts of the design process, including the construction process. In most cases within the development industry, this is unrealistic as some actors remain more powerful than others. Future work is required to more explicitly understand how the complexities of co-creating built spaces with children are navigated by different stakeholders to highlight the potentials and pitfalls of these approaches for placemaking.

Cross-disciplinary, cross-sectoral partnerships.

The review also identified the absence of proper methods and tools for design-oriented practitioners to engage in co-creation processes with children as well as a lack of education/training in how to facilitate and engage in such

We recommend further empirical studies across six areas:

- **Informal play spaces and the spectrum of play**
- **Affordances for play in the built environment**
- **The emotional aspect of play for learning and social development**
- **Defining the co-creation strategy**
- **Consideration of built environment realities**
- **Cross-disciplinary, cross-sectoral partnerships**

processes. Similarly, a finer-grain understanding of play, playful learning, and child development is needed for built environment researchers and practitioners to be more attentive to the different types of play being addressed through design. We advocate a focus on developing cross-disciplinary, cross-sectoral perspectives that integrate and support collaborative design thinking/research with knowledge on play and playful learning, and linking specialists in play with specialists in spatial design as a way to assess the strengths and weaknesses of different strategies and outcomes of the collaborative design process.

Through these gaps, we highlight opportunities for developing stronger theoretical and empirical research on how different spaces afford and invite children's play across the play spectrum as well as how designer-child collaboration can potentially influence placemaking to more readily enable child-friendly design approaches in cities. We put forward that children can – and should – be considered as co-producers of spaces and places through play and their own practices in the built environment. Designer-child collaboration – if executed with due care and consideration – can act as the bridge and translation process to ensure that this environment is designed collectively and a rich landscape of affordances for play are provided.



**Children can –
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Reading guide

This report is structured in three main parts: introductory chapters containing key information about the research project's aims, methodology, and theoretical underpinnings (chapters 1, 2, and 3), followed by the results of the systematic review of academic literature and examples from practice (chapters 4, 5, 6, and 7), and the document closes with review conclusions and references (chapters 8 and 9).

Chapter 1. Introduction outlines the relevance and current context of the research topic, and provides a rationale behind the dual-lens approach – combining co-creation and the embodied cognitive science perspective – to understand how the built environment affects and can promote children's play, playful learning, and creativity. This is followed by **Chapter 2. Theoretical framework** where we introduce, in more detail, the two perspectives of co-creation and embodied cognitive science with definitions of the key terms: children, built environment, play, playful learning, and creativity. **Chapter 3. Methodology** provides a summary of the methodological setup of the systematic literature search and the inclusion/exclusion criteria for assessment of found sources.

After presenting the methodological considerations, chapters 4 to 7 present the results of the analysis and review of identified literature and cases of practice, divided into different sub-themes. Each chapter concludes with a summary of key ideas and findings.

Chapter 4. Children in the built environment: Research context puts forward the general framework and research background related to the issues of children's involvement and use of

urban and architectural spaces as well as the links between built environment, play, and children's health and development.

Chapter 5. Children as agents in the built environment provides an overview of current discussions on children's agency in the built environment analyzing the topics of children's appropriation of spaces and creative interaction through play. Furthermore, it critically reviews the concept of affordances for play in the built environment and the ideas of risky play and curiosity in children's engagement with their environment. **Chapter 6. Built environment as pedagogical space: Promoting children's holistic development through play** presents the current thinking on designing for play and playful learning in formal play settings such as educational spaces as well as the more recent move toward re-thinking play experiences in diverse urban settings. **Chapter 7. Review of practice: The collaborative design process with children in the built environment** discusses the different components associated with designer-child collaborations in the built environment to explicitly exemplify practices of co-creation with children in the built environment and to develop a critical commentary on their features.

After the four review chapters, **Future research and practice** summarizes the themes uncovered in the systematic review of literature and discusses the key implications of our findings highlighting the identified knowledge gaps and recommendations for future research and practice. Finally, **References** comprises the list of references resulting from the systematic search of the existing literature per lens (159 papers in total) as well as the full list of sources cited in the report.



Introduction

How does the built environment influence and support children's play, playful learning, and creativity? How can we promote play, playful learning, and creativity through the active involvement of children and adolescents in the design of urban spaces and architecture? What can we learn from the perspectives of "co-creation" and "embodied cognitive science" about children's agency in the built environment and designing for play and playful learning?

These are the questions that this state-of-the-art research project, initiated and funded by CoC Playful Minds, sought to answer through the systematic literature review, conducted and conceptualized by the architectural and urban design researchers from Aalborg University, Department of Architecture, Design and Media Technology.

In this chapter, we outline the interdisciplinary research focus and relevance of our study. Research interest on designing for play and playful learning in the built environment was found across a range of disciplines including educational and developmental sciences, play research, "co-creation" and participatory design approaches, evidence- and research-based design, and applications of embodied cognitive science knowledge to architectural and urban design domains. As a consequence of this interdisciplinary interest, our investigation adopted a dual-lens approach whereby, through the lenses of co-creation and embodied cognitive science, we attempted to understand how children's play, playful learning, and creativity can be promoted and enhanced in the built environment. Co-creation and embodied cognitive science were selected as they

incorporate elements from the wide variety of disciplines outlined above. Dedicated sections below discuss the dual-lens rationale behind our study as well as the research questions that guided the state-of-the-art systematic review.

RESEARCH FOCUS AND RELEVANCE

In preparing children and young people to be creative problem-solvers and lifelong learners, able to respond to and cope with the rapid changes and global challenges of the 21st century, a holistic approach to their learning and development is required (Hirsh-Pasek et al., 2015; Zosh et al., 2018). This has led to the resurgence of interest in how children learn through play across disciplines – ranging from pedagogy, education, developmental psychology and neuroscience – bringing forth new knowledge on the fundamental role of play in children's social, emotional, and cognitive development (Whitebread, 2018; Yogman, Garner, Hutchinson, Hirsh-Pasek, & Golinkoff, 2018). Moreover, play is increasingly recognized as a path to learning and gaining of a wide range of skills, such as critical thinking, creative innovation, communication, and collaboration (Bustamante, Hassinger-Das, Hirsh-Pasek, & Golinkoff, 2019). Consequently, a variety of pedagogical strategies and methods based on the interconnectedness of play, learning, and creativity are being developed, especially in relation to early childhood education that is strongly associated with later developmental outcomes and academic skills (Farné, 2005; Weisberg, Hirsh-Pasek, & Golinkoff, 2013).

These recognized advantages of "learning through play" together with general socio-cultural and technological changes, urbanization

rates, and rethinking of many national education policies, have also raised awareness about children's learning as occurring throughout their life settings – from school and home, through the community and public spaces, to the wider globalized world. Within architecture and urban design research, this awareness has been translated into a call for creating cities, buildings, and public spaces that take children's needs, experiences, and perspectives seriously. However, in order to do so, it is first necessary to understand the role of the built environment as a spatial context for children's lives, and what impact it has on the young dwellers as spaces for play and learning.

Therefore, in this research project, we approach this complex issue of how can we design architectural and urban spaces that support and promote playful learning and healthy child development from two complementary perspectives – the co-creation and embodied cognitive science lens. The rationale behind this dual-lens approach stems from recent research developments and emerging ways of thinking about users in the built environment, the nature of spatial experiences, and user perspectives in the design process.

On the one hand, a new field of research within architecture and urban design informed by embodied cognitive science has started bringing to light novel understanding of how the built environment influences our brains, bodies, and thus, overall psychosomatic health (Fich et al., 2014; Mallgrave, 2013, 2018; Robinson & Pallasmaa, 2015). Growing empirical and conceptual studies of embodied cognition are supporting the idea that the way we perceive, experience, learn, and think depends on the kind of body we have and the ways we interact with our physical and social environments – and therefore, architectural and urban spaces (Jelić, Tieri, De Matteis, Babiloni, & Vecchiato, 2016; Rietveld, 2016). Consequently, over the last few years there has been an increasing interest in applying embodied cognition knowledge to the design of built spaces – primarily through

research- and evidence-based design. By integrating novel research on how the built environment affects diverse user groups, these design approaches aim to refine designers' understanding of different user perspectives and improve decision-making in the design process. In the context of designing spaces for play and learning, however, the application of embodied cognitive science perspective has so far been limited. While there is a rich body of research on learning environments more generally and especially within educational settings like schools (Barrett, Davies, Zhang, & Barrett, 2015; Tse, Daniels, Stables, & Cox, 2019), these studies mainly focus on assessing the impact of spaces on learning outcomes. These outcomes are frequently measured through standardized tests, which can be criticized for being a narrow conception of learning (Biesta, 2019) compared to a more holistic view of learning through play and child development taken in this research project.

At the same time, a shift has occurred in how children are conceptualized as users and agents in the built environment and in the design process. A growing body of literature has emerged documenting children's use of the built environment (Benwell, 2013; Churchman, 2003). Their works highlight the importance of gathering the perspectives of children in the study of the built environment as well as the significance of children as active stakeholders in the design and creation of places and spaces (Leddy-Owen, Robazza, & Scherer, 2018). Consequently, within built environment studies, children have recently been re-conceptualized as active agents rather than passive objects of design and research, based on a new ethos of "working collaboratively" through "participatory design" (Harris, Jackson, Mayblin, Piekut, & Valentine, 2015). A burgeoning literature on participatory design/research involving adolescents and children in the co-design, co-creation, and co-production of spaces has since materialized. These works have begun to uncover how participatory design/research with children might be operationalized; the

possibilities for creativity and play when designing cities and spaces with children; opportunities to better understand children's use of urban spaces and architecture; as well as the use of temporary structures or installations to encourage learning and child development (Bishop & Corkery, 2017).

Taken together, these two research strands – the embodied cognitive science approach to architecture and urban design and co-creation with children – bring forth an emerging academic and professional awareness within the

built environment that children's physical and mental well-being and their holistic development are directly influenced by their surroundings. Nevertheless, while researchers from various domains are being increasingly attentive to these effects of the built spaces on children, research that explicitly identifies how children's play, playful learning, and creativity can be promoted and enhanced through the built environment via research-based design and the co-creation of urban spaces and architecture is still in its infancy.



RESEARCH AIM AND QUESTIONS

Identifying the state-of-the-art is a first step toward generating a sound research knowledge base of how to design (better) child-friendly environments and spaces that encourage children's play, learning through play, and children's holistic development. Accordingly, the aim of this project is to critically explore existing scholarship and synthesize the key collection of literature and vocabulary associated with the two lenses, as a groundwork for highlighting what is currently known about children's play and the design of the built environment as well as to identify research gaps and areas requiring further investigations.

From the embodied cognitive science perspective, the aim is to gather and synthesize current understanding of how children experience and engage with the built environment, and how the design of spaces can affect and enhance their possibilities for play and playful learning. Additionally, this report provides a systematic overview of approaches and methods for conceptualizing and investigating a child's interactions with the built environment. The purpose of this research synthesis is to indicate how to develop richer and more detailed user profiles of children and young people in built spaces as well as to begin building up a knowledge source for research-based design.

From the co-creation perspective, the aim is to examine existing literature in urban design and architecture on how the active involvement of children in the "co-production" and "co-design" of spaces can be conducted and how this can promote learning through play and creative skills. This will help to gain a systematic understanding of the different components associated with designer-child collaborations in the built environment as well as to reveal how variances in contextual factors of co-creation with children both help and hinder its usefulness to placemaking.

These research aims additionally highlight the complementary nature of the dual-lens approach to children and play in the built environment as both perspectives can enrich and mutually inform designers' approaches to designing for and with children. On the one hand, knowledge gained through research on children and/or children's participation in the design process informs designers' understanding of children and their perspectives as users of built spaces. At the same time, those insights expand knowledge and improve strategies for designing and researching with children, and thus, for taking their role seriously as important stakeholders in the built environment.

In order to address these aims and investigate existing scholarship, two key research questions were formulated, relative to the two selected lenses of co-creation and embodied cognitive science:

- How does the built environment affect children's interaction and use of spaces, and how can it help promote and enhance children and young people's play, playful learning, and creativity?
- How can the active involvement of children in the design of the built environment help promote and enhance children and young people's play, playful learning, and creativity?

The subsequent pages (20-35) discuss the dual-lens theoretical framework of the study. A summary of key concepts and definitions on children, built environment, play, playful learning, and creativity used throughout the report is also supplied. This is preceded by the methodology chapter, which outlines the main tactics used to operationalize the research (pages 36-42).

The embodied cognitive science lens asks...

“How does the built environment affect children’s interaction and use of spaces, and how can it help promote and enhance children and young people’s play, playful learning, and creativity?”

The co-creation lens asks...

“How can the active involvement of children in the design of the built environment help promote and enhance children and young people’s play, playful learning, and creativity?”

Theoretical framework

KEY TERMS

In order to operationalize the literature search and review, "working definitions" for each of the key terms: children, built environment, play, playful learning, and creativity were developed by the research team. These are defined as follows:

CHILDREN

We use the term children to refer broadly to people 0-18 years in accordance with the United Nations Convention on the Rights of the Child (UNICEF, 1989). Throughout the literature, however, definitions of children and young people vary, depending often on each country's educational system. Therefore, two general subgroups can be identified in this range: "children" roughly denotes people aged newborn to 12 years, and "young people" and "youth" refers to adolescents aged 13-18 years (although, some studies also include people up to 25 years under the term "young adult") (Figure 1). Overall, in the report, differentiation between age groups is explicitly stated as needed.

In accordance with existing scholarship on children in the built environment (Churchman, 2003), it is important to consider the implications of children's role and agency in built settings based on a variety of factors, such as children's age and developmental stage; their health status and abilities including any physical and cognitive impairments; the differences between countries and within countries; between urban and rural settlements; between public-private ownership; the influence of socio-economic and cultural factors, including the impact of cultural attitudes to children and gender; among others. Therefore, this report highlights – to the extent of available information in identified scholarship – the role of developmental, health, social, geographical, and cultural context when designing the built environment for and with children.

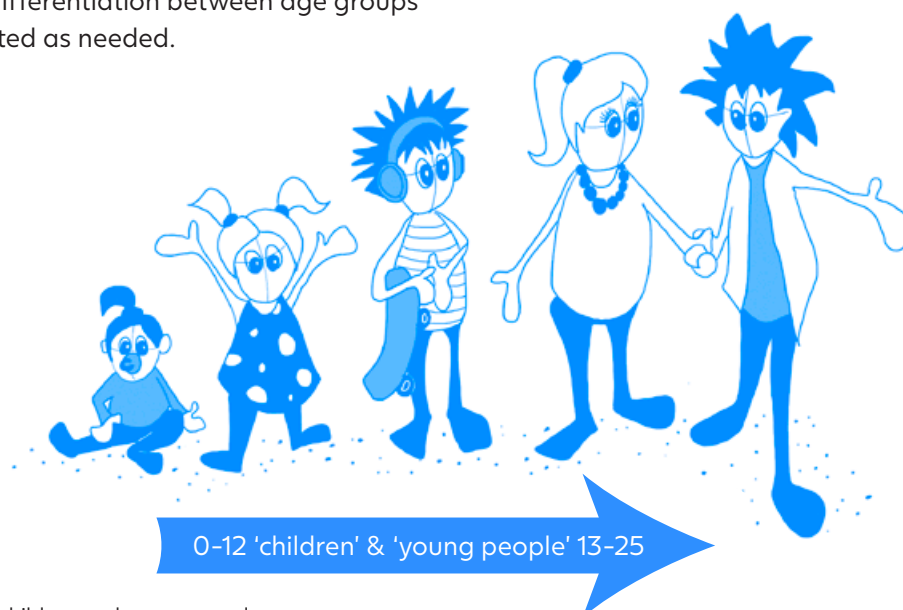


Figure 1. Defining children and young people

BUILT ENVIRONMENT

The term built environment is used as a broad term encompassing any kind of physical environment – indoor and outdoor – that is a predominantly human constructed or fabricated environment. Furthermore, by “built environment”, we mean all types of architectural and urban spaces that can be accessed by children and perceived as offering opportunities for play.

“Formal play spaces” refer to architectural and urban environments traditionally associated with children’s play and learning, including educational institutional spaces (schools and childcare facilities), designed indoor and outdoor playgrounds, parks, and recreational settings.

“Informal play spaces” on the other hand, refer to architectural and urban environments beyond these designated areas for children, which include, but are not limited to, streets, parks, malls, plazas, vacant spaces, and parking lots.

The definition of the built environment used in this report is intentionally broad in order to highlight that children’s play and learning can

– and should – be supported in a wide variety of environments; including both formal child-dedicated and institutionalized educational play spaces as well as informal play spaces, such as streets, open public spaces, and vacant lots, which form an important part of children and young people’s everyday experience of the city (Bishop & Corkery, 2017; Hassinger-Das, Bustamante, Hirsh-Pasek, & Golinkoff, 2018). Additionally, we also consider natural environments as a prominent aspect in contemporary literature on children’s play, insofar as nature is designed (e.g., parks and gardens), and part of the architectural setting or urban landscape.

In line with this broad definition, our literature search considered the built environment at various scales: urban and rural settlements, neighborhoods, streets, and local community environments, individual spaces within the city (e.g., playgrounds or public squares), parts of architectural complexes (e.g., outdoor play areas in childcare facilities) as well as temporary installations, building interiors, and design interventions in architectural and urban spaces.



Play may be understood as a child's way of simultaneously being and becoming.

PLAY, PLAYFUL LEARNING, AND CREATIVITY

Play, playful learning, and creativity are complex notions that are studied from a multi-disciplinary research perspective, integrating knowledge from disciplines such as developmental and evolutionary psychology, educational studies, neuroscience, anthropology, machine learning, and linguistics, among others (Hirsh-Pasek et al., 2015; Zosh et al., 2018). Historically, the topics of play, learning, and creativity have attracted significant attention because of their centrality in child development and education research, which resulted in a variety of definitions and conceptualizations. With that in mind, for the purposes of this project, we have adopted a view on play, learning, and creativity based on two criteria: firstly, it is appropriate for understanding how children play in the built environment, and secondly, it is a state-of-the-art research, developed by leading international play and playful learning researchers. Nevertheless, because of the multi-disciplinary complexity involved in the definitions of play, playful learning, and creativity, a more detailed explanation of these notions is beyond the scope of this report and we would like to refer interested readers to the list of referenced works.

PLAY

What is play? The five characteristics of playful activity. Despite the multiplicity of definitions in contemporary research, there is a growing shared understanding of play as a particular way of acting and engaging with the world driven by a child's own agency, which has value both for the sake of playing and for the positive effects on child development (Lester & Russell, 2010; Yogman et al., 2018; Zosh et al., 2018). In that sense, play may be understood as a child's way of simultaneously being and becoming. This has been further strengthened by evidence that play and situations when children learn best (i.e., deep learning) can be described as sharing five characteristics: actively engaging, meaningful, socially interactive, iterative, and joyful (Hassinger-Das et al., 2018; Hirsh-Pasek et al.,

2015; Zosh et al., 2018, 2017). In particular, characterizing play as joyful – i.e., involving positive affect, experience of surprise in exploration, and intrinsic motivation has been identified as a defining feature of a playful activity (Hassinger-Das et al., 2018; Hirsh-Pasek et al., 2015; Zosh et al., 2018, 2017).

What is play? Toward a nuanced definition of play as a spectrum of play opportunities. In order to address the multifaceted phenomenon of play in a way that better describes how it relates to children's holistic development and learning, a group of researchers have recently proposed to consider play as a spectrum of play opportunities ranging from free play, guided play, games to playful direct instruction (i.e., didactic instruction) (Zosh et al., 2018) (see Figure 2). For the purposes of our literature search, we have included three of these play categories, which Hassinger-Das et al. (2018) and Zosh et al. (2018) define in the following manner:

- Free play – is defined as a play activity that is fun, actively engaging, and voluntary, without adult guidance or scaffolding. Typically described as not having an extrinsic or pre-determined goal. During free play, children often engage in make-believe as well as in discovery learning and exploration with minimal constraints – the activity is child-directed and initiated by children themselves.
- Guided play – is defined as a play activity with many characteristics of free play, in particular joy and playfulness, most importantly, it is a child-directed activity. The main difference is that guided play has a targeted but implicit learning goal; thus, it is typically an activity initiated and scaffolded by an adult. During guided play, children are encouraged to explore and tinker in a constrained environment, informed by adult expertise.

- Games (with learning goals) – are considered under playful learning when they are combined with educational content, and thus, have a learning goal. They align with guided play by being adult designed and scaffolded, while still being child led. In the broad context of educational games, we are interested in games involving technology-mediated play and playful learning in the built environment.

A nuanced definition of play as a spectrum was used in this research, focusing on two aspects characterizing playful activity: child agency in play activity and the level of involvement of adults. Regarding child agency, all three play categories (free play, guided play, and games) are "child directed" (or "child led" or "child driven"). Thus, the child guides his or her own

discovery and play can take a number of different directions within the play activity context. Prioritizing child-directed activities was deemed important to maintain the "playful" aspect in play and learning as well as to align the definition of play with built environment perspectives of taking children's views and agency seriously in contrast to adult-directed activities. Regarding the level of involvement of adults in play activities, these three categories vary – from no adult guidance or support in free play to purposeful adult support and activity initiation in guided play and games. The selection was made in line with built environment research reflecting children and adults as being simultaneous users of spaces or involved together in a collaborative design process.

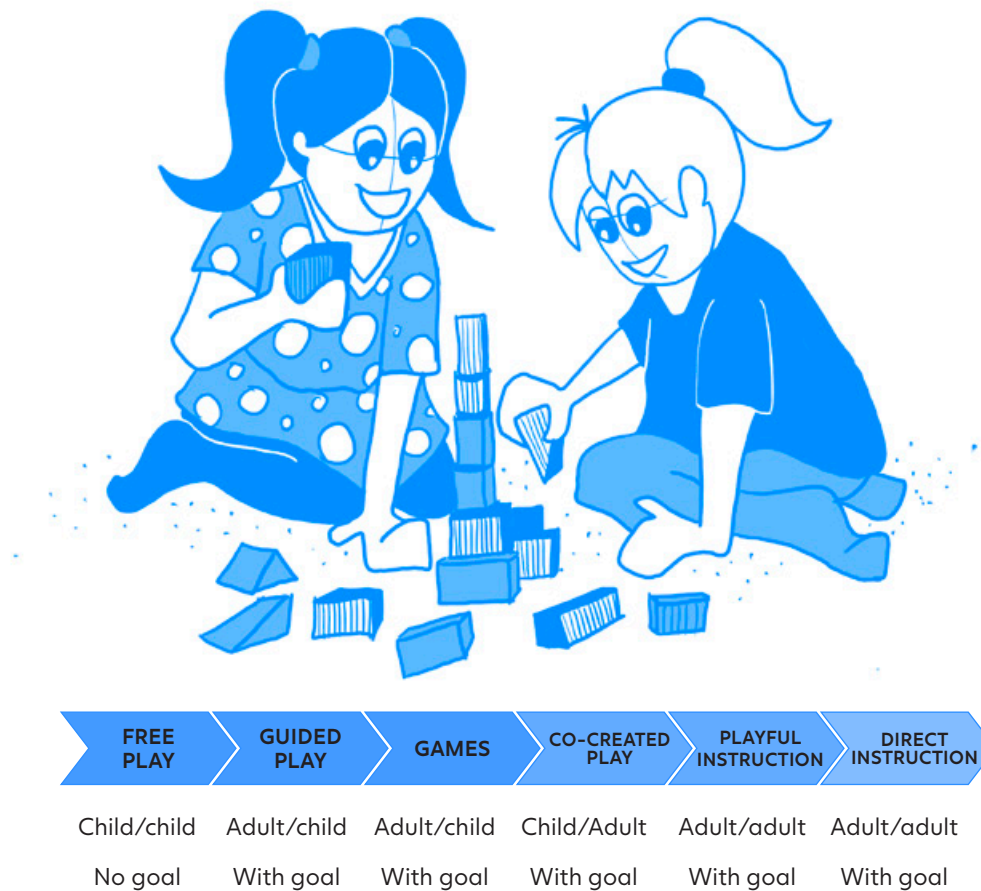


Figure 2: Different types of play inspired by the "play as spectrum"

The five types of play based on their developmental purpose and outcomes. In addition, contemporary literature on play also categorizes play activities based on their developmental purposes into five broad types: (1) physical play (includes active exercise play, rough-and-tumble, and fine-motor practice), (2) play with objects (sensorimotor play through which child explores how objects and materials feel and behave), (3) symbolic play (e.g., writing, drawing, music), (4) pretend or socio-dramatic play (involves non-literal action and representing non-real or fantastical situations), and (5) games with rules (Whitebread, Marisol Basilio, Kvalja, & Verma, 2012; Whitebread et al., 2017) (see Figure 3). It is important to highlight that different types of play will involve different ways of playing, will have different characteristics, and consequently, different developmental and learning outcomes. For example,

free play with peers like physical play of hide-and-seek will be high on joy and social interaction, and could have benefits for development of socio-emotional skills (Zosh et al., 2018).

What these different play categorizations imply for the built environment is that perhaps not all types of play can be equally supported by architectural and urban spaces. In some cases, like physical play, the structuring of the play context is more easily identified, while in the case of pretend play or games with rules, effects of spatial settings might be more indirect. However, based on our main hypothesis from the embodied cognitive science lens, the environment always has a role in the way children engage with the world through play. Our literature search was therefore open to each of these different ways of playing.



Figure 3: The five types of play based on their developmental purpose and outcomes

PLAYFUL LEARNING

The science of learning and play has produced a considerable body of work indicating a tight link between children's play and their learning and development. On the one hand, understanding of learning has been expanded over recent years beyond academic skills and content learning to a more holistic view of developing a broad set of skills that are essential to children's capacity to become lifelong learners (Parker & Thomsen, 2019; Zosh et al., 2017). These five skills for holistic child development are dynamic and interconnected, and encompass: (1) physical skills (e.g., fine and gross motor skills), (2) social skills (e.g., collaboration, communication, social regulation, etc.), (3) emotional skills (e.g., confidence, executive function, motivation, self-regulation, etc.), (4) cognitive skills (e.g., conceptual understanding, decision-making, problem-solving, etc.), and (5) creative skills (e.g., creativity, divergent thinking) (Parker & Thomsen, 2019).

Furthermore, research on infants and young children suggest that close ties between play and learning exist from their earliest moments, and that children grow and develop by exploring and engaging with the world through playful experiences (Yogman et al., 2018; Zosh et al., 2017). For this reason, contemporary literature often discusses play and learning in parallel, by introducing the concept of playful learning (also known as learning through play).

Playful learning can be defined as a broad pedagogical approach to learning that capitalizes on play as child-directed activity with or without adult support, with benefits of the five above described characteristics (e.g., joyful, socially interactive) for more effective and deeper learning experiences (Zosh et al., 2018).

Likewise, in this project, play and playful learning are considered as interrelated, and we therefore focus on activities and experiences centered on play and in connection with playful learning pedagogies implemented in the built environment. Learning approaches and pedagogies that are not explicitly play related

are beyond the scope of this project and report, as they require separate and specific investigations.

CREATIVITY

Creativity can be defined as an ability to generate ideas and artefacts that are new, surprising, and valuable, and it can be considered as a characteristic of human intelligence in general (Boden, 2013). However, creativity is a vast and multi-disciplinary research area in itself, and therefore, in the context of this research project, we wish to highlight three general aspects of creativity that feed into the discussion on how the built environment and collaborative design processes might contribute to creative thinking skills:

The idea of creativity as an everyday skill. The usual view of creativity is that of an individual genius and novel ideas changing the course of societies and history – the so-called "Big-C". Besides this view, researchers have simultaneously emphasized the everyday creativity or "little-c", which might even be pin-pointed as having an essential role in human survival (Richards, 2010; Russ & Fiorelli, 2010). Moreover, when considering creativity in children, "little-c" instances become especially significant as they highlight that children can be creative and come up with novel ideas in the context of their age and abilities (Russ & Fiorelli, 2010). In that sense, emphasis has slightly shifted from the value of creative ideas to nurturing of a creative mindset in children – i.e., as having a curious, explorative, and overall playful attitude to the world and daily challenges (Gauntlett & Thomsen, 2013).

Creativity in play and through play. Creativity researchers have been bringing forth a view that children both demonstrate and improve their creative thinking skills through different types of play. For example, by using their imagination in pretend play and play with objects, or more generally, developing through play their "combinatorial imagination" as the ability to combine elements of experience into new situations and behaviors (Russ & Fiorelli, 2010; Whitebread et al., 2012, 2017).

Creating in interaction. Also closely connected is the view that creativity arises in the interaction between individuals and culture, and that a supportive and stimulating environment is essential for creative processes (Russ & Fiorelli, 2010; Weisberg et al., 2013). Here, environment and interaction encompass everything from materials to create with to the support of other individuals as in the case of guided play and playful learning approaches, which have been found to boost creative thinking and problem-solving abilities (Weisberg et al., 2013; Whitebread et al., 2012).

In the context of this research, creativity in children can be considered as an ability to come up with an idea or solve a problem in a new way, which is meaningful at least in a small scale, and thus, provide positive affect and intrinsic motivation that can support continuing exploration, curiosity, and learning about the world. In that regard, the built environment can contribute to nurturing this creative mindset and creative thinking skills in children by encouraging play and playful learning. As well as by providing opportunities for exploration and "little-c" challenges, to be tackled individually or in collaboration with others.





Two research lenses: Co-creation and embodied cognitive science

In this section, we outline the key aspects of our dual-lens conceptual framework, developed specifically for the purposes of this research project (Figure 4). The purpose of this framework is twofold, firstly, it has been to help navigate the critical reading and systematic analysis of existing scholarship as well as to delimit the literature search and identify appropriate search terms (i.e., keywords). Secondly, in an attempt to extend beyond this report, it sought to strengthen the theoretical background of the existing scholarship and understanding of how children's play, playful learning, and creativity can be promoted and enhanced through the built environment. In doing so, we indicate a way of systematically approaching underexplored themes in this research area and present opportunities and directions for future research.

CO-CREATION LENS

The co-creation lens examines existing literature in urban design and architecture on the co-production and co-design of spaces with children and adolescents. Our conceptual framework aims to address the research question "How can the active involvement of children in the design of the built environment help promote and enhance children and young people's play, playful learning, and creativity?" Thus, in this report, the notion of co-creation is related to the design and creation of the built environment with the emphasis on how children can be active agents in co-creation processes on/in/with the built environment.

CONCEPTUALIZING CO-CREATION

Co-creation arises in a "realm of collaboration" where different stakeholders need to enter together into a collaborative process (Lee, 2008). Sanders and Stappers (2008, p. 6) define co-creation as "the creativity of designers and people not trained in design working together in the design development." Presently, the term "co-creation" remains without a precise or commonly agreed upon definition. This relates to the fact that many different professions co-create (e.g., business developers, health care practitioners, or small local communities) and that multiple interchangeable terms such as "co-design" and "co-production" also exist, the combination of

which appear to be rather indistinct in the literature (Sanders & Stappers, 2008).

The origin of co-creation is within the business environment where it highlights the relationship between firms and their consumers; focusing on how the role of the consumer has shifted in relation to the creation of consumer products. Against this background, Ramaswamy and Ozcan (2018) discuss co-creation "as enactment of interactional creation across interactive system-environments (afforded by interactive platforms) entailing agencing engagements and structuring organizations." In continuation hereof and based on an inquiry of online dictionaries, Sanders & Stappers (2008:6) describe co-creation as a very broad term referring to "any act of collective creativity i.e., creativity that is shared by two or more people" and with applications "ranging from the physical to the metaphysical and from the material to the spiritual."

In a northern European context, co-creation can be related to participatory approaches i.e., understanding users as partners in the creation process, as featured prominently in Scandinavian contexts (Sanders & Stappers, 2008). Nonetheless, some authors argue that co-creation has been employed as a mere relabeling of existing participatory practices (Tortzen, 2017).

CO-CREATION WITH CHILDREN IN THE BUILT ENVIRONMENT

Moving from co-creation in general to the more specific context of co-creating with children, the notion of co-creation might seem closer to the idea of "participatory design", which emphasizes the role of creativity in the collaborative design process. Hence, in the design of urban and architectural spaces, creativity is essential; furthermore, the creative output of the collaborative process goes well beyond the design proposal of an urban or architectural space.

By comparison to the work done with the CoC Playful Minds Research Journal 1 (2019) by Lene Tanggaard and Josefine Dilling on the topic of children and co-creation, in this state-of-the-art research, the focus is narrowed down to a specific view on collaborative processes with children related to the design and creation of the built environment. However, applying co-creation to the design of the built environment brings a distinctive set of constraints given the multi-layered and complex environment it represents. Furthermore, designing built spaces requires different platforms to transform the physical world compared to, for instance, value creation in businesses. The regulated nature of the built environment as well as the often long-winded processes to acquire building licenses and permissions can often surpass the temporal frames and capacities of collaborative efforts. Additionally, in the urban setting, the interests of multiple stakeholders (from a political and governmental point of view) need to be met and public interest be prioritized. This can often result in conflicts between different stakeholder groups (Sanders & Stappers, 2008) – of which children and young people are not immune.

Therefore, the term co-creation with emphasis on the "co-" or collaborative part of the word might be misleading, as it can imply an equal involvement of all stakeholders in all parts of the design process. This also includes the construction process which, in most cases within the building industry, does not allow equal stakeholder involvement and participation. In the past,

scholarship on participation has often described participatory processes according to the level of involvement allowed to the participant by the designer (Sanders & Stappers, 2008). This exposes the main difference of what is implied with "co-creation" in respect to "participation": the user being active, rather than being passively granted "a voice" (Sanders & Stappers, 2008).

An example worth note is that of Hart (1992), who referring to Arnstein's ladder of citizen engagement (Arnstein, 1969), developed the "children's ladder of participation". In Hart's (1992) framework, the level of involvement gradually ascends from "manipulation" at the bottom of the ladder up to "child-initiated" participation at the top. The notion of the ladder inspired extensive discussions about "pseudo" versus "genuine" participation over the past three decades (Birch, Parnell, Patsarika, & Šorn, 2017b) exposing the need to find new ways of describing participatory processes involving children (Hart, 2008). Core to this approach is dealing with the issue of power. In the context of collaboration with children, power relations between stakeholders are a principal concern (revisited at a later stage of the report).

Another way of assessing the roles of participants has been developed by Sanders and Stappers (2008). Their four levels of creativity can serve as a way to understand the different levels of the co-creation process in which non-professionals – like children and young people – can participate. As previously mentioned, the intention is to take levels of creativity as a starting point for assessing participant's role in a co-creative process, as creativity is seen as a precondition for creation (Birch, Parnell, Patsarika, & Šorn, 2017a). This derives from the abovementioned approach to co-creation as any act of collective creativity i.e., creativity that is shared by two or more people (Sanders & Stappers, 2008).

Sanders and Stappers (2008) argue that all people are creative. However, participants in a collaborative design process might take co-creating roles and become co-designers, but

**...facilitators
should meet the
participants on
their level of
creativity and
support them
according to
their needs.**

only under the premise that participants enter with a certain level of creativity. Sanders and Stappers (2008) define creativity as doing, adapting, making, and creating:

- Doing – is motivated by productivity and has the purpose of "getting something done".
- Adapting – is motivated by appropriation and has the purpose of "making things my own way".
- Making – is motivated by asserting one's ability or skills and has the purpose of making something with one's own hands.
- Creating – is motivated by inspiration and has the purpose of expressing one's creativity.

Accordingly, the level of creativity shown by the participants depends on their interest, expertise, and passion. Sanders and Stappers (2008) advocate that facilitators should meet the participants on their level of creativity and support them according to their needs. In this light, co-creation in the context of co-designing the built environment can be described as a collaborative act. A collaborative act carried out by a diverse group of individuals, gathering with the common goal to create an object in a spatial context. Consequently, the central feature of co-creation is the pool of knowledge generated

by the encounter of people with different knowledge bases, which can encourage innovation as well as solutions to complex issues (see figure 4).

From the above, it becomes evident that co-creation and collaborative processes vary according to geographical locations, the aim of the building project, and the various stakeholders involved. Therefore, it is important to understand co-creation in relation to its context while remaining sensitive to the influences of power-relations, changing economics, and political agendas. This is especially true in the case of designing the built environment, city spaces, architectural edifices, or other constructed settings, which are multi-layered and complex. Ultimately, those directly involved in the collaborative process are also the individuals deciding over outcomes and procedures. Therefore, part of the process is the selection and curation of the involved stakeholder groups, who form the basis to deliver creative outputs. Hence, in the context of children, their age and their abilities influence the activities and perspectives that can be included in co-creation processes. This requires developing methods that fit the sensitivity and complexity of co-creation with children.

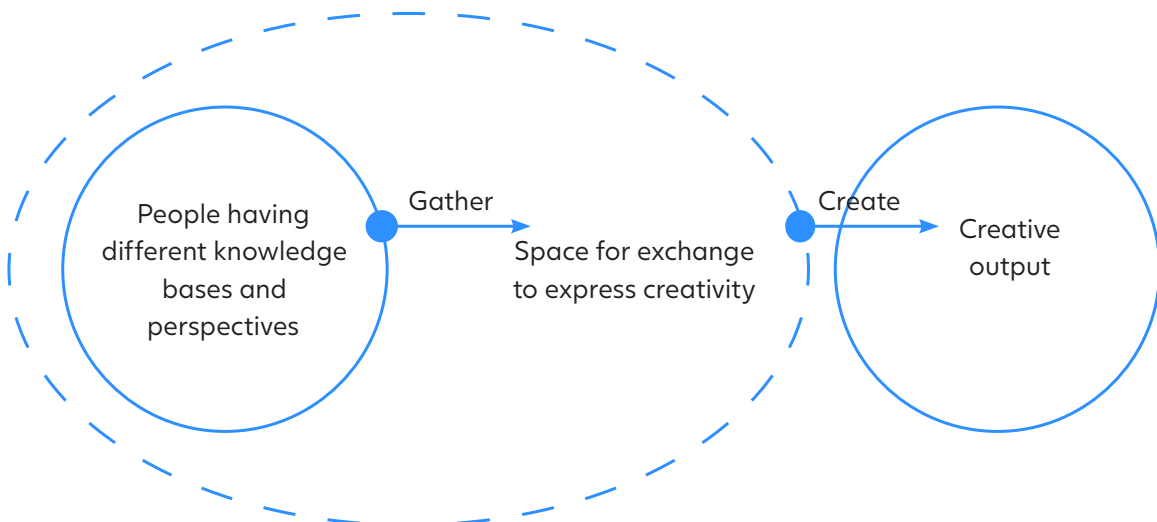


Figure 4: Components of co-creation



EMBODIED COGNITIVE SCIENCE LENS

The embodied cognitive science lens examines existing academic literature in architecture and urban design on children's play and holistic development through play in the built environment; therefore, our conceptual framework aims to address the research question "How does the built environment affect children's interaction and use of spaces, and how can it help promote and enhance children and young people's play, playful learning, and creativity." Embodied cognitive science is, generally speaking, a multi-disciplinary and interdisciplinary field of research focusing on the nature and mechanisms of human cognition and consciousness, including phenomena of perception, emotion, experience, memory, imagination, and language among others (Shapiro, 2014). It encompasses a range of disciplines such as cognitive neuroscience, philosophy of mind, and psychology, with extension to the fields of child development, education, and pedagogy as reflected in the novel research areas of "educational neuroscience" (Ansari, Coch, & De Smedt, 2011; Osgood-Campbell, 2015) and "embodied learning" (Fugate, Macrine, & Cipriano, 2018; Skulmowski & Rey, 2018).

For the purposes of this research project and the context of built environment and children's play research, we have developed the embodied

cognitive science framework. This framework is based on a prominent research strand within the broader field of contemporary cognitive science: the so-called enactive-embodied cognition theory (S. Gallagher, 2017; Varela, Thompson, & Rosch, 1991) with its emerging applications to architecture i.e., the enactive approach to architectural experience (Jelić et al., 2016) as well as the role of embodiment in learning and play (Fugate et al., 2018; Hassinger-Das et al., 2018; Osgood-Campbell, 2015; Skulmowski & Rey, 2018). For simplicity, however, the report employs the term "embodied cognitive science" to refer to this project-targeted framework, intertwining enactive-embodied approaches to cognition, architectural experience, and learning and play.

HOW ARE EMBODIMENT, LEARNING, PLAY, AND BUILT ENVIRONMENT RELATED?

Body-brain-environment interactions as basis of knowledge and experience: The central idea within embodied cognitive science is that the (built) environment in which we live and act, has a fundamental and constitutive role in the structuring of our cognitive abilities on account of continuous body-environment interactions (S. Gallagher, 2017; Albert Newen, De Bruin, & Gallagher, 2018; Varela et al., 1991). Moreover, the embodied cognition theory highlights that our perception, thinking, and experience of the world are not just something that happens in the head (i.e., in the brain and mind). Instead, the body as a whole – with all its neural

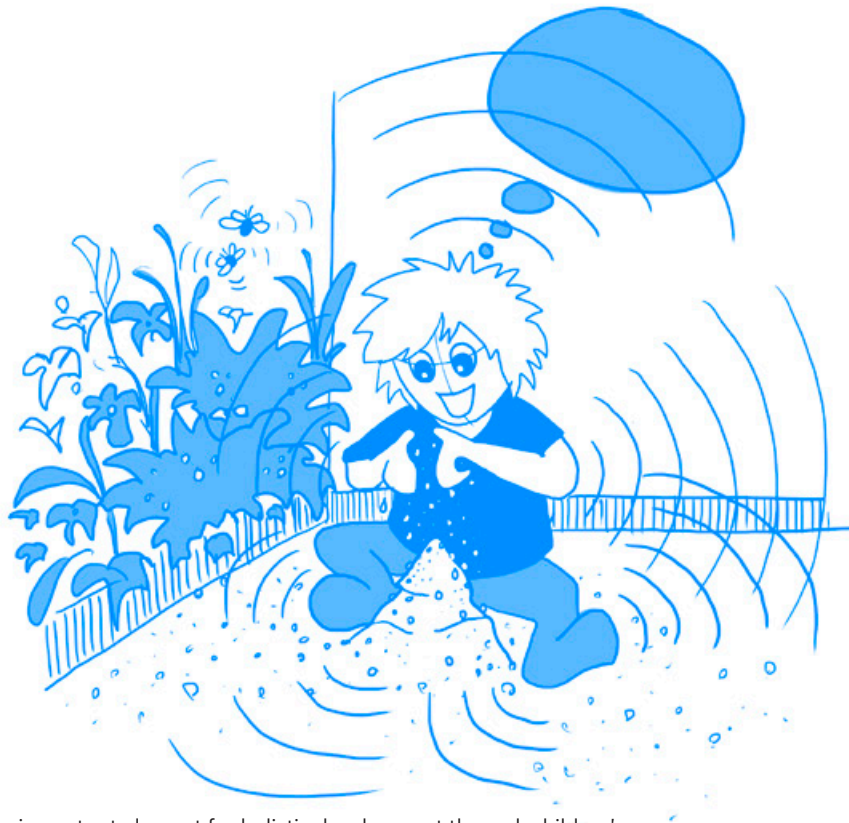


Figure 5: Play as an important element for holistic development through children's engagement and actions in their physical, social, and cultural environments

and physiological systems, including the brain, heart, senses, muscles and joints, hormonal and chemical processes – determines the way we perceive, understand, and engage with the environment (Colombetti, 2014; S. Gallagher, 2017).

For this reason, the "embodied learning" theory argues that the brain is not the exclusive organ of education and that instead, the body plays a fundamental role in learning because humans – and young children especially – come to understand the world through their bodily interactions with it (Osgood-Campbell, 2015; Skulmowski & Rey, 2018; Stolz, 2015). Similarly, play can be conceived as a mind-and-body interaction with the world, whether the primary focus is physical play like hide-and-seek, which entails explicit bodily engagement, or children being involved in pretend play and using elements in the environment as an imaginary "home" (see Figure 5).

Cognitive and learning processes are influenced by emotions: In addition, it is important to highlight that because cognition is shaped and influenced through all the bodily systems, from neural and sensorimotor to physiological, cognition is always

affective. What this means is that all our cognitive processes are "colored" by emotion; the emotional system allows us to make sense of the world by imparting value and meaning to the body-environment interactions (Colombetti, 2014; Thompson & Stapleton, 2009). Emotions are, therefore, considered as our basic form of decision-making because they optimize our survival both at the level of biological organism functioning and within our culture by managing social interactions and relationships (Damasio, 1994, 2010). This intertwining of emotion and thought is especially relevant in the context of play, learning, and education because emotions help us to construct knowledge and to make decisions on how to act and think in socially and culturally relevant and appropriate ways (Immordino-Yang, 2011; Immordino-Yang & Damasio, 2007).

Cognition, play, and learning are shaped by social, cultural, and physical context:

Consequently, the relevance of the social, cultural – and importantly for this research – physical context of all our cognitive processes cannot be underestimated. Because we are always embedded and situated in the world, cognition is

essentially social and influenced by intersubjective interactions with others, and moreover, cognition depends on the spatial, temporal, and cultural context (S. Gallagher, 2017; van Dijk & Rietveld, 2017). Accordingly, play and learning are not just something that happens in a vacuum, but they are structured by the environments children live and play in as well as by peers, parents, and other people around them (Bustamante et al., 2019; Immordino-Yang & Damasio, 2007).

The concept of affordances from the perspective of embodied cognitive science: The notion of affordances is an important concept within the enactive-embodied cognition theory, and as discovered through this review of literature, it is notably present within the discussion on children and play in the built environment. For this reason, we introduce this concept in more detail to clarify our position in the systematic review of existing scholarship.

In short, recent research defines affordances as possibilities for action, dependent on the relations between aspects of the sociomaterial environment and the abilities available in the human form of life (Rietveld, Denys, & Van Westen, 2018; Rietveld & Kiverstein, 2014; van Dijk & Rietveld, 2017). There are several elements in this definition, which should be highlighted. First, the "possibilities for action" here refer to a rich spectrum of human physical and intellectual abilities and skills – from possibilities for movement and motor skills like grasping, to possibilities for creative imagination and social interaction, among others. Therefore, this rich spectrum of abilities is what is intended by the "human form of life". It implies that affordances are determined by the variety of practices and abilities that characterize human species and culture as a whole e.g., socio-cultural practices and behavior patterns, play, creative thinking, the biological properties of human bodies, etc.

Next, the "aspects of the sociomaterial environment" imply that the affordances provided by the environment are always related to both the socio-cultural practices and the features of the

physical environment. Therefore, affordances within the built environment are always physical, social, and cultural at the same time. Last but not least, defining affordances as possibilities for action that are dependent on the relations between aspects of the environment and abilities available means that while a rich "landscape of affordances" exists for humans as a species, what specific affordances will be available to a particular individual at any moment in time will depend on his/her abilities, needs, and preferences (Rietveld et al., 2018; Rietveld & Kiverstein, 2014; van Dijk & Rietveld, 2017).

In sum, this definition of affordances is firmly grounded in the classical understanding of the concept within the field of ecological psychology (Gibson, 1986). But at the same time, it raises awareness of the dominant assumption in contemporary literature, especially within built environment research, that limits affordances primarily to motor actions e.g., locomotion (climbing, walking) and manual behaviors (e.g., grasping, reaching) (Rietveld & Kiverstein, 2014). This is particularly relevant when it comes to the possibilities provided by the built environment for play and learning.

In the context of research on children, play, and playful learning, this enriched definition of affordances enables us to begin distinguishing how same aspects of the environment can afford different possibilities for action for e.g., adults compared to children as well as between children of different ages, cognitive and physical abilities, gender, cultural backgrounds, etc. Importantly, this should not be understood as imposing limitations to affordances available to an individual or a particular group. Instead, it is about highlighting the creative ways of exploiting the existing potentialities the environment already offers, and possibly transforming them into new combinations and new affordances – whether for an individual, a group, or whole of human culture (Rietveld & Kiverstein, 2014; Rietveld, Rietveld, Mackic, Waalwijk Van Doorn, & Bervoets, 2015). This open-endedness of affordances is what underpins creative thinking, innovation, and problem-solving skills.

... play and learning are not just something that happens in a vacuum, but they are structured by the environments children live and play in as well as by peers, parents, and other people around them

IMPLICATIONS OF EMBODIED COGNITIVE SCIENCE FOR UNDERSTANDING CHILDREN'S PLAY, PLAYFUL LEARNING, AND THE EXPERIENCE OF THE BUILT ENVIRONMENT:

In the context of architecture and urban design, embodiment implies that:

- Our ability to experience, think, and therefore – learn and know – is grounded in the bodily interactions with the environment. This indicates that built spaces shape children's cognition and learning processes at the unconscious and pre-reflective levels, and thus have a profound impact on their overall psychosomatic health and behavior.
- These interactions are determined and guided by children's bodies, skillful abilities, emotional states, as well by the social, cultural, and physical context. Thus, the way children interact with the built environment is influenced by both biology and culture.
- Accordingly, we understand the built environment (i.e., architectural and urban spaces) as providing a rich landscape of affordances for living, and in particular, as providing a rich landscape of affordances to children for play and playful learning.
- Affordances for play and learning in the built environment are relational resources available to children based on their skillful abilities, as determined by age, development stage, culture, and gender among other factors.
- Affordances are, by definition, open-ended because they are related to available skillful abilities. Thus, they provide possibilities for development of physical, social, emotional, cognitive, and creative skills i.e., the holistic child development.
- The task of architects and urban designers can be understood as the articulation and careful design of the built environment as a landscape of affordances.
- When designing for children's play, learning, and creativity it is important to be attentive to the rich landscape of affordances available. For example, formal and informal play spaces differ in the degree to which there are intentionally designed affordances for play. Yet, they may contain a multiplicity of open possibilities for action and play, which designers provide even unknowingly.

Methodology

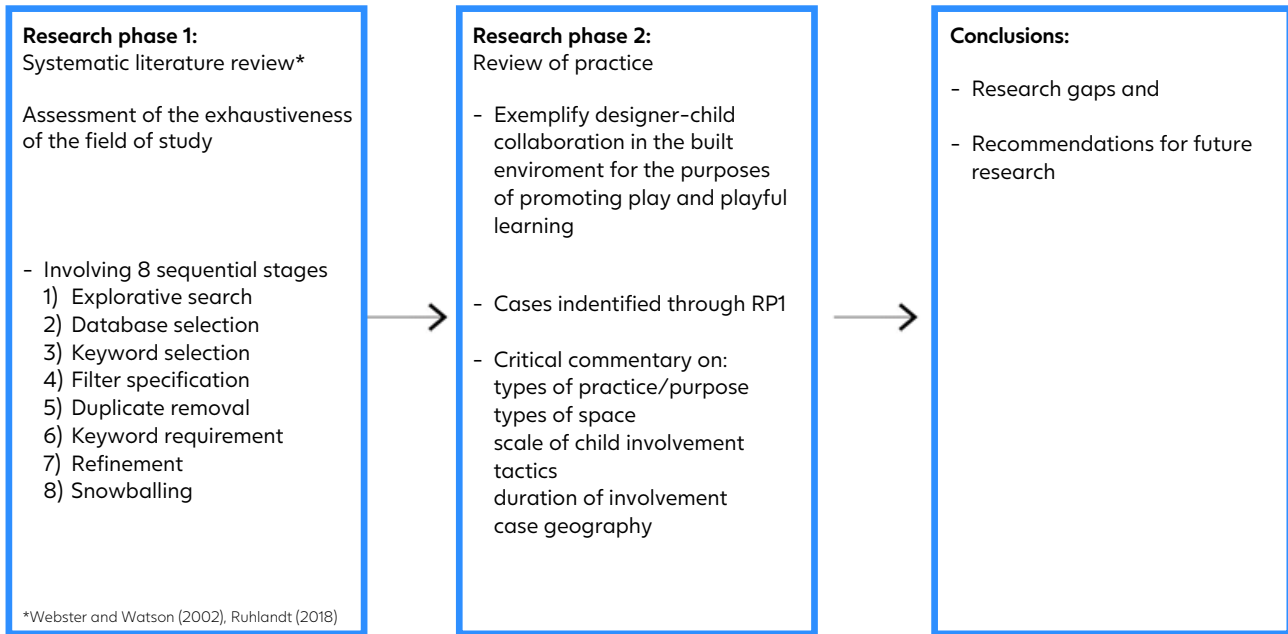


Figure 6: Progression of research methodology and intended results

In this chapter, the principles outlined in the introduction are operationalized in a two-stage methodology. To address the two identified research questions and in tandem with the aim of the study, a strategic, systematic search of literature was conducted – carried out over the period from November 2018 to January 2019. In reviewing and synthesizing existing scholarship to identify the state-of-the-art across five separate and, in some ways, disparate research categories (children in the city, built environment, play, playful learning, and creativity) and two lenses (embodied cognitive science, co-creation), a strict selection strategy was deployed (see Table 1). In line with time and resource availability, the presented two-phase methodology was deemed the most efficient and appropriate way to operationalize the study (Figure 6).

Each research phase was developed to return explicit results on children's agency and designer-child collaboration in the built environment relating to (1) the exhaustiveness of the field of study involving play, playful learning, and creativity and (2) exemplifying practice through a review of published empirical cases. The combination identified a variety of relevant research topics (see chapters 4, 5, 6, and 7) and research gaps and avenues for future research, which are put forward in chapter 8. The subsequent paragraphs outline the main mechanisms associated with the two phases of the methodology.

RESEARCH PHASE 1: SYSTEMATIC LITERATURE REVIEW

Research phase 1 had the purpose of identifying the exhaustiveness of the field of study. With some similarity to Webster and Watson (2002) as well as Ruhlandt (2018), the systematic literature review was defined through the usage of a

comprehensive search that scanned the relevant body/bodies of literature with clearly stated and comprehensible search choices and selection criteria (Table 1). The development of the corresponding search record makes reproduction and assessment of the exhaustiveness of the field of study possible, such that the intended

readership can more confidently (re)use the results for their own research or practice. Therefore, the review sought to avoid any possibility of partiality or prejudice that may potentially emerge if unrevealed or undefined criteria are used for the selection of the literature.

Table 1. Selection stages of the literature search (edited by authors, drawing on Ruhlandt (2018) and Wolfswinkel et al. (2013))

Stage	Procedure	Instructions and guidance	Targeted objective
1	Explorative search	Explorative search of literature to identify possible/relevant keywords and keyword combinations.	Ensure a robust baseline of 'keywords' is established by exploring a subset of the literature related to the main themes (20 articles).
2	Select databases	Examine search to a selection of different databases (e.g., Google Scholar, Web of Science, and/or Scopus).	Narrow the search to the most relevant database for the topic (selected Web of Science and Scopus).
3	Choose keywords	Search for articles that include specific keywords in title or abstract (e.g., collaboration design and playful learning).	Single out the suitable literature for the research topic (83 keywords across seven descriptors, see also Figure 8).
4	Specify filter type	Confine filtering to certain type(s) of journal articles, here, given time/resource restraints, peer-reviewed journals only were prioritized (e.g., Journal of CoDesign or Children's Geographies).	Safeguard the overall significance and appropriateness of the research (2333 results).
5	Remove duplicates	Remove journal articles that emerge in multiple instances.	Exclude articles since duplicates do not provide additional value (711 duplicates removed)
6	Require keywords	Require that all keywords occur at least once in the full body of the article.	Guarantee significant usefulness and pertinence (1307 papers removed).
7	Refine based on full text	Read abstract, introduction, and conclusion of all articles to exclude potential false positives.	Dismiss journal articles that lack a significant association or connection to the overall review topic (132 papers removed).
8	Add forward/backward citations	Add further relevant articles through forward and backward citation tracing (snowballing method).	Include seminal literary works that have not been a part of the selected databases (24 papers added, final result 159 papers).

Initially, the methodology was employed in the academic fields of architecture and urban design, with specific focus on the lenses of embodied cognitive science and co-creation, but spread to encompass a broad variety of academic disciplines. In doing so, the academic field of inquiry was not deemed to be of the most vital significance, rather, the review sought to incorporate any scholarship that matched the predetermined keywords associated with the seven descriptors. Nonetheless, continuous analysis, synthesis, and filtration of the gathered material occurred, thus ensuring that only the most meaningful literature, relevant to the foci of the review, remained.

RESULTS OF THE SYSTEMATIC SEARCH

Across the seven descriptors associated with the review (co-creation, embodied cognitive science, built environment, children, play, playful learning, creativity), a total of 83 keywords was identified to coordinate the search (Figure 7). A subset of 20 articles on similar topics was used to stratify the possible keyword combinations in different databases. This explorative phase enabled decisions to be made on the most effective literature databases to be used for the study. Due to the multiple lenses and foci of the review, databases that could combine synonyms and

combinations of keywords into singular "block" search queries were prioritized. An illustrative example of a block search is provided:

- Search
- Topic 1: "co design" OR "user involvement" OR "co-creation"
- Topic 2: AND "public spaces" OR "built space" OR "built environment"
- Topic 3: AND "child*" OR "adolescent"
- Topic 4: AND "free play" OR "outdoor play"
- Topic 5: AND "playful learning" OR "embodied learning"
- Topic 6: AND "creativity"
- Topic 7: AND "embodied cognition" OR "affordance" OR "embodied experience"
- Timespan: 1900 – 2019.

Two interfaces were subsequently selected, Scopus and Web of Science. Iterative testing and searching conducted from November 15 to December 31, 2018 (cut-off date) returned a total of 2333 peer-reviewed academic journal articles, 1372 from Scopus and 961 from Web of Science. This was reduced to 1622 articles once all duplicates had been removed (see Figure 8). Two relevance assessment stages were initiated to



Figure 7: Keyword blocks and examples

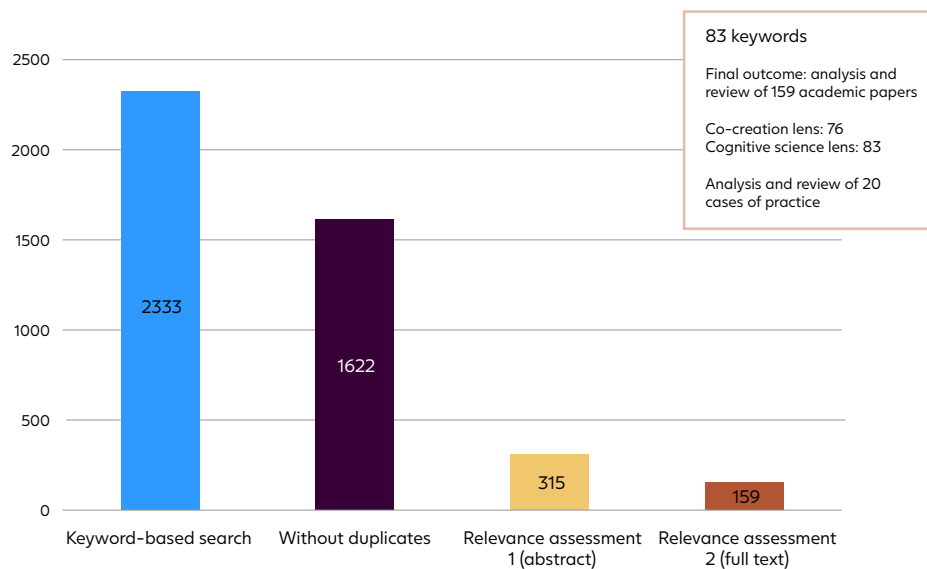


Figure 8: Summary of literature search results

ensure, first, that all keywords occurred at least once in the body of the text (1307 articles removed), and second, that upon reading the abstract, introduction, and conclusion of the paper, a significant association or connection to the overall purpose of the review could be clearly determined (132 articles removed). Finally, snowballing to include seminal works that had not been part of the database selection were added (24 articles). This resulted in an end output of 159 papers for analysis and review, 76 associated with the co-creation lens and 83 with the cognitive science lens (Figure 8). The full list of literature identified in the systematic search for each lens can be found in the references.

Using the outcomes of research phase 1, research phase 2 sought to develop a critical commentary on practice. In doing so, the 159 papers from RP1 were screened for relevant cases, the subsequent section elaborates on this process.

RESEARCH PHASE 2: REVIEW OF PRACTICE

In contrast to phase 1, the purpose of which was to provide the state-of-the-art in existing scholarship, phase 2 was introduced in a bid to exemplify practice through a review of published empirical cases. The intention of this phase was

to provide examples of designer-child collaboration in the built environment that promote play, playful learning and creativity. To that end, cases identified through the results of phase 1 were reviewed and their relevance to designer-child collaboration in the built environment for the purposes of either/or a combination of – (1) play, (2) playful learning, or (3) creativity were identified. In doing so, the second phase of the study develops a critical commentary on practices of co-creation with children in the built environment, analyzing their features.

Seven variables were deemed to be of particular interest in analyzing and reviewing practice. To develop a baseline understanding of empirical examples and in order to determine the opportunities offered by previous cases, the review focused on: the geography of cases; the scale of children's involvement in recorded practices; the purpose of each collaborative process; the tactics employed to engage children; the types of space on which the process focused; the duration of children's involvement; and the participants/facilitators involved (Table 2).

Table 2. Derivation of variables/categories for analyzing and reviewing empirical cases of collaborative design with children in the built environment

Variable	Derivation
Case (geography)	Refers to the empirical example of co-creation in the built environment with children discussed within the paper. Here, academic papers from the co-creation lens associated with phase 1 of the research were reviewed to identify cases that reflect or feature the key descriptors associated with the state-of-the-art review, including: collaborative design with children as well as creative play and learning.
Scale of involvement	Refers to the type of participation in the design, development, and construction process that children were actively involved in (e.g., generation of design ideas only vs. formulation of a design proposal with on-site surveys and construction).
Purpose	Refers to the intended output/outcome of the collaborative process.
Tactics	Outlines the methods adopted to achieve the intended purpose. Here, the scale of involvement must be taken into consideration as the methods employed may only involve children as collaborative designers up until a specific point.
Type of space	Defined via the distinction between architectural and urban project scales/environments. Architectural project scales/environments refer to school buildings, school playgrounds, or youth centers, whereas, urban projects scales/environments refer to the collaborative redesign of neighborhood spaces, public spaces, or city streets/squares.
Duration of involvement	The amount of time children were actively involved in the process of co-creating the intended output (e.g., 2 hours, 3 months, or 1 year).
Participants	Refers to the children engaged in the design process and their facilitators (e.g., primary school children facilitated by teachers and university students).

Through these variables and their associated categories, the analysis attempts to show how practices of co-creation converge and contrast across different contexts and spaces in the built environment. This is presented in the form of a map, summary table, and discussion on the patterns identified (see chapter 7).

RESULTS OF THE REVIEW OF PRACTICE

In collecting empirical cases of collaborative design with children in the built environment, only the papers associated with the co-creation lens matched the selection criteria associated with phase 2 of the research. Despite the inclusion of multiple types of built environment spaces (including public spaces, outdoor play areas, and natural environments), the emphasis of the cognitive science literature did not

explicitly focus on the collaborative design process with children or the re-design of specific spaces with children. Thus, of the 159 papers from phase 1, only 76 (co-creation lens) were reviewed for relevant cases of practice. Following screening, 20 papers with explicit cases that matched the assessment criteria were identified (namely, those with empirical evidence of collaborative design with children in the built environment featuring either play, playful learning, or creativity). Multiple accounts outside of the selected papers featured small, demonstrative examples; however, the level of breadth was not satisfactory for a consistent, comparable analysis across the seven variables associated with the review of practice (see Table 2). A summary of the selected papers including their source, case context, and title are provided (Table 3).

Table 3. Review of practice: Selected papers

Reference	Case Context	Paper Title
Şahin and Türkün Dostoğlu (2012)	Turkey, Nilüfer	The importance of pre-schoolers' experience in kindergarten design
Lozanovska and Leilei (2013)	Australia, Melbourne	Children and university architecture students working together: A pedagogical model of children's participation in architectural design
Häkikilä et al. (2013)	Finland, Oulu	Co-creating a digital 3D city with children
Christidou et al. (2013)	Greece, Athens	Exploring primary children's views and experiences of the school ground: The case of a Greek school
Magnussen and Elming (2015)	Denmark, Copenhagen	Cities at play: Children's redesign of deprived neighborhoods in Minecraft
Xu and Izadpanahi (2016)	Australia, Geelong	Creative architectural design with children: A collaborative design project informed by Rhodes's theory
McGlone (2016)	Australia, Melbourne	Pop-Up kids: Exploring children's experience of temporary public space
Zhou et al. (2016)	China, Yantai	Using web-based participatory mapping to investigate children's perceptions and the spatial distribution of outdoor play places
Malone (2017)	Australia, Sydney	Child friendly cities: A model of planning for sustainable development
Robbé (2017)	Australia, Sydney	Designing with children: A practitioner's perspective
Dimoulas (2017)	Australia, Tamworth	At the 'center': Young people's involvement in youth centers from design to usage
Million (2017)	Germany, Aachen	Preparing children and young people for participation in planning and design: The practice of built environment education in Germany
Polyzou et al. (2017)	Greece, Drama	Children's evaluation of a computer-based technology used as a tool to communicate their ideas for the redevelopment of their schoolyard
Katoppo and Valencia (2017)	Indonesia, Tangerang	Empower the future: The inside story of building creative space for suburban Kampong's children
Scholten et al. (2017)	Netherlands, Amsterdam	Geocraft as a means to support the development of smart cities, getting the people of the place involved - youth included

Mintzer and Flanders Cushing (2017)	USA, Boulder	Engaging children and adolescents in local decision-making: Growing Up Boulder as a practical model
Leddy-Owen et al. (2018)	England, Portsmouth	Participatory design, temporary structures and the appropriation of urban space by marginalized youth: The problem of the Odd Triangle
Menconi and Grohmann (2018)	Italy, Perugia	Participatory retrofitting of school playgrounds: Collaboration between children and university students to develop a vision
Itenge-Wheeler et al. (2018)	Namibia, Windhoek	Child designers creating Personas to diversify design perspectives and concepts for their own Technology Enhanced Library
Reiersølmoen et al. (2018)	Norway, Trondheim	DELTA: Promoting young people participation in urban planning

This chapter has outlined the main components associated with the methodology, detailing the intended purpose of the two-phase research strategy and the acquired results. The subsequent chapters unpack the analytical outcomes of the systematic literature search and the review of practice, proceeding with a discussion of children in the built environment (chapter 4), their agency and different ways of conceptualizing

child-environment interaction (chapter 5), followed by the potentials of the built environment as a pedagogical space for children's holistic development (chapter 6). Chapters 4-6, are then complemented with a review of practical examples of collaborative design processes with children in the built environment (chapter 7).



Children in the built environment: Research context

The question posited by this literature review of how children's play, playful learning, and creativity can be promoted and enhanced through the built environment is situated in the broader research context of why play and playful learning matters in children's lives. Moreover, why children and their agency matter in the realm of architecture, urban design, and planning. The existing scholarship discussing these "whys" is extensive and multi-disciplinary, and therefore, a detailed exploration and overview of such wealth of research was beyond the scope of the present research project. Nevertheless, in order to position the literature review findings within this broader research context on children's play and children in the built environment, the aim of this chapter is to highlight two key ideas that are of particular relevance. Concretely, based on the dual-lens approach of co-creation and embodied cognitive science, our explorative and systematic literature search identified two closely related themes: (1) children's right to play and (2) children's right to the city.

On the one hand, children's right to play is considered here from a public health and educational perspective in line with the burgeoning evidence across different disciplines on the vital role of play in healthy child development. On the other hand, children's right to the city is considered as a multidimensional issue of conceptualizing children and childhood within architecture and urban design domains. Notably, this entails recognizing children as important stakeholders in the built environment, whose voices and perspectives should be

included in the design and creation of spaces. Accordingly, we position our literature review at the intersection of these two themes by examining the role of the built environment as the "rightful" setting of children's lives that supports their right to play. Additionally, we examine how recognizing children as active citizens and their needs for play potentially contributes to creating healthier and more inclusive environments.

CHILDREN'S RIGHT TO PLAY: A PUBLIC HEALTH PERSPECTIVE

The children's right to play is part of a long-standing call for providing children with time and spatial resources to engage in play, leisure, recreational, cultural, and art activities appropriate to the age of the child, as it was formally defined in the United Nations Convention on the Rights of the Child (UNCRC) (UNICEF, 1989, Article 31). More recently, the emphasis on children's right to play has gained strength through the growing recognition of the importance of play for child's health and holistic development (Lester & Russell, 2010; Whitebread, 2018; Whitebread et al., 2012). This wide interest in play and playful approaches to learning, across research fields, appeared in part as a response to an observed decline in children's health over the last few decades. Including among others, the increase of childhood obesity, diabetes, and mental health problems, like anxiety, depression, attention and conduct disorders (Gray, 2011; Immordino-Yang & Damasio, 2007; Whitebread, 2017; Yogman et al., 2018).

On the one hand, these physical and mental health issues have been linked with the inadequate amount of physical activity in children. A number of studies have examined the potential of physical or active play interventions to promote and increase children's physical activity in a variety of settings, including playgrounds, outdoor play environments, and indoor play in early childhood care centers, among others (K. E. Henderson, Grode, O'Connell, & Schwartz, 2015; Johnstone, Hughes, Martin, & Reilly, 2018). Evidence suggests that active play has indeed the potential to contribute to children's daily physical activity needs as well as to the development of fundamental motor skills (Adams, Veitch, & Barnett, 2018; Johnstone et al., 2018; Tortella, Haga, Loras, Sigmundsson, & Fumagalli, 2016).

On the other hand, one of the dominant hypotheses in the literature is that the increase of mental health issues among children – in the western world at least – is related to the decline in children's opportunities for play, especially with other children, due to the shrinking of spaces and time available for free play (Gray, 2011; Whitebread, 2017). According to Gray (2011), children's free play, in particular outdoor play with other children, has declined sharply since mid-twentieth century in the United States. In the same period, measures of psychopathology in children and adolescents – including anxiety, depression, feelings of helplessness, and narcissism – has steadily increased. Therefore, Gray (2011) argues that there might be a link between reduction of time spent playing as children and the increase in mental health issues in late primary school, high school, and college. Similarly, a 2016 report by Public Health England estimated that close to 10% of all children aged 5-16 in England had a clinically significant mental health illness, including conditions like anxiety, depression, conduct disorders, self-harm, and suicidal feelings (Whitebread, 2017). In parallel, it has been documented in UK that the area where children are allowed to roam unsupervised around their homes has shrunk by 90% since the 1970s, and that overall opportunities for free play

have been affected by increased focus on school readiness and academic skills (Whitebread, 2017).

IMPACT OF PLAY ON BRAIN AND HOLISTIC SKILLS DEVELOPMENT

Conclusive and causal evidence is yet to come about the full effects of play on children's physical and mental health as well as the mechanisms by which play may affect their learning and development (Liu et al., 2017; Whitebread, 2018). Nonetheless, there are clear indications that play, especially in early childhood, is critical for brain development and consequently, for development of a range of skills, including physical, social, and emotional skills (Liu et al., 2017; Whitebread et al., 2017; Yogman et al., 2018). What we know today about the neural mechanisms of play and learning comes primarily from adult and animal studies. While these findings have, of course, their inherent limitations to direct applicability to children, both adult and animal studies have so far provided a rich pool of inspiration and a valid starting point for investigating the effects of play on children's brain development (Immordino-Yang & Damasio, 2007; Liu et al., 2017).

The main insight coming from animal experiments is that play supports learning because it is motivating, and moreover, because it trains and enhances efficiency of key areas of the brain. For example, play deprivation studies with rats demonstrated that rats which did not have the opportunity for social play as juveniles (e.g., through rough-and-tumble play), have an immature prefrontal cortex (PFC) as adults (Pellis, Pellis, & Bell, 2010). The significance lies in the fact that the prefrontal cortical areas of the brain have a crucial role in regulating social skills, such as using and recognizing appropriate social signals in appropriate contexts, and in inhibiting activity in the amygdala – which is known as the brain center for fear and assessment of novel situations – and thus, preventing emotional overreaction. In short, rats with immature PFC grew up to be socially incompetent and more fearful (Pellis et al., 2010).

Therefore, researchers proposed a theoretical hypothesis that play may contribute to two important aspects: (1) play is training for the unexpected and for building resilience in an unpredictable world, and (2) play develops motor skills through physical play (Pellis et al., 2010).

Studies of humans with acquired damage to the same brain area, the prefrontal cortex (PFC), provided similar findings. Concretely, when researchers looked at adult patients, which have sustained brain damage to the prefrontal area either as adults or in early childhood, they have found important differences (Immordino-Yang & Damasio, 2007). In the case of patients who acquired brain damage in early childhood, they did not show any consequences for IQ or logical reasoning. However, their social behavior was compromised by being insensitive to others' feelings, unable to learn from their mistakes, and crucially, being oblivious to the consequences of their actions. In other words, being unable to learn the rules governing social and moral behaviors (Immordino-Yang & Damasio, 2007). Accordingly, researchers like Immordino-Yang and Damasio (2007) have argued that the training of the PFC during childhood, through play, might have implications for the individuals' mature social life as well as to the culture of a society more broadly.

Last but not least, one of the key characteristics of play as being a joyful activity has been associated with the increased dopamine levels – an important neurotransmitter involved in human brain's reward system, which has been linked to enhanced memory, attention, creativity, and intrinsic motivation (Liu et al., 2017; Whitebread, 2018).

IMPORTANCE OF CONSIDERING PLAY IN DIFFERENT CONTEXTS OF CHILDREN'S LIVES

Existing research suggests that play helps children to develop intrinsic interests and competencies, learn how to make decisions and exert self-control as well as to learn how to regulate their emotions, experience joy, and learn how to follow rules and develop relationships

with others (Gray, 2011; Liu et al., 2017; Whitebread, 2018; Yogman et al., 2018). In particular, developmentally appropriate play with parents and peers supports the formation of secure emotional attachments, which have been shown to be essential to children's ability to cope with stress and anxiety and to respond to complex situations (Yogman et al., 2018). Such abilities to cope with uncertainty and complexity have been suggested as holding the origins of creativity (Immordino-Yang & Damasio, 2007). Therefore, the role that adults have – and can have – in children's play should not be overlooked.

This evidence supports the recent call to challenge the prevailing unilateral focus in the literature on children's free and outdoor play as the most authentic, natural, and developmentally wholesome way for children to play (Holloway & Pimlott-Wilson, 2018). As argued by Holloway and Pimlott-Wilson (2018), this exclusive focus on free and outdoor play does not give justice to the complexity and richness of children's everyday lives in contemporary society. Instead, this view should be extended in favor of recognizing and asserting children's right to participate in a diversity of playful spaces – including free, structured, and care-based play environments (Holloway & Pimlott-Wilson, 2018). In other words, it is necessary to consider different contexts of children's lives and where they play (including both formal and informal play spaces), and different types of play (such as free and guided play). In addition, it is necessary to consider the intergenerational needs as parents and adults, in general, can have a significant positive role in children's play (e.g., through family outings) in contrast to typically considered parental role in social risk aversion and limitations to child's capacity for independency (Figure 9).

Based on such health and developmental benefits, play has been highlighted as an essential child right, not a luxury after the others (Lester & Russell, 2010). In this sense, play and children's right to play have been taken on as a

It is necessary to consider different contexts of children's lives and where they play (including both formal and informal play spaces) and different types of play (such as free and guided play)



Figure 9: Importance of considering child/adult relationships and intergenerational needs in play and playful learning

matter of public health in the context of the built environment as well, considered in various sectors; from educational settings through improvement of play environments (Adams et al., 2018; Luchs & Fikus, 2013; Tortella et al., 2016) to considering how urban spaces can be the place for public health interventions in providing play opportunities (Bustamante et al., 2019; Hassinger-Das et al., 2018). These efforts are in line with the embodied cognitive science perspective emphasizing that the environmental context of play is of particular importance by being inextricably linked with children's emotional and bodily responses. In that sense, the built environment can be considered as one of the relevant factors contributing to and affecting children's health and well-being. Hence, the question arises: how can designers help to address this issue of the lack of play and playful learning opportunities in the built environment? We argue, based on our systematic and explorative literature search, that this question can be addressed in the broader context of children's right to the city.

CHILDREN'S RIGHT TO THE CITY: TOWARD DESIGNING CHILD-FRIENDLY ENVIRONMENTS

The children's right to the city has been derived from the UN Convention on the Rights of the Child (UNICEF, 1989), and can be understood as establishing a twofold perspective on children's rights in the built environment and public realm in particular. On the one hand, it asserts a right for children to have access to supportive, healthy, and sustainable environments – thereby including their right to play and need for play opportunities across different settings, from schools and early childhood care centers through playgrounds to open public spaces (Bishop & Corkery, 2017; Churchman, 2003; Monaghan, 2019; Vincelot, 2018). On the other hand, it establishes a right for children to be recognized as citizens, experts, and stewards of the environment; thereby providing them with a greater sense of ownership and involvement both in their communities and in decision-making on the issues that affect their lives (Bishop & Corkery, 2017; Chawla, 2002; Monaghan, 2019).

Importantly, it can be argued that these two aspects of understanding children's rights in the built environment – as the right to a supportive environment and a right to be heard – are tightly



interwoven through children's right to play. Namely, based on the above-described characteristics and benefits of play in children's lives, play in the built environment can be conceptualized as being a primary way for children to participate in their communities by exploring the environment, learning about the society, and living with others (Lester & Russell, 2010; Whitebread et al., 2012). Accordingly, establishing children's right to the city can be seen in part as providing play opportunities in the built environment.

URBAN CHILDHOODS AND THE EFFECTS ON CHILDREN'S PLAY OPPORTUNITIES

Children's opportunities for play, and consequently, their right to the city, have been compromised by a range of social and environmental factors. For example, from the inadequate or missing recognition of the importance of play for child's health and holistic development in favor of school readiness and academic skills (Hoskins & Smedley, 2018; Whitebread et al., 2012) to increased risk aversion in society and reliance on technology that affect the ways children engage with their social and physical environments (Bishop, 2017). At the same time, the decline of play opportunities presents a subset within identified broader decline of environmental opportunities for children and

young people in the built environment – primarily due to the increasing urbanization and closely related processes of commodification and control of spaces.

The ongoing urbanization across the globe, with the estimate that 68% of the world's population will be living in cities by 2050 (UN DESA, 2018), implies that most of the world's children and young people will grow up in urban contexts from this time forward. In other words, the childhoods of the future will be largely urban childhoods, implying the importance of specifically addressing children in the design and planning of cities (Churchman, 2003; Malone, 2017). However, the child-blind design and planning – that is, the lack of consideration of the presence of children in the built environment – is still a dominant trend across different geographies (Bishop & Corkery, 2017; Drianda, Kinoshita, & Said, 2015; Elshater, 2018; Severcan, 2018). In particular, children's play opportunities are highly affected by the urban densification and the increase of high-density living. This is complemented with general shrinking of informal, undeveloped spaces in urban neighborhoods and with the scarcity of natural settings for play close to children's homes like backyards, small local parks, and vacant lots (Bishop, 2017).

Parallel to these urbanization processes is a shift toward more controlled and commodified spaces by replacing public spaces with highly controlled, regulated, and consumer-oriented places. Several authors have argued that these tendencies can limit children and young people's environmental and social access to the public spaces – and moreover, constrain them to prescribed functional zones and activities i.e., child-designated areas (Bishop & Corkery, 2017; Churchman, 2003; Severcan, 2018). These child-designated areas typically include the three traditional environments – homes, schools, and recreational settings like playgrounds – similarly to the definition of formal play spaces employed in this review. In the case of younger children, tendencies to constrain access to a variety of play spaces are additionally supported with the increasing concerns for safety and liability (Brussoni et al., 2015). In the case of adolescents, a deliberate marginalization can also be observed in the public spaces in relation to a prevailing perception of youth as being troublesome and unruly, leading in turn to the design solutions aimed at diminishing young people's presence in the cities (Németh, 2006; Owens, 2017).

These (un)intentional processes of "compartmentalization" of children and young people into prescribed and play designated areas can come at a significant cost to their physical and mental health and well-being (Bishop, 2017). These practices limit children's opportunities among others, to be physically active, move and play freely within public spaces and in-between different settings, and have spontaneous interactions with people outside their home and school environments (Monaghan, 2019; Severcan, 2018). This may consequently compromise the development of children's social and problem-solving skills, how they respond to complex situations and discover their identities. Importantly, compartmentalization may prevent children and young people to take part in urban life and thereby, exercise their right to citizenship and to participate in society (Elshater, 2018; Németh, 2006; Severcan, 2018). In short, children and young people have the right to the city as a whole – including formal and informal play spaces – in order to access opportunities to social and physical development as well as for establish a sense of identity and belonging.

DESIGNERS' RESPONSE: TOWARDS CHILD-FRIENDLY ENVIRONMENTS

Urbanization presents a significant challenge for architects, urban designers, and planners to develop built spaces inclusive of children and young people. Nonetheless, this transformation and expansion process of cities also contains an opportunity to provide spaces that are welcoming to children or child-friendly i.e., responding to children's environmental, developmental, and educational needs (Churchman, 2003; Malone, 2017; Scholten et al., 2017). The concept of "child-friendly cities" implies designing and creating environments that are healthy, safe, sustainable, and well suited for children on account of providing conditions for holistic skills development (Bishop & Corkery, 2017; Broberg, Kytta, & Fagerholm, 2013; Cilliers & Cornelius, 2016; Monaghan, 2019).

Up until now, there has been an abundance of research literature and a rich pool of initiatives across the world relative to defining and creating environmental child friendliness. For example, starting with Kevin Lynch's "Growing Up in Cities" movement in the 1970s through "Child Friendly Cities Initiative" (CFCI) beginning in the 1990s (Chawla, 2002; Malone, 2017) to more recent initiatives like "Urban95" (Vincelot, 2018) and "Learning Landscapes" (Bustamante et al., 2019; Hassinger-Das et al., 2018). All these initiatives and strategies address and produce solutions specific to local conditions and contexts, and are thus strongly influenced by socio-economic factors (e.g., whether it is about providing additional play spaces in cities or ensuring basic safety in the streets for children). The implication of such contextualized approaches is that there is not one single definition of what a child-friendly environment entails. The basic premise is that child-friendly cities as environments adapted to the needs of children will be healthier, safer, more sustainable, and inclusive for all citizens (Churchman, 2003; Malone, 2017; Vincelot, 2018).

Several themes have dominated the discourse within research and professional communities that include (but are not limited to): safety, available green space, children's independent mobility possibilities, diversity settings, active socialization or "neighborliness", and integration of children in decision-making processes regarding the quality of their living environments (Broberg et al., 2013; Churchman, 2003; Elshater,

...children and young people have the right to the city as a whole – including formal and informal play spaces – in order to access opportunities for social and physical development as well as to establish a sense of identity and belonging.

2018; Gokmen & Tasci, 2016; Severcan, 2018). While these issues have been discussed extensively elsewhere, what is important to highlight in the context of this literature review is that all these essential criteria for environmental child-friendliness are underpinning the provision of play opportunities for children in the cities, especially as so-called "informal play spaces" (e.g., open public spaces like squares and streets). In this sense, child-friendly here is primarily considered in terms of "play-friendly" factors.

Designing for and with children: A dual-lens perspective. It is worth emphasizing that from designers' perspective, the task of designing for children and young people in the built environment and thereby acknowledging their right to the city, has been approached in two complementary ways as design for and with children. First, through efforts to design for children by recognizing the presence of children, their needs, and experiences in the built environment and taking them seriously in design. These efforts correspond to the emerging field of evidence- and research-based design on children-related issues like play and playful learning (Hassinger-Das et al., 2018). Second, efforts to design with children resulted from the recognition of children as capable experts in their own lives and active citizens in the built environment. This corresponds to the rise of participatory or collaborative design approaches with children as a way of including children in the decision-making, design, and creation processes (Bishop & Corkery, 2017; Monaghan, 2019).

However, a particular challenge to be addressed is the application of the available multi-disciplinary evidence and research findings from participatory research and design processes about children and young people's experiences. This extensive knowledge is often not used, nor sufficiently valued, in informing design and planning practice and policy that affect children's experiences of cities (Bishop, 2017). Therefore, promoting children's rights to healthy, supportive, educative, inclusive, and environments rich in play opportunities through research-based design and co-design and co-creation practices also requires establishing conditions for knowledge transfer between involved stakeholders and sectors.

LIMITATIONS TO CHILD-FRIENDLY ENVIRONMENTS

Lastly, there are some limitations to be considered in designing child-friendly cities. The first issue is the close link between child-friendly neighborhood developments and gentrification processes. For example, in a study in Izmir, Turkey that inquired children on their views about child-friendly cities, children themselves have observed the relationship between an increase of child-friendly environments and economic wealth (Gokmen & Tasci, 2016). Similarly, in her analysis of strategies undertaken by the municipality of Rotterdam to promote a child-friendly city, Van den Berg (2013) assessed that efforts to develop child-friendly environments were closely tied to gentrification processes. In the municipal plans, child-friendly implied "middle-class friendly" and was targeted toward affluent families with children to encourage them to move into previously neglected neighborhoods (Van den Berg, 2013). In doing so, the municipal plans exploited a widespread perception of children as producers of urban liveliness for economic purposes (Van den Berg, 2013). Additionally, there is a danger of abuse of the term "child-friendly" for branding purposes and economic and political interests (Carroll & Witten, 2017; Van den Berg, 2013).

Secondly, a diverse urban setting and a "right to city for all" comes along with the presence of fringe groups of society and functions not intended for children (Witten, Kearns, & Carroll, 2015). Whilst most adult activities can occur at night, effects will be visible and noticed by children at daytime as well. It can limit children's freedom for play, exploration, and independent mobility for reasons of safety concerns and eventually, impact children's development. That said, a diverse city cannot be transformed to be entirely child-friendly, in fact, no environment can be completely so (Chaudhury, Hinckson, Badland, & Oliver, 2019). Nonetheless, this might also bear opportunities for children to navigate unfamiliar situations, to learn to interpret the street life as well as to consider different viewpoints and ways of living inherent to urban life, a process that perhaps would not be considered otherwise (Witten et al., 2015).

SUMMARY

According to our review and systematic search of literature discussing why play and playful learning matter in children's lives and why children and their agency matter in the realm of architecture, urban design, and planning, the following implications for promoting and designing for children's play in the built environment should be highlighted:

- Play has been highlighted as an essential child right thanks to a myriad of effects that play has on children's physical and mental health, and on the development of key physical, emotional, and social skills.
- Play in the built environment can be conceptualized as being a primary way for children to participate in their communities by exploring the environment, learning about the society, and living with others.
- It is necessary to consider different contexts of children's lives and where they play (including both formal and informal play spaces), different types of play (like free and guided play), and overall, the intergenerational needs by considering that parents and adults, in general, can also have a significant positive role in children's play, besides the traditionally perceived role as limiting children's capacity for independency.
- From designers' perspective, the children's right to the city has been manifested in two overlapping ways. First, through efforts to design for children by recognizing the presence of children, their needs and experiences in the built environment, and take them seriously in design. Second, through efforts to design with children by recognizing them as capable experts in their own lives and active citizens in the built environment, thereby including children in the decision-making, design, and creation processes.





Children as agents in the built environment

According to our dual-lens framework, children and young people can be understood as agents that are both affected by and that are affecting the built environment. On the one hand, the embodied cognitive science lens highlights that the way children interact with the built environment is always relational and depends on children's skillful bodily and cognitive abilities. That is to say, that their capacity to perceive affordances for play is not simply a passive response to pre-designed play opportunities. Instead, it is an active engagement and often a creative transformation (through play) of the existing potentialities that the built environment offers (Jelić et al., 2016; Rietveld & Kiverstein, 2014; Withagen & Caljouw, 2017). In parallel, according to the co-creation lens, recognizing children and young people as active citizens and experts in their own lives entails that their particular ways of engaging with and experiencing the built environment should be acknowledged and implemented in the design of architectural and urban settings. Moreover, such recognition of children's capacity to be "agents of change" should be embraced by actively involving them in the design process and creation of spaces (Birch et al., 2017b; Bishop & Corkery, 2017; Chawla, 2002).

Therefore, based on this dual-lens approach, one of the key issues for understanding how the built environment can be designed for and with children to promote their play, playful learning, and creativity, is the issue of children's agency and how they interact with the built environment. Within the reviewed academic literature on

children's play and playful learning in architectural and urban spaces, the child-environment interaction has been conceptualized and investigated from diverse thematic and disciplinary perspectives. In this chapter, we present four themes: "children as active citizens and experts", "children's independent mobility", "affordances for play", and "risky play and children's curiosity" – in the built environment. These four themes were identified in the systematic literature search as providing significant understanding of the child-environment relationship and the factors influencing and shaping these interactions. In this sense, the focus of present chapter is on children's agency and interaction with the existing built spaces, whereas the children's role as change agents in the design process will be addressed in chapter 7.

CHILDREN AS ACTIVE CITIZENS AND EXPERTS IN THE BUILT ENVIRONMENT

The theme of "children as active citizens and experts" stems from an extensive body of research on the value of engaging children in built environment planning and design, particularly in the context of rights-based and collaborative design approaches. As discussed in "Children's right to the city" section of this report, since the 1970s and especially with the ratification of UN Convention on the Rights of the Child in 1989, there has been a significant emphasis on designing not only for children, but also with children's involvement, where they are seen as capable and rightful decision-makers (Birch et al., 2017b; Bishop & Corkery, 2017;

Chawla, 2002). The main rationale behind these ideas is that children and childhood need to be comprehended and recognized on their own terms. In other words, that the fundamental precondition for designing and building child-friendly environments is to acknowledge that children and young people have their own ways of interacting with spaces and appropriating places, which might be different from adults' needs, habits, norms, and expectations (Churchman, 2003; Cloke & Jones, 2005). In the scholarship we reviewed, there are several reasons offered in favor of such acknowledgement. Firstly, there is the issue that majority of spaces today, especially cities, are designed with adult ergonomics, requirements, and experiences in mind, with little to no regard to the presence and needs of children in the built environment. Such child-blind planning and design is manifested through different aspects. For example, from the questions of accessibility and scale of various elements in the physical environment not matching children's ergonomics and capabilities (e.g., whether one needs to be able to read to find their way around) to the general trend of "compartmentalizing" children and limiting their opportunities for play and learning to the boundaries of child-designated spaces (e.g., playgrounds and "architecture for children") (Carroll & Witten, 2017; Churchman, 2003; Cloke & Jones, 2005). Secondly, these design manifestations are tightly linked to socio-cultural conceptions of childhood, such as adults' romanticized views of children as "little angels" or "little devils" – in relation to the perceived innocence or disruptive otherness of childhood, respectively (Cloke & Jones, 2005).

These polarized views reflect the fact that because children live in built settings that are scaled and ordered to fit adults' requirements, the ways in which they adapt to and negotiate the use of spaces – especially through play – are likely to differ from adults' preconceptions (Carroll & Witten, 2017; Cloke & Jones, 2005). One of the consequences of such polarized perception of children and their use of spaces is the increase of child-designated spaces – either

due to safety concerns, or as an attempt to control and regulate behaviors, including play activities, that are seen as disruptions to adults' expectations of children and site-specific cultural norms (Bishop, 2017; Cloke & Jones, 2005). This in turn often leads to sanctioning and underestimating the value of play, by seeing play as trivial, disorderly, or even threatening – thereby compromising children and young people's primary way for participating in the everyday lives of their communities (Lester & Russell, 2010).

CHILDREN'S AGENCY THROUGH PLAY AS CREATIVE INTERACTION WITH THE BUILT ENVIRONMENT

Instead, it is argued for the conceptualization of children as social agents – meaning that their actions, including use of spaces, should be recognized as appropriating information and knowledge as part of the adult world, while producing and participating in their own peer culture outside of the domain of adults (Ladru & Gustafson, 2018; Malone, 2013). The implications of children's agency are twofold: (1) children act as change agents through play by creatively appropriating spaces and (2) children's play is contextualized and situated in physical as well as socio-cultural environments as behavior settings, enabling children to learn how to participate in collective social practices and become active citizens.

Children as change agents through play in existing built spaces. Firstly, children can act as change agents through play on account of their ability to appropriate places that might be invisible to adults, such as abandoned or vacant spaces, and make them into their own theatres, staging their play and imagination (Cloke & Jones, 2005). An interesting example comes from a study of participatory art project "The Walking Neighborhood hosted by Children" in Chiang-Mai, Taiwan that investigated, through sensory ethnography and child-led walks, how children experience and interact with their local environments in an affective, embodied, and sensorial way (Phillips & Tossa, 2017). The authors

describe two instances illustrating how children understand and interact with spaces in ways juxtaposing adults' expectations and experiences. In the first instance, the child-led walk host (aged 7) demonstrated to her walking audience a game she plays by imagining and guessing what trees in a street look like. In the second instance, the child host (aged 9) led her followers to an open space in front of a building, with leaves piled in the base of the entrance stairs, and asked the walk-participants to make a "rain of leaves" by collecting them and throwing them in the air. These descriptions of rather natural, carefree child's play were in stark contrast – from adults' perspective – with the meanings and functions of the spatial settings where these instances occurred. In the first instance, the trees were in front of a tall wall with barbed wire of a women's prison, while the second space was a parking lot and forecourt of a government office.

As argued by Phillips and Tossa (2017), these examples illustrate how children accept the different functions of places as part of the urban landscape, while identifying play opportunities even in spaces not specifically designed for children's movement and exploration. According to the embodied cognitive science lens, this is possible thanks to the open-endedness of affordances based on the skillful abilities of children – one of them being imaginative play (Rietveld & Kiverstein, 2014). In this sense, children's agency through play in the built environment can be understood as an opportunity for creative engagement and transformation of spaces (Figure 10).

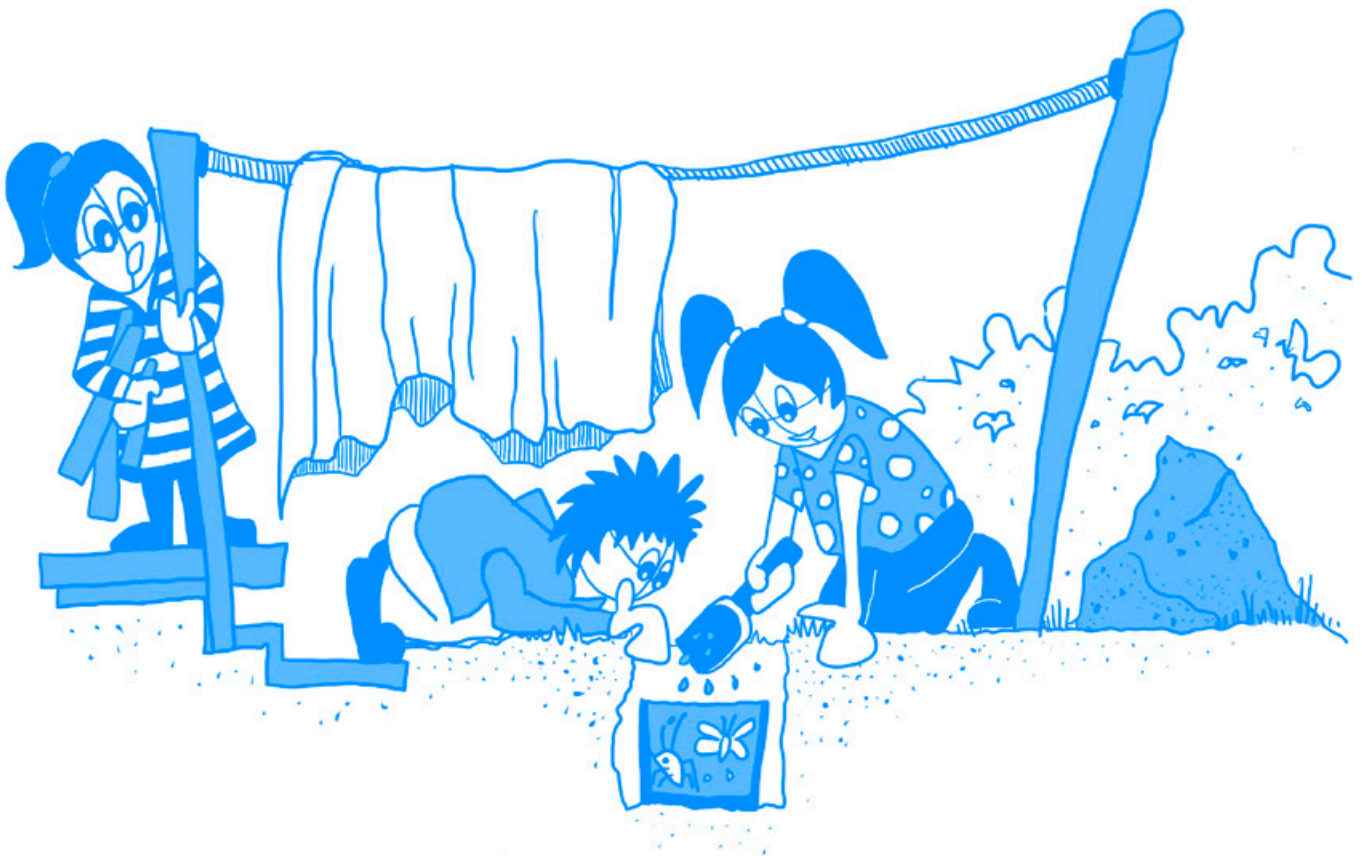


Figure 10: Children as change agents through play: the built environment offers opportunities for creative engagement, transformation, and appropriation of spaces through play

Children as co-producers of behavior settings through play. Secondly, by being and playing in places, children learn how to participate in collective social practices because the built environment is always a socio-cultural and behavior setting. Therefore, children can – and should – be considered as co-producers of spaces and places through their own practices in the built environment (Ladru & Gustafson, 2018). This implies that a child joins a behavior setting as a participant and in so doing, contributes to its ongoing functioning, by reproducing and extending adult routines through participation in everyday community life (Heft, 2018; Ladru & Gustafson, 2018). As argued extensively in the literature on environmental child-friendliness, the immersion of children in the social settings, especially in the public realm, has substantial benefits for children's development because of social interactions and the possibilities for developing their own identities and ways of acting in place and society (Elshater, 2018; Freeman, 2010; Mårtensson & Nordström, 2017; Severcan, 2018). Simultaneously, children's presence in local environments and public spaces may bring forth interaction between adults as well, and thus constitute a source for social cohesion in the neighborhood, which is one of the key indicators of child-friendly environments (Hooper, Ivory, & Fougere, 2015).

Means of translating children's creative interactions for design and planning purposes.

Finally, it is worth highlighting that children's own ways of interacting with the architectural and urban spaces have been translated for the design and planning purposes into understanding of children as experts in their own lives as well as by embracing the possibility to involve them as active citizens that have the expertise to voice their experiences and needs in the built environment. Besides the abovementioned child-led walks as an intergenerational and intercultural method of civic learning between children and other stakeholders (Phillips & Tossa, 2017), children's affective experiences of spaces have also been used through participatory methods like "emotion-mapping" (Bosco & Joassart-Marcelli, 2015; Deitz, Notley, Catanzaro, Third, & Sandbach, 2018). For example, a study of children's emotions in the case of revitalizing a nature-urban space in California, USA, has revealed the significance of children's emotional landscapes as related to the diverse landscapes of their everyday lives (including their homes, school, neighborhoods) (Bosco & Joassart-Marcelli, 2015). Similarly, children's emotional experiences have been used as a resource, an "emotion report", for communicating their personal perceptions of spaces in participatory planning processes (Deitz et al., 2018). Therefore, children's own ways of interacting – or, in other words, inhabiting, negotiating, interpreting, and building knowledge about everyday spaces – is a rich source of children's "spatial stories" (Deitz et al., 2018) of their affective, embodied, and multi-sensory interactions with the built environment in designing for and with children.

... children accept the different functions of places as part of the urban landscape, while identifying play opportunities even in spaces not specifically designed for children's movement and exploration.

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... children's agency through play in the built environment can be understood as an opportunity for creative engagement and transformation of spaces

AFFORDANCES FOR PLAY IN THE BUILT ENVIRONMENT

According to reviewed scholarship on children and play in the built environment, the concept of affordances is another prominent theme for understanding children's agency and their ways of interacting with architectural and urban spaces. As introduced in the theoretical framework, section Embodied cognitive science lens, affordances are defined as possibilities for action, which depend on the relations between aspects of the socio-material environment and the skillful abilities of a perceiving agent, e.g., a child (Heft, 2010; Rietveld & Kiverstein, 2014).

The notion of affordances has two important implications for considering the child-environment relationship. Firstly, its usefulness lies in describing the environment in terms of possibilities for action – that is, what a child can do in an environment. As recognized in the seminal work by Harry Heft (1988), the environment is better described in terms of actions and behaviors it offers (i.e., *affords*) for a child, rather than in terms of forms or geometric properties. This is to say that when a child intends to play at a jumping stone playground, she will not perceive the distance between two stones in terms of centimeters, but in terms of whether the gap is crossable for her (Heft, 1988; Jongeneel, Withagen, & Zaal, 2015). Therefore, the concept of affordances brings forth an action-oriented understanding of children's interaction with their environment (Heft, 2010; Jongeneel et al., 2015; Kernan, 2014). Accordingly, the built environment (i.e., architectural and urban spaces) can be described as providing a rich "landscape of affordances" (Rietveld & Kiverstein, 2014) for children's play and playful learning.

Secondly, affordances are inherently relational because they exist as a relationship between the properties of a socio-material environment and an individual's skillful ability to act. In other words, what a child can perceive as action possibilities in an environment depends on the child's numerous bodily and cognitive skills. This includes – but is not limited to – action capabilities of the body,

developmental readiness to engage in different types of play, child's current emotional state and social context, and overall ability or willingness to "actualize an affordance" i.e., to act on a perceived affordance (Heft, 2010; Jongeneel et al., 2015; Kyttä, 2004; Morrissey, Scott, & Rahimi, 2017; Withagen & Caljouw, 2017). Hence, affordances for play and playful learning in the built environment should be understood as relational resources available to children based on their skillful abilities as determined by age, development stage, gender, and socio-cultural context among other factors. Importantly, this relational definition implies that (perceived) affordances are always functionally significant and meaningful properties of an environment for a specific individual (Heft, 1988, 2010).

Two research tracks in affordance-based literature.

Based on our review of literature, we identified two notable tracks in which the concept of affordances has been applied to examining children's play in the built environment. The first track comprises studies that take the abovementioned seminal research by Heft (1988) and his affordance-based approach to describing children's environments as a function of observable behaviors, including play activities, as the point of departure. Given the time span of three decades, this has been a prolific line of research as manifested in the diversity of investigated environments falling within the scope of our literature search. Concretely, these include (with few illustrative references): play spaces within educational settings (e.g., schools and early childhood care centers) (Storli & Hagen, 2010), various types of playgrounds and outdoor environments more generally (Morrissey et al., 2017), and urban neighborhoods and public spaces (Kyttä et al., 2018; Lopes, Cordovil, & Nato, 2018).

The second track, on the other hand, comprises a few recent empirical studies that investigated the relationship between affordances in designed playgrounds and action capabilities of children's bodies. The main difference between the two tracks is the scale of investigation (e.g., urban neighborhoods and outdoor play environments compared to smaller

scale playground equipment respectively) as well as a more fine-grained focus of the second track studies on examining how a particular affordance invites a playful activity for a particular child. In the following sections, we will outline the key insights from these two research tracks.

AFFORDANCES FOR PLAY AND CHILDREN'S INDEPENDENT MOBILITY IN NEIGHBORHOODS AND URBAN SPACES

Functional affordance-based description of children's environments. By introducing the concept of affordances in consideration of the child-environment relationship, Heft (1988) developed a functional taxonomy (i.e., classification) of children's outdoor environments in which different environmental features were clustered according to affordances (i.e., action possibilities) they offer to children. Notably, the principle behind this taxonomy allows it to be modified and redeveloped according to any group of children or young people, any environment, or type of play that is of researchers' interest. While researchers generally acknowledge that any such classification cannot be exhaustive in capturing all possible children's actions and behaviors, they nevertheless agree on the usefulness of the affordances concept for describing and mapping children's meaningful places based on their engagements with their lived environments (Heft, 2010; Kyttä, 2004).

Heft's preliminary functional taxonomy included ten categories for environment description: (1) flat, relatively smooth surface – affords walking, running, etc.; (2) relatively smooth slope – affords rolling, sliding, rolling objects down, etc.; (3) graspable/detached object – affords drawing, building structures, etc.; (4) attached object – affords jumping on/over/down from, etc.; (5) non-rigid attached object – affords swinging on, etc.; (6) climbable feature – affords exercise/mastery, etc.; (7) aperture – affords locomoting from one place to another, etc.; (8) shelter – affords prospect/refuge, affords privacy, etc.; (9) moldable material e.g., sand – affords sculpting, construction of objects, etc.; and (10) water – affords splashing, pouring, mixing with other materials, swimming, etc. (Heft, 1988, 2010).

This functional, affordance-based approach to describing children's environments has inspired a series of studies over the last three decades, and has been further extended or partially revised by several researchers, by adding dimensions like affordances for sociality and emotional affordances of places (Kyttä, 2002; Lerstrup & van den Bosch, 2017; Lopes et al., 2018). In fact, a well-known set of studies by Marketta Kyttä (2002, 2004) are considered pivotal in operationalizing Heft's functional taxonomy (1988) to investigate the relationship between affordances in children's lived environments and their independent mobility. By comparatively examining four environments with different degrees of urbanization (urban, suburban, small town, and rural environments) in Finland and Belarus through interviews with 8-9 year-old children, Kyttä (2002, 2004) found a close relationship between children's possibilities for independent mobility and the diversity of activity settings and neighborhood affordances.

Children's independent mobility and the importance of socio-cultural context for actualizing play affordances.

The seminal nature of Kyttä's research is twofold. On the one hand, it tackles the issue of children's independent mobility – i.e., children's freedom to move and play within their local environments without adult supervision – which has been recognized as one of the key conditions for child-friendly environments (Broberg et al., 2013; Chaudhury et al., 2019; Kyttä et al., 2018). The extensive body of research on children's independent mobility supports a view that children's capacity to move autonomously and thereby explore their environment is essential for learning and constructing knowledge about the world (Broberg et al., 2013; Kyttä, 2004; Lopes et al., 2018). Consequently, there are a number of observed benefits for children's development, physical health, and well-being. For example, children's possibilities for active travel (e.g., walking and cycling) and outdoor play in local environments have been linked with increased opportunities for children to develop their spatial and motor skills, improve social competences, learn to navigate risky situations, increase their physical activity as well as

contributing to children experiencing a stronger sense of community and social attachment (Chaudhury et al., 2019; Drianda et al., 2015; Kyttä, 2004; Kyttä et al., 2018; Lopes et al., 2018; Webb Jamme, Bahl, & Banerjee, 2018). Furthermore, children's independent mobility is demonstrably affected by a number of factors, including socio-economic and gender differences, and general perceptions of safety and potential hazards in the neighborhoods by both caregivers and children (Chaudhury et al., 2019; Drianda et al., 2015; Kyttä, 2002; Lopes et al., 2018; Schoeppe et al., 2015). Such "mobility licenses", according to Kyttä (2002, 2004), were found to be one of the mediating factors between the degree of urbanization and actualization of environmental affordances.

These findings support the view that affordances are always situated in a socio-cultural context (van Dijk & Rietveld, 2017). Therefore, whether an affordance for play will be perceived and/or actualized by a child will depend not only on child's abilities, but also on the situation and social practices e.g., parents and caregivers' encouragement or prohibition to play at a certain place or in a certain way (Heft, 2018; Kyttä, 2002, 2004; Kyttä et al., 2018). For instance, parents correcting children not to climb (on their feet) up the slide as it is contrary to expected ways of using the equipment (Withagen & Caljouw, 2017). Few other reviewed studies in outdoor and nature environments similarly highlighted the importance of considering children's interaction with other people – including parents, teachers, and peers – and their role as caregivers and playmates in mediating children's access to different affordances as well as an initiation of novel action possibilities (Kernan, 2014; Lerstrup & van den Bosch, 2017; Schubert-Peres, Dos-Santos-Raymundo, Longhinotti-Felippe, & Kuhnen, 2017).

Interrelationship between children's mobility and actualized affordances: "Bullerby" model. The other significant insight from Kyttä's studies refers to demonstrated interrelationship between the degree of children's independent mobility and a number of affordances that children actualize

as two central criteria for evaluating environmental child friendliness (Broberg et al., 2013; Kyttä, 2002, 2004). Specifically, researchers proposed an assessment model (named Bullerby model), which defines four qualitatively different types of children's environments based on the co-variation between opportunities for movement and opportunities for different activities at neighborhood level (Broberg et al., 2013). These four environment types have been labelled: Bullerby (high mobility-high affordances), Wasteland (high mobility-low affordances), Glasshouse (low mobility-high affordances), and Cell (low mobility-low affordances) (Kyttä, 2004). The Bullerby type is most representative of a child-friendly environment as it provides an abundance of mobility licenses and a diversity of affordances to be actualized. What is more, this particular co-variation creates a positive cycle: the more children can autonomously move around and explore an environment, the richer variety of affordances they will discover and actualize, which will in turn motivate further exploration and mobility (Broberg et al., 2013; Kyttä, 2004). In contrast, the three other environment types indicate a dull environment, inadequate to children's needs for play despite high degree of mobility licenses (the Wasteland); an awareness and second-hand knowledge via e.g., media of the richness of environmental affordances but which are inaccessible for independent exploration (the Glasshouse); and the negative cycle with little information about available affordances often leading to decreased mobility in the environment (the Cell) (Broberg et al., 2013; Kyttä, 2004). General tendencies observed are the decrease of Bullerby environment types and increase of the Glasshouse types as the degree of urbanization increases (Kyttä, 2004).

Implications of affordance taxonomy and participatory mapping for future research.

Relevant to our dual-lens perspective in more recent studies, Kyttä and colleagues further tested the Bullerby model by using participatory mapping of children's meaningful places in urban neighborhoods through the relationship between children's mobility behaviors and number of

actualized affordances (Broberg et al., 2013; Kyttä et al., 2018). Concretely, by utilizing a Public Participation Geographic Information System (PPGIS) in the form of a internet-based softGIS tool developed specifically for children and youth, researchers mapped neighborhood places that were experienced by participants as functionally, emotionally, and socially meaningful (Broberg et al., 2013; Kyttä et al., 2018). These works, together with a similar study by Lopes et al. (2018), revealed promising results and methods for better understanding the characteristics of child- and youth-friendly urban neighborhoods with important implications for design practices.

As argued by leading scholars in this research track, these tools and methods offer an opportunity for further empirical studies, especially for in-depth comparative analyses of the places that children and young people experience as meaningful and affordance rich in their surroundings and the physical, objective characteristics of these mapped environments (Broberg et al., 2013; Kyttä et al., 2018). It is proposed that the affordance taxonomy of children's environments can provide a shared vocabulary for cross-sectoral collaboration in understanding and designing different play spaces (Lerstrup & van den Bosch, 2017). What is more, both the applied affordance taxonomy in combination with participatory mapping tools present an important step to capture the experiential, place-based knowledge from children and young people and bring their perspectives to dialogues with designers, urban planners, and decision-makers (Broberg et al., 2013; Chaudhury et al., 2019; Kyttä et al., 2018; Lopes et al., 2018).

AFFORDANCES FOR PLAY, CHILDREN'S BODILY ACTION POSSIBILITIES, AND PLAYGROUND DESIGN

The first track of affordance literature focuses primarily on mapping meaningful affordances for play activities in children's environments, including studies of what children do, where and how they play in their neighborhoods or designated play environments. In contrast, the second track of literature primarily explores how and why a particular affordance in a playground offers or invites playful activities for a particular child.

The idea that affordances can invite or solicit certain action is especially relevant in the context of design, since it highlights the link between what designers intend to achieve and how the designed spaces perform when used. In other words, if we consider the built environment as a landscape of carefully and intentionally created affordances for play and playful learning, these designed spaces will invite children to explore the action possibilities provided. Importantly, some affordances are more often actualized in a manner that is "prescribed" through design, as it is for example with play equipment like slides or swings. In contrast, other designs are more open-ended as they offer a richer variety of possible play actions, like some of the play equipment designed by renowned Dutch architect Aldo van Eyck. In fact, he termed his playground designs "tools for imagination": his intention was to create minimalistic structures that do not dictate children how to play; instead, the structures were to stimulate children's creativity by inviting children to explore a manifold of different possible uses (Withagen & Caljouw, 2017).

Specifically, a group of Dutch researchers investigated two interrelated questions: (1) how the attractiveness of a playground or a piece of play equipment depends on children's bodily action capabilities, and (2) whether children's play behaviors differ in relation to the design of play equipment with standardized or non-standardized elements – such as variability of distances between bars or gaps to cross (Jongeneel et al., 2015; Prieske, Withagen, Smith, & Zaal, 2015; Sporrel, Caljouw, & Withagen, 2017a, 2017b; Withagen & Caljouw, 2017). In a series of experiments, they have tested their ideas on several playground mock-ups. Relevant for our review, one of their experimental setups was inspired by a well-known "jumping stone" playground designed by Aldo van Eyck and installed in many public playgrounds across the Netherlands and beyond (Withagen & Caljouw, 2017). The jumping stone playground consists of several round stones placed in a symmetrical configuration resembling a number 8, with two different gap widths that a child can cross – and

hence, it can be considered a standardized play configuration. At the same time, researchers envisaged an alternative, non-standardized playground by letting children participate in the experiment to design their own playground configuration by arranging six jumping stones at their disposal. This allowed the researchers to compare children's play on standardized versus non-standardized playground configurations by virtue of variability of gap widths between the jumping stones (Jongeneel et al., 2015).

Three key insights on children's play relative to bodily action capabilities and playground design

These empirical studies brought forward several novel, first-time findings that have important implications for the design of playgrounds and study of children's play behaviors. The first insight is that children's use of playground settings is directly related to their bodily abilities to act on play affordances (Jongeneel et al., 2015; Prieske et al., 2015; Sporrel et al., 2017b). Children sought affordances corresponding to their own perceived and actual bodily capabilities, such as the maximum jumping and stepping distance, the maximum height of blocks to climb on and step off, and the average gap-crossing distances a child chose to cross. Moreover, in the case when children had the freedom to design their own play configurations, the created gap widths between the jumping stones were scaled to bodily action capabilities of the specific child. Hence, the kinds of play affordances actualized in tested playgrounds corresponded to child's body size (i.e., leg length) and movement capabilities for jumping, stepping, climbing among others (Jongeneel et al., 2015; Prieske et al., 2015; Sporrel et al., 2017b).

The second insight is that children do not exclusively seek the largest crossing gaps – instead, the studies revealed that all children crossed the narrower gaps more frequently than the wider one, which were more challenging for them (Prieske et al., 2015; Sporrel et al., 2017b). However, it was observed that children more often chose to jump over gaps, even when they could easily step over the gap width. Accordingly, researchers argued

that this highlights the essential nature of play as a joyful activity and that children find pleasure in the movement itself (Prieske et al., 2015).

The third finding of interest is that non-standardized playground configurations were found to be more attractive compared to standardized ones, since children spent more time playing in the former than the latter, whether they played alone or in groups of four, and reported the non-standardized one to be more fun to play in (Sporrel et al., 2017a). Significantly, when children acted as playground designers, they created "messy" jumping stone configurations with much more variety of gap widths in contrast to van Eyck's original standardized design with only two gap-crossing widths (Jongeneel et al., 2015; Sporrel et al., 2017a).

Implications of empirical findings for the design of playgrounds. The implications of these studies for the design of playgrounds are twofold. On the one hand, these findings contribute to ongoing discussion on shortcomings of playground standardization by indicating that standardized play equipment – i.e., with equal or constant dimensions between play elements like bars, climbing heights, crossing gaps – presents a lack of opportunities for children to play (Jongeneel et al., 2015; Prieske et al., 2015; Sporrel et al., 2017a, 2017b; Withagen & Caljouw, 2017). The standard dimensions in designed equipment mean that it caters only to a limited group of children e.g., of certain age and body size. Instead, by introducing more variety and possibly modifiability into playgrounds, it would create opportunities for play for children with a range of bodily action capabilities, which aligns well with the concept of affordances as a relation between the environment and individual's skillful abilities.

On the other hand, non-standardized configurations have the advantage of offering variability of movements and motor actions over time, which is crucial for children's motor learning and development of child motor skills as established in human movement sciences

(Jongeneel et al., 2015; Prieske et al., 2015; Sporrel et al., 2017a, 2017b; Withagen & Caljouw, 2017). Overall, this second track of affordance literature has set an important precedence in studying affordances for play in the built environment and has indicated a valuable path for future empirical

research. Not only do these studies contribute to empirically testing many long-standing practices of designing children's playgrounds, but also show the potential of children's involvement and active participation as co-researchers.



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RISKY PLAY AND CHILDREN'S CURIOSITY IN THE BUILT ENVIRONMENT

Another prominent theme and ongoing debate within examined literature on play in the built environment is the notion of risky play. Risky play, and especially risky outdoor play, is defined as thrilling and exciting play, involving uncertainty and often challenging physical activity (Brussoni et al., 2015; Coe, 2017; Sandseter, 2009). Risky play includes six categories based on the physical activity and risk involved: (1) play with great heights – such as climbing, jumping down, etc.; (2) play with high speed – such as sliding, swinging at high speed, etc.; (3) play with dangerous tools – such as using a saw for cutting wood, etc.; (4) play near dangerous elements – such as near deep water or fire; (5) rough-and-tumble play – such as playing fighting, fencing with sticks, etc.; (6) play where there is a chance of disappearing/getting lost – such as exploring unknown areas, etc. (Brussoni et al., 2015; Coe, 2017; Sandseter, 2009). Thus, depending on the features and qualities of the physical environment, different types of play and opportunities for risk-taking can be afforded (Sandseter, 2009). The risky play activities can take place in open or secluded areas, on varying surfaces and topographies, or features that vary in height and form, such as trees and rocks (Brussoni et al., 2015; Coe, 2017; Little, 2017).

As emphasized by key researchers investigating this topic, risk here implies not so much the dangers and possibilities of physical injury, as much as the form of play in which children can recognize and evaluate a challenge and decide on a course of action (Brussoni et al., 2015; Sandseter, 2009). In that sense, it is argued that risk-taking in play enables children “to test their limits, try new skills and activities, and learn about their bodies and their capabilities” (Little & Sweller, 2015, p. 338). At the same time, the relevance of risky outdoor play came into focus as a response to the lack of stimulating outdoor play environments due to limited resources and increasing safety/liability concerns (Brussoni, Ishikawa, Brunelle, & Herrington, 2017). In addition, risky play highlights the children's agency and need to explore their environments,

with all its possibilities and boundaries (Little & Sweller, 2015). Hence, this theme aligns well with the more general discussion of children's right to the city and pinpoints the necessity to move from child-designated and compartmentalized play spaces toward embedding play and play opportunities in the urban landscape.

According to a recent systematic review of risky play literature (Brussoni et al., 2015), there are several noteworthy benefits of risk-taking in play for children's health and skills development. Specifically, risky play is found to be positively associated with increased physical activity, social interactions, creativity, and resilience, with little evidence that it increases the likelihood of injury (Brussoni et al., 2015). While stronger evidence for these positive association is needed according to Brussoni and colleagues (2015), the idea of risky play has been instrumental to the current efforts of creating play environments that are supportive of more uncertain, unstructured, and flexible play.

For example, we identified several studies that explored affordances for risky play in different types of playgrounds and outdoor play spaces, typically as part of early childhood educational settings. In particular, there is a growing consensus on the advantages of nature and natural elements in children's outdoor play environments for promoting and supporting risky play. Nonetheless, the main difference between naturalized play environments and traditional playgrounds when it comes to providing opportunities for risk-taking and physically challenging affordances is not in the quantity of affordances for risky play offered – instead, natural outdoor playgrounds afford higher *level* of risk in children's play (Kernan, 2014; Sandseter, 2009). Additionally, some authors highlighted that one of the ways for creating more favorable conditions for risky play is by educating caregivers and decision-makers through collaborative design processes with children (Menconi & Grohmann, 2018). In a participatory retrofitting of a school playground in Italy, teachers' perspectives and expectations for control at all times were shifted by working with

children toward acknowledging the significance of designing spaces for risk-taking and free play (Menconi & Grohmann, 2018).

Advantages of reformulating risky play as children's curiosity. Interestingly, a team of researchers has recently proposed that the concept of risky play as the prevailing discourse on children's play in natural environments should be reformulated into "curious play" in order to better protect children's diminishing rights to play outdoors (Gurholt & Sanderud, 2016). Gurholt and Sanderud (2016) argue that instead of innately seeking physical danger and risky activities as such, these children's behaviors should be better thought of as part of children's natural attitudes towards exploration of their environments – in other words, as a mode of their own agency through exploratory play. As discussed in the previous section, this corresponds with children's need to engage only occasionally with more challenging affordances – where the perceived and appropriate challenges depend on what the environment offers and child's action capabilities and readiness to test themselves (Prieske et al., 2015; Sporrel et al., 2017b).

In addition, the two researchers refer to Scandinavian traditions of nurturing children's relationship with nature as well as the variety of well-established theories of learning like experiential learning, place-based learning, and

environmental or sustainability-oriented education, to highlight the advantages of thinking in terms of curiosity and wonder over risk-taking in play (Gurholt & Sanderud, 2016). For instance, this idea is supported with substantial body of research on environmental education, which argues that by immersing children, especially in the early years, into outdoor exploratory play and first-hand sensory experiences of nature and living creatures, it is possible to foster children's sensibility toward nature and to promote environmentally responsible behaviors that will last into adulthood (Goltsman, Kelly, McKay, Algara, & Wight, 2009; Jorgensen, 2016; Wight, Kloos, Maltbie, & Carr, 2016).

In sum, by offering curious play as an approach to understanding the interplay between children playing in nature and children's growth, an opportunity is opened to conceptualize children as active explorers and playful agents that – through interaction with their environment through play – embody and create knowledge, skills, and understanding of themselves and their life-worlds (Gurholt & Sanderud, 2016). This is in accordance with our dual-lens understanding of children as agents in the built environment elaborated earlier in this chapter. Consequently, it is worth emphasizing children's curiosity in play as being an inherent part of how they explore and interact with the built environment, and therefore, both are closely linked to children's opportunities to actively and creatively engage with architectural and urban spaces.

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SUMMARY

The dual-lens review of children's agency and interaction with the built environment shows that children are both affected by and are affecting their environments through creative transformation and co-production of spaces and places – especially through the practice of play. The following aspects and factors influencing child-built environment interaction should be highlighted:

- To conceive children as active citizens and experts in the built environment means acknowledging that children have their own ways of interacting with spaces and appropriating places.
- Children's agency through play in the built environment can be understood as an opportunity for creative engagement and transformation of spaces – therefore, children can act as change agents through play by creatively appropriating places and co-producing spaces through their own practices (of play).
- By being and playing in places, children learn how to participate in collective social practices as well as to develop their own identities and ways of acting in place and society because the built environment is not only a physical setting, but a socio-cultural environment and behavior setting.
- Children can perceive and engage with a rich landscape of affordances for play in the built environment.
- Children's independent mobility in the built environment, is one of the pre-conditions for children's presence and participation in the public realm, and an important means of exercising their agency in architectural and urban environments by being tightly linked with affordances for play.
- Children's capacity to perceive affordances for play is not simply a passive response to pre-designed play opportunities. Instead, it is an active engagement and often a creative transformation (through play) of the existing potentialities that the built environment offers.
- There is a need for designing open-ended and non-standardized play spaces, appropriate for children of different ages, physical and cognitive abilities that, at the same time, provide challenging affordances and opportunities for risky play and nurture children's curiosity and sense of wonder through environmental exploration.
- Overall, there are opportunities for stronger theoretical and empirical research on how different spaces afford and invite children's play across the play spectrum.





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Built environment as pedagogical space: Promoting children's holistic development through play

The idea of the built environment as pedagogical space stems from the two intertwined aspects of children's agency and the nature of their interactions with the built settings. From an embodied cognitive science perspective, it has been argued that children experience and engage with the built environment with their whole bodies: learning and play are embodied, multi-sensory, affective, and movement-based activities. Consequently, children can be best thought of as agents that actively explore and creatively engage with the built environment. In this process, play becomes a means of co-producing spaces, places, and children's own knowledge and understanding of the world around them (for detailed discussion see chapter 5). Furthermore, the embodied cognition lens implies that everything children are able to perceive, experience, and know – and thus, learn – is dependent on their surroundings through the possibilities for body-environment interactions. Accordingly, the built environment should be considered as one of the key factors in children's holistic i.e., social, emotional, physical, cognitive, and creative development by providing meaningful opportunities for play and playful learning. Therefore, the built environment can act as a pedagogical space in two ways: through children's agency and spontaneous interactions with spatial settings as well as through carefully designed play and playful learning experiences.

The aim of this chapter is to exemplify current practices and knowledge of how to promote play, playful learning, and creativity through designing for children – while accounting for their agency in interacting and actively exploring the built environment. As a general trend across the literature, we identified a predominant focus on formal play spaces (e.g., playgrounds, schools, childcare facilities, parks) in comparison to informal ones (e.g., streets, public spaces, vacant lots). Specifically, our analysis of 83 selected papers from the embodied cognitive science lens revealed a significant imbalance of studies on formal play spaces (56 papers) over informal play spaces (16 papers). While the imbalance of studies on formal and informal play spaces is fairly constant throughout the time span of the systematic review, it is notable that the frequency of works related to children's play in informal play environments has significantly increased, with 13 out of 16 reviewed papers published in the last five years. By systematically reviewing this existing research-based evidence of how different types of spaces (formal and informal play spaces) and/or particular spatial elements and features can support and promote children's holistic development through play, a number of noteworthy themes as well as knowledge gaps were identified. The following sections Play and playful learning in formal and informal play spaces unpack these findings in more detail.

... children experience and engage with the built environment with their whole bodies: learning and play are embodied, multi-sensory, affective, and movement-based activities.

PLAY AND PLAYFUL LEARNING IN FORMAL PLAY SPACES

This dual-lens review defines formal play spaces as referring to architectural and urban environments traditionally associated with children's play and learning, including among others, educational institutional spaces like schools and childcare facilities, youth centers, designed indoor and outdoor playgrounds, parks and recreational settings. Thus, these play environments can be considered child-dedicated spaces and are typically designed with play and learning in mind. While the dominant focus on investigating play in formal play spaces should be critically examined in the context that children learn beyond child-designated spaces, these formal play spaces nevertheless present important spatial resources for providing play and learning opportunities. In this section, we present key insights from the state-of-the-art understanding how to design spaces that can support and promote children's play and playful learning in the context of child-designated play environments. The first review outcome is evident in the structure of this section that reflects the main types of formal play spaces investigated in the found literature: (1) playgrounds in educational settings and open public spaces and (2) museums and hospitals.

PLAYGROUNDS IN EDUCATIONAL SETTINGS AND OPEN PUBLIC SPACES

The majority of examined literature on formal play spaces reports on empirical studies concerning playgrounds as outdoor play environments as part of three different built settings: childcare facilities (termed differently across the world as preschools, kindergartens, early childhood education settings); schools; and playgrounds within open public spaces. Such prevalence of empirical studies on playgrounds likely stems from two aspects. On the one hand, it reflects the broader focus on children's outdoor play which is seen as beneficial for children's mental and physical health (as discussed in section Children's right to play: A public health perspective). At the same time, choosing playgrounds as a field of study may be linked with the controllability of the experimental setting and

participants (e.g., playgrounds within educational settings are often fenced) as well as due to the ease of institutional access and well-established procedures to recruiting child participants.

Among this extensive research-based knowledge, there are several prominent themes identified through the review which illustrate well the current practices and knowledge base in playground design. Importantly, the selected themes and design approaches have the idea of children's agency and child-environment interactions at their core for promoting play. These themes are: (1) the focus on promoting physical activity and motor skills development by designing for physical play; (2) the emphasis on nature and natural features in play environments to promote free play; (3) the availability of movable play equipment and open-ended character of environmental affordances to support creativity and diversity of play behaviors; and (4) the implications of research methodologies and participant characteristics like gender, cultural context, and cognitive abilities.

Promoting physical activity and motor skills development by designing for physical play.

The relevance of the first theme – (1) the focus on promoting physical activity and motor skills development by designing for physical play – lies in the emphasis on bodily engagement with play spaces as essential to child development. This line of studies stems from broader research efforts on the benefits of physical activity for improving children's health and prevention of different noncommunicable diseases (e.g., diabetes, cancer, cardiovascular diseases, etc.) (Adams et al., 2018; Little & Sweller, 2015; Tortella et al., 2016). Several of the reviewed studies have empirically explored how different playground designs and play equipment affect children's physical activity and fundamental motor skills development. The fundamental motor skills include: locomotor skills (e.g., running, hopping, sliding), body management or stability skills (e.g., balance, turning, climbing), and object-control skills (e.g., catching, throwing, kicking).

For example, Adams and colleagues (2018) conducted a comparative study of children's physical activity (measured using accelerometers) on three types of playgrounds: traditional, contemporary, and adventure playgrounds. Generally, traditional playgrounds include standard play equipment like swings, slides, and seesaws; contemporary playgrounds are typically a continuous play structure, including elements like monkey bars, castle, and slides; adventure playgrounds are often designed to include play equipment like bird-nest swing, climbing nets, rock climbing wall, as well as to allow children to create their own environments and/or equipment out of loose parts and malleable materials (Adams et al., 2018; Susa & Benedict, 1994). Contrary to their hypothesis, researchers found that children had the highest amount of moderate physical activity at traditional playgrounds, despite the limited range of equipment provided compared to other two (Adams et al., 2018). A possible explanation for such results might be that at the traditional playground children were observed engaging in other kinds of active play (e.g., chasing and running games), perhaps to keep themselves entertained and therefore compensate for the lack of relevant play equipment. Similar results were also found in a study comparing traditional playgrounds versus natural environment (Storli & Hagen, 2010), or in an early childhood center playground that was redesigned to include more natural features (Brussoni et al., 2017). Moreover, the study by Adams and colleagues (2018) did not find any significant differences between the three playground types on fundamental motor skills.

These results are particularly interesting in the context of another study (Tortella et al., 2016) that highlights the need for a mixture of unstructured and structured play (i.e., free and guided play) and specifically targeted play equipment to encourage physical activity and especially, fundamental motor skills development. With their study on a playground specifically designed to enhance certain fundamental motor skills related to manuality/dexterity, mobility, and balance, authors discovered that while training of a specific motor skill does result in improvements of that

skill, there is a limited transfer of motor competences from gross- to fine-motor domains and e.g., between different balance tasks (Tortella et al., 2016).

The implications are twofold. On the one hand, the most recent studies show no significant differences between different types of playgrounds, which somewhat contradicts an earlier idea that more environmental complexity and diversity lead to increased physical play and physical activity (Fjørtoft & Sageie, 2000). At the same time, due to the complexity of play and child development as evidenced with motor skills competences, a one-solution-fits-all approach may not be a suitable one. In other words, one type of play space might not be equally supportive of different types of play. Instead, holistic child development through play and playful learning may require a mixture of play spaces designed for more or less specific purposes of children's physical, cognitive, emotional, social, and creative skills. Therefore, as indicated in the reviewed literature, there is a need for more evidence on how different playground designs can support different types of play, including physical play and motor skills development.

Role of nature and natural features in play environments for promoting free play. The second theme – (2) the emphasis on nature and natural features in play environments to promote free play – originates in the recognized benefits of children's outdoor play and exposure to nature for their mental and physical health, emotional regulation, and motor development among other aspects (Brussoni et al., 2017; Cooper, 2015; Kernan, 2014; Mårtensson et al., 2009). Accordingly, our systematic search found a number of studies investigating children's play in naturalized playgrounds i.e., playgrounds redesigned to incorporate some nature features, often situated within educational settings, as well as so-called playscapes i.e., designed natural landscapes, situated within open public spaces, which typically contain vegetation and water features; malleable and loose natural materials (such as sand, branches, rocks); topographic

Our review identified several prominent themes for playground design:

- promoting physical activity and motor skills development by designing for physical play;**
- promoting free play through nature and natural features in play spaces;**
- supporting creativity and diversity of play behaviors through movable play equipment and open-ended affordances**

variations (e.g., mounds, terraces, slopes, ditches); climbable elements like smooth rocks, logs, and wood; a looping path and a variety of ground surfaces and so forth (Carr & Luken, 2014; Cooper, 2015; Woolley & Lowe, 2013). Additionally, a particular characteristic of some naturalized playgrounds is that they contain playground equipment made of natural materials such as wood and ropes that can simulate traditional play equipment like swings and climbing bars (Luchs & Fikus, 2013).

The reviewed studies generally indicate that children's play episodes (e.g., in sociodramatic play) are longer, more complex, and diverse in natural play spaces compared to fixed equipment-based playgrounds (Luchs & Fikus, 2013; Morrissey et al., 2017). However, while there are promising results for incorporating natural features within playground design, researchers have called for more investigation prior to broader application – especially, when it comes to the variety and complexity of play and environmental affordances in these spaces (Luchs & Fikus, 2013). This should be kept in mind in the ongoing efforts of greening school playgrounds for instance (Hyndman, 2017) – a commendable and necessary initiative occurring across the world as a way to provide children with access to nature that is being diminished with urbanization processes. Moreover, while the focus on nature in children's play environments is certainly relevant, the current literature shows that the "built" aspect of the environment remains neglected and understudied. Hence future research could expand the field of study by looking into play spaces where there are limited opportunities to introduce nature or natural elements, but which could still be transformed into a landscape of play affordances with other means and design solutions.



Modifiability, variability, and open-endedness of playground affordances for creativity. The third theme – (3) the availability of moveable play equipment and open-ended character of environmental affordances to support creativity and diversity of play behaviors – is closely linked with the above-noted advantages of nature and natural features in play spaces. Concretely, the long-standing idea of malleable and movable elements/loose parts has been particularly emphasized within the design of naturalized playgrounds and playscapes through the use of materials like water, sand, wood, rocks, vegetation, etc. (Carr & Luken, 2014; Cooper, 2015; Hyndman, 2017; Morrissey et al., 2017). In a similar fashion, it has been argued that introducing movable elements (such as crates, tire tubes, buckets, hay bales, wooden planks, etc.) into school playground settings can support students' engagement in creative, diverse, and adventurous play and physical skills development (Hyndman, 2017; Hyndman & Mahony, 2018). A recent study on primary school grounds showed that the presence of movable equipment can support children's creativity by promoting "greater 'open-ended' ability for students to manipulate, adapt, construct, design, develop, and relocate equipment for more complex purposes, roles, and spaces" as well as to develop social and collaborative skills (Hyndman & Mahony, 2018, p. 253). Therefore, it can be concluded that children prefer variability and open-endedness in their play spaces, which might be achieved through freedom to manipulate and modify their play environments.

These findings align with the previously discussed open-ended character of affordances for play in the built environment as well as the capability of children to transform through play (creatively) the existing potentialities in the environment and create new affordances (see chapter 5). Moreover, this capacity of children to create meaning in their environments through pretend or imaginative play can be illustrated with findings from a study comparing traditional versus naturalized playgrounds for affordance use (Morrissey et al., 2017). Researchers

unexpectedly found that the limitations of traditional playgrounds can sometimes trigger more imaginative responses to overcome the limits of play affordances – in contrast to general study findings that open-endedness of naturalized playgrounds promotes more creative play (Morrissey et al., 2017). In other words, limited play affordances are not inherently negative. This implies that the distinctions between different types of playgrounds as well as explicit calls for abandoning one type in favor of others should be more nuanced and subjected to further empirical investigations.

Implications of research methodologies and participant characteristics. The fourth theme – (4) the implications of research methodologies and participant characteristics like gender, cultural context, and cognitive abilities – highlights several observed issues relevant for future research and design practice. Despite the large number of publications gathered through this systematic review, there were only 3 out of 83 studies on play spaces that had children with cognitive and/or physical impairments as main participants; see (Hussein, 2017; Ripat & Becker, 2012; Yuill, Strieth, Roake, Aspden, & Todd, 2007). The scarcity of evidence on how children with diverse cognitive/physical abilities and needs engage with play affordances presents a significant challenge for ensuring neurodiversity and access for all to play opportunities in the built environment. Similarly, there is a need for a fine-grained understanding of the differences in the actualization of environmental affordances between genders, especially for young people (Kernan, 2014). In addition, while the majority of identified studies were conducted by using different research methods like ethnography, behavior-mapping, recordings, there is a growing recognition of the value of considering children's perspectives on their play environments more closely – through their involvement as active participants and/or co-researchers; see (Caro, Altenburg, Dedding, & Chinapaw, 2016; Merewether, 2015).

Another observed issue relates to the cultural context of where the study is conducted and the implications for research design and generalization of results. For example, it has been suggested that some of the studies in Nordic context on risky-play could have been culturally-influenced (e.g., Sandseter, 2009). The reason might be that even traditional playgrounds in Nordic countries could be affording more challenging and diverse play opportunities compared to traditional play spaces in other contexts – due to the site-specific socio-cultural practices and norms (Kernan, 2014). The lack of visual documentation of studied playgrounds across all identified research studies prevents us from making a thorough comparison. Nonetheless, some differences between tested environments classified under the same type (e.g., traditional playgrounds) in different cultural contexts were observed. Therefore, it is worth emphasizing that the generally used classification of different playground types (i.e., traditional, contemporary, adventure, naturalized, playscapes) may not provide sufficient environment descriptors for proper comparison, especially in cross-cultural contexts.

In fact, the review identified a predominance of examined literature situated in the global north and western countries (Europe and North America) as well as English speaking countries. A significant portion of Europe-based studies (16 out of 38 papers) was conducted in Scandinavian countries: Denmark (2 papers), Finland (4), Iceland (1), Norway (5), and Sweden (4). This highlights the limitations to possible generalizations of research findings and calls for attentiveness to the geography of scholarship. Such consideration is important for the research going forward as well as for any application of research-based knowledge for developing playground design solutions.

MUSEUMS AND HOSPITALS

In addition to playgrounds as children's play spaces par excellence, our systematic literature search returned a small number of papers exploring children's engagement with

architectural spaces such as museums and hospitals. The main reason for including these works in the review lies in the particular ways in which children and children's play are conceptualized and designed within these architectural settings. In fact, they are considered here under formal play spaces as they typically delimit or enclose children's play into designated spaces within a building or within a wider urban context.

Hospitals have been recognized as environments that lack opportunities for play and learning because they are designed for safety and comfort, rather than stimulating children to move and play (Boon, Rozendaal, & Stappers, 2016). This becomes especially problematic for children requiring long-term hospitalization due to injury or disease which might limit their options for being physically active and thus, negatively influence their motor skills development. To amend such situation, Boon and colleagues (2016) outlined a new approach to thinking about play in hospital environments based on the idea of playscapes as landscapes for physical play. Their proposed design interventions in the context of a pediatric oncology were developed in ways that encourage bodily play, play beyond the boundaries of the play space, and opportunities for ambiguity, unpredictability, and open-endedness in play – with empirical testing yet to be conducted (Boon et al., 2016). Additionally, in a study on children's emotional responses to a pediatric hospital atrium, play spaces were described by children patients as offering not only a distraction from their treatments, but as therapeutic and integral to coping with stress (Koller & McLaren, 2014).

When museums are designed for children, more emphasis is traditionally placed on cognitive or museum-content learning rather than on play (Hackett, Holmes, MacRae, & Procter, 2018). The several studies identified in our systematic review challenge this position. They proposed to look beyond the idea of a "child as a learner" and to consider child's embodied experiences in and of museum spaces as guidelines for design decisions

(Birch, 2018; Hackett, Holmes, et al., 2018; Hackett, Procter, & Kummerfeld, 2018). These researchers argued that museums offer distinctly different environments compared to children's everyday places (e.g., home, school, playground, etc.). Specifically, museum settings can provide children with unprecedented spatial, multi-sensory, and affective experiences as well as with new ways to explore their bodily capabilities by enticing movement – something that often falls outside of accepted norms for a museum visit (Birch, 2018; Hackett, Holmes, et al., 2018). Importantly, it is necessary to think beyond the learning value that novel embodied experiences can bring. The researchers highlighted that spaces within a museum, but not specifically dedicated to museum-content can provide valuable – and kinetically joyful – play opportunities e.g., like climbing the large marble stairs, running, and wandering independently around the museum space (Birch, 2018; Hackett, Procter, et al., 2018).

This brings forward the idea that museum design should nurture the possibilities for serendipity, the "chance of space", and unpredictability of museum visiting experience – both in terms of

spatial design as well as improvisatory practices of visitors themselves (Hackett, Holmes, et al., 2018). In that sense, this emerging paradigm – given the very recent publication dates from 2018 – fits well within our dual-lens framework for considering the built environment as providing open-ended affordances for play and learning. Lastly, strong emphasis is placed on the intergenerational dialogues and child-adult relationships during museum visits (Birch, 2018; Hackett, Holmes, et al., 2018; Hackett, Procter, et al., 2018). Contrary to prevailing concept of children as isolated museum visitors, the researchers call for considering the ways that young children and their accompanying adults make sense of museums as they experience and engage with the spaces. Therefore, museums can be thought of as places offering opportunities for play across the play spectrum, including playful learning and guided play – as can be evidenced from some of the existing practices of participatory engagement and collaborative sensemaking in museum settings (T. Z. Henderson & Atencio, 2007; Kumpulainen, Karttunen, Juurola, & Mikkola, 2014).

... the built environment can act as a pedagogical space in two ways: through children's agency and spontaneous interactions with spatial settings as well as through carefully designed play and playful learning experiences.

PLAY AND PLAYFUL LEARNING IN INFORMAL PLAY SPACES

This dual-lens review defines informal play spaces as referring to architectural and urban environments beyond designated areas for children which include, but are not limited to, streets, open public spaces, squares, plazas, malls, vacant and parking lots. The value and necessity of considering these spaces as possible children's play environments are twofold. On the one hand, due to the processes of urbanization and commodification, children and young people are increasingly being denied access to their neighborhoods and urban spaces and compartmentalized into child-designated areas, like playgrounds in outdoor public spaces or skate parks (Bishop & Corkery, 2017). This is in contrast to children's needs to be immersed in spaces not exclusively dedicated to them. Instead, children and young people's participation through play in public spaces should be seen as a means of co-producing places as well as of their own identities (see sections "Children's right to the city" and "Children as active citizens and experts in the built environment"). On the other hand, as discussed previously, children learn everywhere and continuously – and therefore, the built environment as a key factor in their holistic development should be designed to provide a rich landscape of affordances for play and playful learning.

Based on our systematic review, it can be suggested that there is a growing recognition of the importance of investigating children's play and playful learning in informal play spaces. One approach to investigating how children actualize play affordances within open public spaces and thus, beyond the places that are specifically and exclusively designed for them has been discussed in detail in section "Affordances for play in the built environment". Some additional reasons for considering the potentials of public spaces to act as pedagogical and play spaces can be found in the approaches of place-based learning and environmental education, which both underline the value of being-in-places and active exploration for knowledge creation (Bowen, 2015; Gurholt & Sanderud, 2016). A couple of reviewed studies highlighted how children's

sensorial and affective experiences of public spaces are involved in children's meaning making and connection to places in their local environments (Bozkurt, Woolley, & Dempsey, 2018; Ladru & Gustafson, 2018; Phillips & Tossa, 2017). Moreover, games and other forms of play can provide children with embodied connection and embodied understandings of social and material aspects of their local environments (Bowen, 2015). Such observation has been made for both rural and urban contexts, with Asia being the most common geographical location of examined papers on this topic – with notable studies from Taiwan (Phillips & Tossa, 2017) and India (Bowen, 2015).

These research approaches have in common the idea that the built environment is transformed into a pedagogical space through children's agency. In other words, the built settings are not deliberately designed as play spaces – which is a typical characteristic of informal play environments. Instead, the children "unlock" the potentials and possibilities (i.e., affordances) through play that the built environment offers (see chapter 5). Thereby, emphasis is placed, often implicitly, on children's agency and free play as a child-initiated and child-directed activity – as the golden standard in current play in the built environment research.

"Learning Landscapes" initiative: Designing for play and playful learning opportunities. This section aims to highlight another approach in reviewed research proposing a more deliberate consideration of the built environment as a pedagogical space in ways that encourage play across the spectrum – thus, including not only free play, but guided play and games as well. The two recently published studies report on the "Learning Landscapes" initiative, which used playful learning methods to develop design interventions for public spaces and created opportunities for children and caregivers to play and learn (Bustamante et al., 2019; Hassinger-Das et al., 2018). The rationale behind this initiative is twofold. On the one hand, the idea of "Learning Landscapes" is grounded in the public health perspective on fundamental value of play

for healthy child development. With increasing evidence on the negative impact of factors like poverty on children's brain development, children and families from under-resourced communities are especially affected by the lack of play opportunities (Hassinger-Das et al., 2018). At the same time, the growing recognition that children's learning occurs in all spheres of life (home, school, community), urban environments have been targeted as pedagogical spaces as a way of enhancing children's opportunities for play and learning and importantly, the relationship between children and their caregivers through shared activities (Bustamante et al., 2019; Hassinger-Das et al., 2018).

Accordingly, the "Learning Landscapes" initiative – so far implemented in several cities in the United States – aims to foster playful learning by

"turning ordinary spaces throughout the city into extraordinary opportunities for interaction, engagement, and learning" (Hassinger-Das et al., 2018, p. 2). Hence, this approach to play and playful learning in the city envisions that affordances for play are intentionally designed and provided in selected public spaces. Some of the "Learning Landscape" design interventions include transforming the unexpected places in the city into opportunities for playful learning (e.g., installing human-sized board games to enhance STEM and reasoning skills in a public park). Significantly, this initiative considers playful learning as contributing to holistic skills development with some elements of academic skills as well, especially in the context of under-resourced communities (Bustamante et al., 2019; Hassinger-Das et al., 2018).



For example, one of such pilot projects is "Urban Thinkscape", installed in Belmont neighborhood in West Philadelphia in fall 2017 which transformed and activated a bus stop and an adjacent vacant lot into a play hub. This play hub included several play activities (like Puzzle Bench, Jumping Feet, Stories, and Hidden Figures) which were created to "tap into active, engaged, meaningful, and socially interactive learning contexts while also targeting specific areas of learning, such as spatial skills, language development, and executive functioning" (Hassinger-Das et al., 2018, p. 9). Additionally, strong emphasis is placed on creating opportunities where children and caregivers can come together, since strengthening intergenerational relationships significantly contributes to formation of secure emotional attachments and children's ability to cope with stress and anxiety (Bustamante et al., 2019; Hassinger-Das et al., 2018; Yogman et al., 2018).

Possibilities of place-making through play and temporary uses in the built environment. Besides the child development and learning benefits, the activations of public spaces such as a bus stop or a vacant lot also speak to the value of children's presence and play in public spaces that can contribute to placemaking. By implementing these playful learning interventions organically within the urban landscape, children are granted the opportunity to participate in the everyday life of their cities and communities, and consequently, have the chance to act as "co-producers of places and practices" (Heft, 2018; Ladru & Gustafson, 2018).

Such transformations of public spaces, especially vacant lots, fit well with the idea of temporary urbanism and the recognized, albeit underexplored, potential of short-term use to provide opportunities for children's play. For instance, it has been argued that informal play spaces such as brownfields or pop-up parks afford a range of possibilities for children's free play and development of their creativity in the process (McGlone, 2016; Rall & Haase, 2010; Rupprecht & Byrne, 2014). To highlight another

example, a placemaking project called "Seating for Socializing" in Hong Kong illustrates the potential of temporary uses to re-activate public spaces and encourage spontaneity and serendipity (Rossini, 2018). The main idea behind the project was to equip public spaces with boxes for people to sit on as well as to incite interaction between users by placing and arranging the boxes. While this project was not aimed exclusively at children, their contribution through the acts of play was essential to the success of the intervention; children-initiated play with the cubes triggered a more articulated participation by others, involving peers as well as adults (Rossini, 2018). Moreover, some advantages of temporary uses have also been recognized in the context of collaborative design process and co-creation with children in the built environment. Specifically, temporary interventions are faster implemented and can be often built together with children and young people (Leddy-Owen et al., 2018; Lundy, 2018). However, since the temporary uses are typically interim uses awaiting long-term developments (i.e., the developed interventions will be removed within a set amount of time), a careful conversation on purposes and expectations with involved children should be done prior to such projects (Schaller & Guinand, 2018).

In conclusion, the built environment and public spaces in particular can have a significant role as pedagogical spaces for supporting children's holistic development through play and playful learning. The strength of public spaces lies in the fact that these environments can bring forth the dual side of play as both the process of sensemaking and learning the rules of social and cultural practices as well as of creatively transforming the world. The state-of-the-art research reviewed in this report shows a promising line of thinking about play and playful learning in both formal and informal play spaces. Importantly, this body of research also clearly emphasizes the need and opportunities for gathering empirical evidence on designed spaces in order to measure and assess the impact of such interventions for promoting play and playful learning in the built environment.

SUMMARY

According to our dual-lens review of academic literature examining how the built environment could act as a pedagogical space by promoting children's holistic development through play and playful learning, there are several aspects to be highlighted:

- Children experience and engage with the built environment with their whole bodies: learning and play are embodied, multi-sensory, affective, and movement-based activities.
- Children's play and learning occur in all spheres of life: school, home, community and consequently, it is necessary to consider different contexts of children's lives and where they play – including both formal and informal play spaces – and different types of play across the play spectrum (free play, guided play, games).
- Children in play spaces should not be considered in isolation – instead, considering that the intergenerational dialogues and child-adult relationships are important as well as the role of adults as caregivers in providing and enhancing children's opportunities for play and playful learning in the built environment, especially in disadvantaged communities and public spaces.
- Play experiences can help individuals connect with places around them by providing an embodied connection and embodied understanding of both social and material aspects of their environments.
- Potential of "placemaking through play": by transforming unexpected places in the city into opportunities for playful learning, meaningful play experiences, and for children and caregivers to come together (e.g., through temporary use interventions and creation of "Learning Landscapes").
- Current research indicates that there is a need for a mixture of unstructured and structured play (i.e. free and guided play) to increase children's physical activity and positively affect fundamental motor skills development – free play alone is not enough.
- Future research should be attentive to nuances between different types of playgrounds (e.g., traditional, contemporary, naturalized, playscapes) and their effects on different types of play – as well as to the cultural context of where the study is conducted.
- Children prefer variability, novelty and possibility of change, and the unpredictable to happen in their play spaces, which might be achieved in part through freedom to manipulate and modify their environments. Strong emphasis is placed on the open-endedness of affordances for play in both formal and informal play spaces.
- Overall, while there are promising interventions for encouraging play and playful learning in both formal and informal play spaces, there is a need for gathering empirical evidence to assess and measure the impact of designed spaces and interventions.



...the built environment and public spaces in particular can have a significant role as pedagogical spaces for supporting children's holistic development through play and playful learning.

Review of practice: The collaborative design process with children in the built environment

A total of 20 cases was identified following the outcomes of the systematic review of literature associated with phase 1 of the research. The second phase of the study sought to explicitly exemplify practices of co-creation with children in the built environment and to develop a critical commentary on their features, including: the geography of cases; the scale of child involvement in these practices; the purpose of each project; tactics for operationalizing these methodologies; types of built environment spaces; the duration of each project; and the participants/facilitators involved. These elements are explored over the subsequent sections, first through a discussion of the geography of the reviewed cases followed by an analysis of the outcomes of the review of practice, summarized in a table with an accompanying commentary on key identified patterns and relationships.

GEOGRAPHY OF REVIEWED CASES

Analyzing the geography of cases highlighted some notable features and patterns. Due to the scope of the review – an analysis of academic peer-reviewed journals published in English – the map returned that published scholarly knowledge on the topic is particularly dominant in English speaking countries (40% or eight cases). Tied to this is an unhealthy predominance of cases situated in the global north and western countries, particularly European and Australian cities with nine and six cases respectively (75% of featured cases stem from these geographical

areas). Outside of this, the remaining 25% or five cases stem from Asia (three), Africa (one), and North America (one). In recognizing the limitation of geographical emphasis based on published material, the map of cases and the subsequent discussion on practices recognize that the examples listed are not exhaustive. Our review does not suggest that similar occurrences are not a reality in Latin America or other parts of Africa or Asia. Rather, we recognize that valuable knowledge will exist beyond these cases, emphasizing a limitation in our methodology as opposed to a lack of awareness in these geographies.

Alongside geographical distinctions, temporal patterns in scholarship on the topic can be identified in two areas. Firstly, we can see that the cases reviewed span a period of six years, from 2012-18. In assessing the progression of empirical cases via the frequency of publication, it is possible to identify that empirically the topic is an emerging area of urban scholarship, with 75% of the reviewed cases published between 2016 and 2018 (15 papers). Secondly, spatial-temporal analysis highlights that the geographic emphasis of the literature has shifted as documented cases progress from seminal works in Asia and Oceania (2012-2017) to Europe (2017-2018). This suggests that the former continents are particularly adept at the practice, having had a longer association in the literature, by comparison to the latter territory. Here, we see

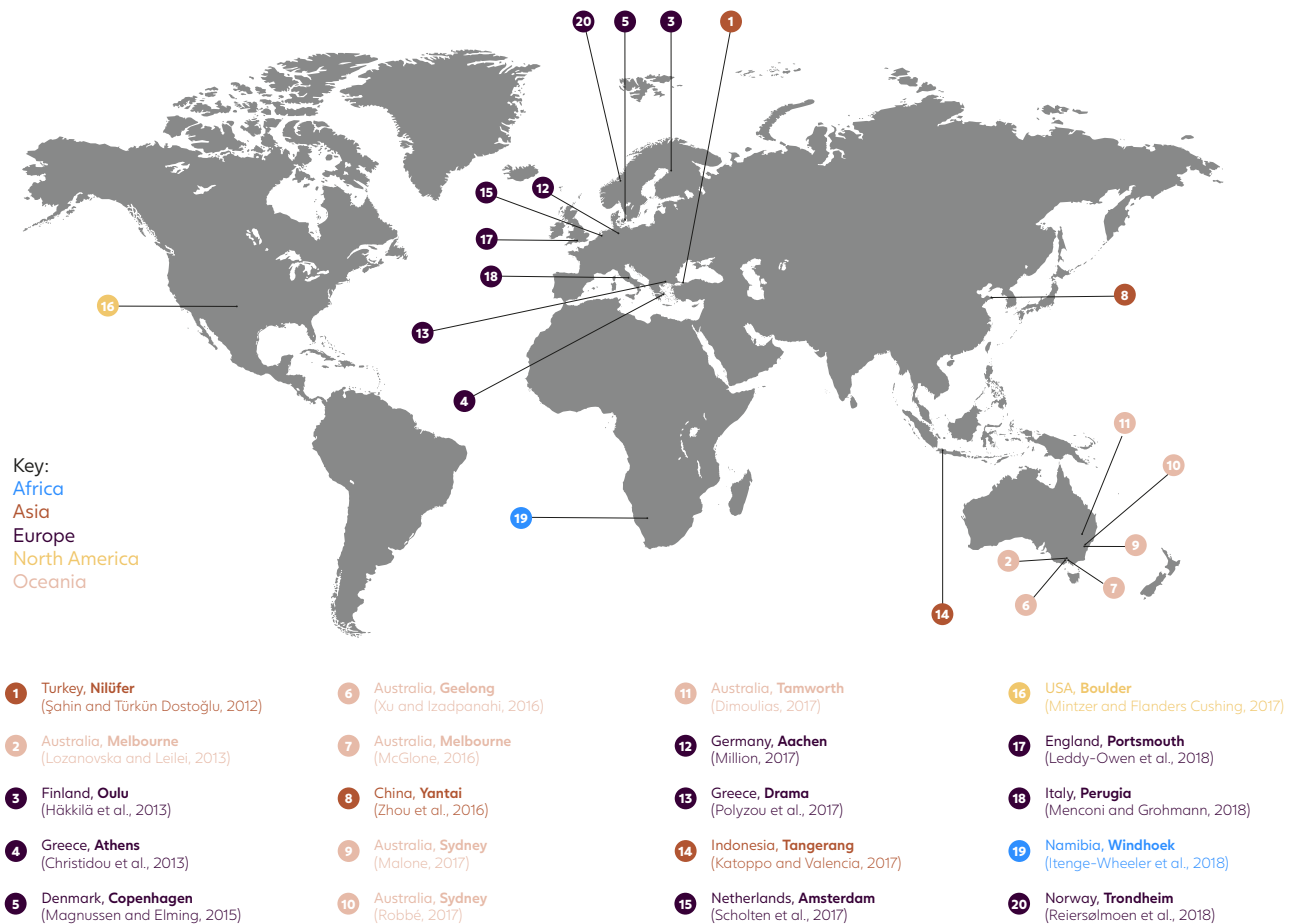


Figure 11: Geography of reviewed cases

how practices transfer across space and time with European cases entering the literature with greater frequency in the last two/three years. Nonetheless, taken together, it is possible to show that empirical interest in co-creating the built environment with children is increasing in academic publication overall, but remains underexplored.

The subsequent sections unpack the twenty cases featured in Figure 11 via a summary of their key components, an expanded table, and a discussion of the critical outcomes of the review. The geography of cases (Figure 11) and review of practice (Table 4) can be read in parallel as the order, listing, and color-coding are used consistently throughout.

KEY HEADLINES AND EXEMPLARY CASES

The researchers identified six variables to be of particular interest in analyzing and reviewing practices of co-creation in the built environment with children. In wanting to develop a baseline understanding of empirical examples and in

order to determine the opportunities offered by previous cases, the review of practice identified the following variables: the scale of children's involvement; the purpose of the collaborative process; the tactics employed to engage children; the types of space on which the process was focused; the duration of children's involvement; and the participants of the process (see Table 2). Through these variables and their associated categories, the authors highlight how practices of co-creation converge and contrast across different contexts and spaces in the built environment.

The derivation of variables and categories outlined in Table 2 should be used to navigate the review of practice (Table 4). The inclusion of a comprehensive and extensive summative table in conjunction with the text narrative enables readers to pursue the cases/practices that are of most explicit relevance to their interests while also ensuring a consistent analysis is provided. A summary of the key headlines of the review are subsequently outlined.

KEY HEADLINES

Scale of involvement:

- **10 of 20 cases** (50%) involved children in the generation of design ideas only (often with some form of spatial analysis, sketching, or mapping)
- **4 of 20 cases** (20%) involved children in the development of a design proposal.
- **3 of 20 cases** (15%) were representative of consultation as opposed collaboration.
- Only **3 of 20 cases** (15%) involved children in the entire design process from initial analysis to construction.

Purpose:

- **10 of 20 cases** (50%) related to the re-design of formal play spaces (including school playgrounds, school buildings, or youth centers).
- **10 of 20 cases** (50%) focused on the re-design of informal play spaces (including public spaces, squares, or city streets). However, four of these cases focused on the creation of virtual models while another did not involve children at all.
- Only **5 of 20 cases** (25%) focused specifically on the collaborative redesign of informal play spaces in the built environment (see Type of space).

Tactics:

- **20 of 20 cases** (100%) featured spatial workshops and design charrettes with children for different purposes as a core component of their methodology, representing a standard tactic.
- **7 of 20 cases** (30%) employed the use of virtual games or digital technology as the main mechanism to capture children's design ideas (Minecraft, smartphone app, or web-based mapping software).
- **7 of 20 cases** (30%) developed physical 3D models of the children's proposed interventions for comment, review, and improvement.

Type of space:

- **9 of 20 cases** (45%) related to architectural project scales/environments. Of which 7 cases (78%) focus on school playgrounds/yards.
- **9 of 20 cases** (45%) related to urban project scales/environments. Of which 8 cases (89%) focus on public spaces (squares, city streets, and the public realm).
- **2 of 20 cases** (10%) relate to architectural and urban project scales/environments. Both focus on public spaces.
- Only **3 of 20 cases** documented a collaboratively constructed physical design intervention. One architectural case relating to a school playground, one urban case relating to a temporary pop-up park, and one architectural/urban case relating to the construction of a temporary structure in a public space.

Duration of involvement:

- **4 of 20 cases** (20%) involved children in the process for a period of 1 day or less (24 hours or less).
- **2 of 20 cases** (10%) involved children for a period of more than 1 day, but less than 1 week.
- **7 of 20 cases** (35%) involved children in the process for 1 month to 6 months.
- **3 of 20 cases** (15%) involved children in the process for 1 year to 3 years.
- Missing information from source was recorded for 4 of the 20 cases in this category.

Participants involved:

- **20 of 20 cases** (100%) involved some form of adult facilitation (e.g., children with researchers, spatial professionals, or university students)
- **20 of 20 cases** (100%) represented a collaborative partnership of one or more organization (e.g., a university and a youth center or a consultancy, the local authority, and a school)
- **19 of 20 cases** (95%) involved collaborations with children linked to a particular school.
- **14 of 20 cases** (70%) involved university researchers/students as the translators of children's ideas.
- **6 of 20 cases** (30%) involved spatial/built environment professionals as the translators of children's ideas.
- **5 cases** (25%) involved a combination of university researchers/students and spatial/built environment professionals.
- Missing information from source was recorded for 1 case in this category.

EXEMPLARY CASES

Based on the broader descriptors associated with the review and the outcomes emphasized above, the researchers identified five exemplary cases, worthy of particular note, across the twenty cases featured. Each case represents a unique set of practices demonstrative of "good" or "better" practice in the collaborative involvement of children in the design and creation of the built environment:

- 7) Australia, Melbourne (McGlone, 2016) see: *Purpose; Type of space*
- 10) Australia, Sydney (Robbé, 2017) see: *Scale of involvement*
- 11) Australia, Tamworth (Dimoulis, 2017) see: *Tactics; Participants involved*
- 16) USA, Boulder (Mintzer and Flanders Cushing 2017) see: *Scale of involvement*
- 17) England, Portsmouth (Leddy-Owen et al., 2018) see: *Scale of involvement*

For more information on each of these cases among others, please see the review of practice table overleaf. A discussion is provided at the conclusion of Table 4.

Table 4. Review of practice: Summary of cases across six key variables

Case	Scale of Involvement	Purpose	Tactics	Type of Space	Duration of Involvement	Participants Involved
1) Turkey, Nilüfer (Şahin and Türkün Dostoğlu, 2012)	Generation of design ideas	Children evaluate the physical conditions of their kindergartens to put forward positive and negative experiences of preschool environments to provide designers with data to influence their design concepts.	Children selected via random sampling to participate in an interview about the physical environment of their kindergarten (e.g., classroom conditions as well as indoor and outdoor environments).	Architectural - School building - School playground - Indoor/ outdoor	1 day	24 children ages 5-6 years, facilitated by the researchers.
2) Australia, Melbourne (Lozanovska and Leilei, 2013)	Research, design ideas and proposal	A pedagogical model for children's genuine participation in architectural design, developed in an architectural education context. Architecture university students work with primary school children to design a school playground. The final product of the project was a 1:20 scale model.	Run in the form of a series of workshops focusing on preparation; development of design; and installation, evaluation, and exhibition. During this process, children took the role of designers and the university students "design partners/scribes", recording the children's creativity. They listened to the children's ideas, passed on their design knowledge, and facilitated the design process by employing their architectural training. The collaboration was realized through a range of design activities such as storytelling, discussion, sketching, and model-making.	Architectural - School playground - School buildings - Outdoor/ indoor	1 month	90 primary school children, facilitated by 90 university students.
3) Finland, Oulu (Häkikilä et al., 2013)	Generation of design ideas*	Use of 3D city modelling as a creativity platform to operationalize school children's design ideas to reimagine a public square and street. The purpose is to show how virtual "world" representations can be used to enable children's ideas/perceptions of city spaces.	Workshop which tasked children with drawing content that could be placed on the walls of a 3D model of the city center. Children were provided with a collection of different drawing and painting equipment and asked to mark where they wanted their drawing to be placed on the 3D city model. 40 drawings - developed by the children - were then integrated into a 3D virtual model of a public square and street by the research team.	Urban - Public square - City street - Outdoor *Emphasis on virtual models to influence the future of urban spaces.	4 hours	40 participants, 16 aged between 7-10 and 24 aged between 10-13, facilitated by three university researchers.
4) Greece, Athens (Christidou et al., 2013)	Research, design ideas, sketching	Exploration of how a specific school ground is perceived and used by children. Study focused on how children communicate their experience of place in order to analyze how participatory design methods can actively involve school children in the redesign of spaces.	Mapping of the physical features of the school ground; children's drawings of the school ground (36 pupils); interviews with children (36 pupils) and observation and mapping of children's behavior in/on the school ground (230 pupils). The combination was analyzed to determine those elements considered by the pupils as most important or prevalent in/on their school ground.	Architectural - School playground - Outdoor	1 year	266 children aged between 9-11, facilitated by academic researchers.

Case	Scale of Involvement	Purpose	Tactics	Type of Space	Duration of Involvement	Participants Involved
5) Denmark, Copenhagen (Magnussen and Elming, 2015)	Spatial analysis and design ideas*	A community-driven science gaming project where students in collaboration with urban planners and youth project workers used Minecraft to construct models for redesigning a deprived neighborhood in order to collectively generate solutions to problems in their local area and increase safety.	School pupils were exposed to a five-phase process with different tactics and elements on how to use game tools to apply their knowledge and ideas to redesign spaces in their neighborhood. Field trips and dedicated sessions on core concepts in urban planning by spatial professionals helped children identify spatial challenges and dedicated sessions on modelling in Minecraft enabled them to put forward 3D versions of their ideas.	Urban - Public spaces - Neighborhoods *Emphasis on virtual models to influence the future of urban spaces.	4 days	25 school children ages 13-15 years, facilitated by spatial professionals in urban planning and academic researchers
6) Australia, Geelong (Xu and Izadpanahi, 2016)	Design ideas and proposal	Architecture university students collaborating with primary school children to design a playground structure.	Each child created a portfolio, which documented their weekly activities and his/her experiences. The architecture students listened to the children's stories, inspired the children's design ideas, drew with them, and built models with them.	Architectural - School Playground - Outdoor	2 months	Primary school pupils, facilitated by university students
7) Australia, Melbourne (McGloone, 2016)	Knowledge creation with children* **	To examine the potential role of temporary public space in the lives of children by analyzing children's experiences of a temporary Pop-Up Park. Findings suggest temporary public spaces can provide children with opportunities for unstructured creative play, connections with place and community, and offer relaxation.	Mosaic approach to children's participation was used which views children as the experts of their own lives while also allowing data to be collected from children's guardians and other adults who influence their world. Multiple methods used for engagement including deep listening; reflexivity; semi-structured (conversational) interviews; verbal, written, or drawn responses; focus groups (one with children only and one with adults only); and observations of the pop-up park at differing days/times. Research designed to give children the highest possible level of control over data manufactured and gathered, enabling children to be active protagonists in the study.	Urban - Public space - Streets - Temporary park - Outdoor *Emphasis on the actual use of a temporary space to demonstrate its value to children (seminal approach).	-	20 children ages 5-12 years, facilitated by seven adults **Gender bias as only five of the 20 children were male. Additionally, there were no men among the 7 adults.
8) China, Yantai (Zhou et al., 2016)	Web-based participatory mapping	Examination of where children play in a city undergoing rapid urbanization to understand how spaces for urban play are selected and how children perceive these places. The goal is to assist city planners and professionals to encourage more outdoor play in the redesign of the urban environment.	Participants recruited from a primary school to gather children's opinions about the quality of play spaces within a specific study area. Participant mapping in which children - with the help of their parents - were asked to think about their neighborhood play spaces and identify their quality (good/bad). Training sessions were conducted to teach all children how to use Google Maps and the mapping interface associated with the research.	Urban - Neighborhoods - Public spaces across the city - Parks - Outdoor	1 month	327 children ages 10-13 years and a parent per participant, facilitated by planning professionals.
9) Australia, Sydney (Malone, 2017)	Design ideas and spatial analysis	To create an opportunity for children to provide input for the design of a new playground in their neighborhood alongside the development of child-friendly neighborhood themes/indicators for future projects.	Toolkit of quantitative and qualitative methods to evaluate the child-friendly qualities of the existing physical neighborhood, including: workshops; surveys; questionnaires; cognitive mapping; drawings; photography; spatial observations and mapping; interviews; storytelling; and time schedules. Children as co-researchers could identify which data collection methods provided the best fit between their own interests and skills and the context of the study/study site.	Urban/ Architectural - Public spaces across the city - Neighborhood - School playground Outdoor/ indoor	3 months	150 children, 30 aged between 5-6 years and 120 children from 9-10 years, facilitated by a research team on behalf of a national urban developer.

Case	Scale of Involvement	Purpose	Tactics	Type of Space	Duration of Involvement	Participants Involved
10) Australia, Sydney (Robb�, 2017)	Entire process (from analysis and generation of design ideas to construction inspection)	Student-led design process, redesigning a school playground to better facilitate open-ended outdoor play. Landscape architecture professionals facilitated the participatory design process and the translation of the children's ideas into a fully resolved design for construction (16 week construction period).	Each child created a booklet entitled "Playgrounds" with all of their ideas for the site (444 total). The 28 booklets were analyzed systematically to ascertain common themes. Negotiation of requests and discussions on available budget enabled children to formulate a working design brief to be taken forward by the professionals. Children reviewed the concept plan, design suggestions, and costs produced by the professionals. Once agreed, children then assisted with gathering additional site information to commission detailed drawings for tender (including surveying slope and drainage). The 28 participants were involved in the selection and interviewing of contractors. Children carried out construction inspections during live works and had the opportunity to ask questions and gather information.	Architectural - School - Playground - Outdoor	3 years *From initial contact to the opening of the playground.	28 children aged between 6-7 years, facilitated by their school principal and landscape architecture professionals.
11) Australia, Tamworth (Dimoulas, 2017)	Consultation, design ideas, mapping	To create a purpose-built youth center and skate park with young people's involvement from design to usage in a deprived area with high incidence of crime.	A two-phase strategy was initiated over a prolonged timeframe. Users and citizens in the project neighborhood were involved in a variety of consultation and design activities including: community asset surveys with residents and young people; focus groups with young people; community-wide workshops; "kitchen table" consultations with residents and young people in their homes; two "world caf�" consultations with 60 local government/non-government agencies; a community petition (over 500 signatures); a two-day forum with young people; and door knocking with those situated in close proximity to the two proposed sites. The combination was employed to ensure that users, neighbours, the community, and local government were involved in the design process - to better understand what young people need from these spaces.	Architectural - Youth center - Neighborhood - Strategic site selection - Indoor/ outdoor	-	228 young people (10-18 years old) and 649 residents facilitated by a consultant and academic researchers.
12) Germany, Aachen (Million, 2017)	Generation of Design Ideas	To promote built environment education and the participation of children and young people in urban planning and design. Jugend Architektur Stadt e.V. (JAS) conducts educational workshops and participatory planning projects for and with children and young people in cooperation with different partners, such as private initiatives, schools, municipalities, universities, and other institutions with a focus on enabling children and young people for more effective participation.	Multiple visual methods are used to enable children and young people to learn about the city and processes of spatial production and to express their ideas including: speech, text, images, film, site analysis, models, or 1:1 scale installations in buildings, on streets or in plazas. Notable examples include: use of historic paintings to challenge young people's views about their neighborhood; testing ideas for public spaces through temporary events such as the closing of a neighborhood street; a billboard campaign to present young people's ideas for public spaces and high school and university students producing a game to be played in the public realm to define the elements involved in redesigning a specific public square.	Urban - Streets - Plazas - Parks - Public spaces - Outdoor	-	-
13) Greece, Drama (Polyzou et al., 2017)	Generation of initial design Ideas*	Emphasis on utilizing ICT as a tool for generating children's ideas through a decision-making process which results in changes to their schoolyards (two urban primary schools). The preferences of the school pupils are to be translated into plans/drawings by landscape architecture students at a local university. The redevelopment plan will be funded by the local municipality.	Use of an adapted drawing program (TUX paint) as a research tool in which children were asked to develop a vision for their schoolyard combining hand drawn plans and sketches utilizing the software. Children were involved in walking tours of the schoolyard to map elements they liked/disliked accompanied by photographs and a description. Individual A3 drawings of their dream schoolyard and use of internet precedents to present similar ideas were presented to the class for comparison and agreement. Individuals/pairs then worked with the software to realize their vision.	Architectural - Schoolyards - Outdoor *Emphasis on virtual models and the evaluation of ICT tools as a means of operationalizing children's design ideas.	4 months	116 primary school children between 10-12 years old, facilitated by the local authority and the Department of Landscape Architecture at a local university.

Case	Scale of Involvement	Purpose	Tactics	Type of Space	Duration of Involvement	Participants Involved
14) Indonesia, Tangerang (Katoppo and Valencia, 2017)	Map generation	Building creative urban spaces for the children to champion change within the community.	Workshops designed to build creativity and sense of awareness toward a more hygienic and "green" environment. Mapping of children's play activities in urban spaces. Creation of 3D models to activate children's ideas.	Urban - Public spaces across the city - Outdoor	2 hours/ 1 day	50 children, facilitated by 6 researchers.
15) Netherlands, Amsterdam (Scholten et al., 2017)	Generation of design ideas*	Use of Minecraft (Geocraft) to give children a voice to express their wishes and ideas about the spatial design of the former industrial area surrounding their newly built school. Children were asked to redesign the public space around the high school as part of a wider regeneration initiative to develop a lively residential area with spaces for sports, shopping, and education. The project was initiated and facilitated by a public engagement consultancy in conjunction with a professional planner and university research lab.	Students either already knew Minecraft or learned on the job. Students were divided into design teams working for 2 hours per week for 4 weeks. Each team was given a simple instruction "change the current space into one you like!" Based on the input of the student design teams, a professional urban planner amalgamated the ideas into a feasible design. The project collected and inventoried the students' needs and wishes as the users of the space, which were subsequently presented to deciding stakeholders. The final design (generated by the professional urban planner) was recognized by the students as their own design.	Urban - Public space - Outdoor *Emphasis on virtual models to influence the future design of a former industrial space.	2 hours per week for 4 weeks	High school students, facilitated by public engagement consultancy, a professional urban planner, and university research lab.
16) USA, Boulder (Mintzer and Flanders Cushing, 2017)	Entire process (from analysis and generation of design ideas to adoption of proposals in planning policy*) *Construction to follow	Children, adolescents, and university students (studying environmental design, architecture, landscape architecture, and planning) designing a public space in the heart of downtown Boulder. Primary school children designed tree houses for the space to see birds, touch trees, read books, and relax. This outcome was a result of activities facilitated through Growing Up Boulder, an ongoing child, and youth-friendly city initiative that has enabled community leaders to embrace young people's design and planning ideas transferring them into dedicated policies.	Creative, multimodal methods of engagement including photovoice, 3-D model making, mapping, persuasive writing, drawing, and digital presentations. Projects commence by establishing children as experts and increasing children's competence through slide-shows, videos, field trips, independent research, and conversations with experts. "Share-out" events then allow children to synthesize what they have learned and share their recommendations. University students contribute technical and graphic communication skills, and an understanding of the physical environment enabling the children to operationalize their proposals.	Urban - Public spaces - Indoor/ outdoor	3 years	Children between 3-18 years old, facilitated by university students and staff, teachers, city government, and the community-at-large.
17) England, Portsmouth (Leddy-Owen et al., 2018)	Entire process (from analysis and generation of design ideas to construction)	To co-design and construct a temporary structure in a neglected urban space. Researchers consulted and worked with members of a youth club in a deprived area to try to enable spatial appropriation through participatory design. Researchers highlight how age- and class-based relationships between marginalized youths constrained and inhibited their participatory approach.	Co-design workshops convened by the academic research team (comprised of an architect and two sociologists) explored what types of temporary timber structure club members would like to be built. Workshops facilitated by university student volunteers prioritized club member-led input and were split between three phases: site analysis; design ideas; and final design and construction. Varying degrees of success were recorded across each stage due to the club's social dynamics and behavior of some members (including disciplinary issues, swearing, references to sex and bodies, or the giving of scatological nicknames to researchers/students). The architecture students recorded members' ideas via field notes, sketches, drawings, and models. Members were then presented with 11 final designs to vote on. Once the design was agreed upon, participants were given opportunities to be involved in the construction process. Prior to construction, a main component of the agreed and voted on design was rejected by local government on health and safety grounds (referring to the potential dangers of a swing) subsequently dissuading a number of younger members. Varying degrees of success were recorded in the co-construction of the temporary structure, with some members claiming the process to be "boring".	Urban/ Architectural - Temporary structure - Public space - Outdoor	3 months	Children/youth 11-19 years old*, facilitated by university staff, architecture students, and members of the youth club *Researchers attempted to encourage older members (16-19) to get involved in the design and construction process, but with limited success.

Case	Scale of Involvement	Purpose	Tactics	Type of Space	Duration of Involvement	Participants Involved
18) Italy, Perugia (Menconi and Grohmann, 2018)	Generation of design ideas	To develop a transferable method to build a children-led vision for retrofitting elementary school playgrounds and form alliances between universities, elementary schools, and public bodies to encourage children's participatory processes and public decision-making.	Organized across seven workshops with two stages: a "preparation stage" using words, texts, posters, drawings with the objective of creating a children-led vision for the school playground and a "design stage" using physical models built by the children with recycled materials and virtual 3D models built by university students with the objective of realizing a 3D representation of the children's ideas. Here, university students (accompanied by their lecturers and the elementary teachers) acted as moderators to help children realize their design ideas and models.	Architectural - School playground - Schoolyard - Indoor/ outdoor	6 months	327 participants, 288 children between 5-10 years old, facilitated by 37 university students, two university academics, and support from elementary school teachers.
19) Namibia, Windhoek (Itenge-Wheeler et al., 2018)	Generation of design ideas	Redesign of school library to create a conducive reading space with technologies that cater to children with a variety of reading skills/abilities.	Personas used to understand different uses of the space, creative workshops, and use of different materials to create ideas.	Architectural - School Building - Indoor	2 hours a week over a period of 4 months	19 children between 10-13 years old facilitated by 4 researchers.
20) Norway, Trondheim (Reiersølmoen et al., 2018)	Application testing*	Creation of a smartphone platform that allows young people to be actively involved in planning processes that affect their daily lives.	App development and survey. Every survey revolves around one specific development project. The survey is designed like a treasure hunt, where each task of the survey is connected to locations that the user has to find and interact with by contributing ideas and thoughts about the place.	Urban - Specific development project/initiatives - Outdoor	-	4 test participants facilitated by the researchers. *Only one young person (15 years old). Pilot project involved three adults (28, 44, 45 years old respectively).

(-) Similar information missing from source.

DESIGNER-CHILD COLLABORATION IN PRACTICE

The review of practice and associated analysis raised important insights on existing empirical scholarship, particularly on the potential complexities associated with defining and realizing designer-child collaboration in the built environment. Across 20 built environment cases, very little consistency could be identified on the practice of co-creation involving children. While most cases went beyond tokenistic engagement or "co-creation" as a label to sell a particularly progressive approach, the conceptual underpinning of the co-creation strategy as a whole remains difficult to define. Ultimately, determining genuine co-creation strategies involving children in the design of the built environment is a complex procedure, relating to three key aspects: (1) the scale of child

involvement, (2) the specificity of the purpose or outcome of the project as well as (3) the duration of children's active involvement in the process. For example, only three of the abovementioned practice-based cases involved children throughout the entire design process from analysis to construction/intervention (Leddy-Owen et al., 2018; Mintzer & Flanders Cushing, 2017; Robbé, 2017). Furthermore, in analyzing the intended purpose, more projects focused on the realization of virtual games and physical 3D models with children than actual interventions in built space. This may hint at the complexity of involving children any further in the process or that the realistic expectation for co-creation in the built environment with children might stop at a particular point, both affect conceptions and definitions of the practice.

Determining genuine co-creation strategies involving children in the design of the built environment is a complex procedure, relating to three key aspects: (1) the scale of child involvement, (2) the specificity of the purpose or outcome of the project as well as (3) the duration of children's active involvement in the process.

Despite wanting to explore a broad range of urban environments, half of the cases reviewed were concerned with the re-design of formal play spaces in schools or youth centers. In reality, all recorded cases were directly linked with a school or youth center. Thus, disciplined environments remain the principle entry point to engagement processes with children, which in tandem affect the type of space documented. Likewise, applications of co-creation in urban settings or informal play environments also displayed a particular pattern, with a preponderance of cases in public spaces. Instances beyond squares or streets were not recorded, thus it is not possible to comment on the contribution of parks, vacant land, or other urban environments. Moreover, the relationship between urban cases and public spaces highlights another limiting factor, namely the complexity of the built environment itself. Unlike schools or youth centers where ownership is clear, intervening in urban spaces is complex and subject to a host of regulatory standards and procedures such as the need for formal permission from owners, the potential need for planning permission, a requirement to comply with building standards, health and safety protocols, and licensing, amongst other factors (Martin et al., 2019). Only two cases document a collaboratively constructed physical design intervention in urban spaces (Leddy-Owen et al., 2018; Million, 2017). Nonetheless, neither researcher touches upon these regulatory complexities bar a mention of planning officers rejecting portions of the collaborative design featured in Leddy-Owen et al. (2018), much to the children's disappointment. Coupled with this, details relating to cost and the positionality of decision makers were not a common feature of either source. Therefore, there is a need to develop more depth on the potentials and pitfalls of co-creation in urban settings with children than can be ascertained from the review. Opportunities exist to augment these studies through further empirical research on the topic.

Finally, in reviewing the duration of children's active involvement, projects more commonly ranged from months to years than days to weeks (Menconi & Grohmann, 2018). Furthermore, adult facilitation and collaborative partnerships with one or multiple

organizations were a feature of all cases shown. In reflecting on the partnerships recorded, it would appear similar approaches can be more commonly realized in academic and research environments than in professional practice. This may highlight the types of institution or organization that can more readily commit to these strategies. Nonetheless, time and resource requirements represent significant determining factors in the success of the collaboration. Outside of these, ethical and risk related factors were also a concern.

Following the outcomes of the review, and as emphasized immediately above, it was possible to determine that designer-child collaboration in the built environment gives rise to a range of benefits as well as challenges. The subsequent sections of the review of practice discuss this dichotomy in more detail. In doing so, we focus on three prominent benefits (use of play, child development, and unique collaborative partners) and three critical challenges (practitioner interest, tokenistic engagement, and unequal power relations).

CHILDREN AS AGENTS OF CHANGE: THE BENEFITS OF INVOLVING CHILDREN IN PLACEMAKING PROCESSES

The examples of practice reviewed show how children can be involved as active agents (see chapter 4) in the development and design of the built environment through approaches prioritizing collaborative design. Cases illustrate how co-creation can enable children by providing them with opportunities to shape and design the cities of tomorrow. The advantages of involving children in collaborative design processes have been discussed widely in academic literature (see, for example, Chawla & Heft, 2002; Christidou, Tsevreni, Epitropou, & Kittas, 2013; O'Connor, 2013; Robbé, 2017). Here, scholars demonstrate how collaborative design with children can benefit spatial/design professionals and communities by offering a different perspective on place and space (Birch et al., 2017b; Bishop & Corkery, 2017; Can & Inalhan, 2017; Driskell, Bannerjee, & Chawla, 2001). Literature showed how children's often very creative and inventive ways of approaching both the design process

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and the design solution influenced the outcome, frequently changing the emphasis or direction of the process. Thus, inviting children as a stakeholder group into a co-creative design process brings value, not only to the creative output of the process, but also to the community and the practitioners involved (Chawla & Heft, 2002; Malone, 2017; Robb , 2017). For children, co-creation design processes were shown to help develop a variety of skills in "critical thinking, creativity, imagination, and communication as well as generating a sense of belonging or group membership" (Christidou et al., 2013, p. 78). However, involving children in the collaborative design of the built environment remains a novel strategy.

The review highlighted the benefits of involving children in design processes, nonetheless, only a small, but emerging body of literature actually explored the "co-creative design process" itself and how designer-child collaboration strategies may form or evolve. Initial efforts include Lundy (2018), Birch et al. (2017b), and Bosco and Joassart-Marcelli (2015). Birch et al. (2017b), for example, investigated four different collaborative projects with children, studying the dialogue between practitioners and children in co-creation processes. Their work stressed that collaborative dialogue with children requires empathy and attentive listening as well as the need for the designer to give up a certain amount of control. This space for dialogue was at the core of the collaborative design process, where "children and designers build a shared narrative and arrive to a point one would not get to alone" (Birch et al., 2017b).

ENGAGING CHILDREN THROUGH PLAY

One common method in developing this shared narrative was the recognition of children's playfulness as a facilitation tool. In each of the reviewed cases, play was used as a core component of the methodology, enabling children to engage in multifaceted spatial workshops or design charrettes through a common entry point. Play also provided opportunities for design professionals to enter into the children's world and understand their

perspective. Acting as "the intermediary in child-designer encounters" (Birch et al., 2017a, p. 250), play supports design professionals to better connect with children meeting them on their own terms. Here, play empowered children to more readily communicate their visions, ideas, and desires to design professionals. In co-creation processes with children, play was shown to "enable the construction of a dialogue and thus enhance communication [between players], as players are required to respond to something unexpected, which is not under their control" (Birch et al., 2017a, p. 251).

Reviewed cases included a plethora of play oriented methods, techniques, and tactics to engage children in built environment collaborative design processes. Methods such as drawing by hand, map making, and doodling represented the most common approaches (Polyzou, Tamoutseli, & Sechidis, 2017). Outside of these traditional methods, multiple cases prioritized the involvement of children in the development of physical 3D models. Several others employed the use of virtual games and digital technology – including Minecraft, smartphone applications, or web-based mapping software – to capture children's design ideas (Magnussen & Elming, 2015; Scholten et al., 2017). The review suggests that a mixed-method approach, combining drawing by hand/craft with digital tools, can be an effective strategy to operationalize collaborative design processes with children.

CHILD DEVELOPMENT THROUGH COLLABORATIVE PROCESS

In analyzing these unique cases, the review showed that co-creation has the potential to provide children with new knowledge and skills. In participating in the process, children acquire new factual knowledge (content learning) about the built environment as well as knowledge on the co-creation process itself (Figure 12). In their case of "Growing Up Boulder", a project focused on developing a nature play area, Mintzer and Flanders Cushing (2017), observed that children were provided with the opportunity to learn and reflect about nature play areas based on

examples from cases around the world. By participating, children were exposed to a broader set of knowledge than just the specific design they were involved in. Rather, as also emphasized by Hart (2008), the collaborative process produced local and content knowledge as well as innovation. By entering into the process, participants were able to learn outside of their school environment, acquiring new skills in a different setting than would be possible under the normal educational system (Hart, 2008). The unique situation of the collaborative process also fosters social learning, requiring children – often of different ages or abilities – to act as part of a collective to achieve a common goal (Eggertsen Teder, 2018). Lozanovska and Xu (2013), in their study of the collaborative design of a primary school playground in Melbourne, demonstrate how co-creation processes can “teach children literacy (through storytelling), mathematics (through the operation of multiplication and division, which are essential to drawing to scale), art (through drawing), crafting

(through modelling), and communication (through working in teams)” (Lozanovska & Xu, 2013, p. 223). In working collaboratively with designers to envision the future of a specific physical environment, multiple studies emphasized that children and young people acquired a range of new skills and competencies including, advances in spatial understanding, spatial connectivity, and spatial literacy, which in turn increased children’s confidence and autonomy (Campos & Garcia, 2018; Katoppo & Valencia, 2017).

UNIQUE COLLABORATIONS AND PARTNERSHIPS

Collaborative partnerships of one or more organizations were a feature of every case registered in the review. In engaging with children and fostering a co-creative process, the exchange was often authorized by one stakeholder, typically the children’s school (i.e., through their teachers or in some cases, the school principal), but managed by another stakeholder, commonly a university researcher or built environment professional. Nevertheless, in



Figure 12: Collaborative process as an opportunity for children to develop holistic skills and co-create new knowledge

...co-creation can enable children by providing them with opportunities to shape and design the cities of tomorrow.

...collaborative design with children can benefit spatial/design professionals and communities by offering a different perspective on place and space.



the review, we identified the presence of a third category of actors in co-creation processes, namely the “translator”, those individuals who were responsible for translating the children’s ideas into specific results. In 14 separate cases, these “translators” took the form of university students from architecture and design degree programs (Lozanovska & Xu, 2013; Menconi & Grohmann, 2018; Xu & Izadpanahi, 2015). These studies suggest that students in higher education have a valuable role to play in facilitating designer-child collaboration. For Menconi and Grohmann (2018), the involvement of university students allows participants to move outside of their traditional learning environments.

Similarly, for Lozanovska and Xu (2013), who recorded the experience of a collaborative design project with children and university students to remodel a school playground in Victoria, Australia, the exchange opened up the possibility for knowledge transfer between two groups of learners that would not otherwise interact. Children were given access to

university level knowledge and experience which directly benefited their learning process while, at the same time, multiple advantages were also observed for the university students (Lozanovska & Xu, 2013). Through their involvement, university students were given the opportunity to apply and improve their professional as well as social skills, providing practical experience of stakeholder engagement which enriched their learning experience as well as job prospects (Menconi & Grohmann, 2018). Outside of this, children provided a source of inspiration and inventiveness since their “creativity and enthusiasm were great resources for design, and helped to overcome challenges such as a lack of ideas and the frustration that first year architecture students often experience in studio design projects” (Lozanovska & Xu, 2013, p. 223). Moreover, Lozanovska and Xu (2013) observed that the shift in role enabled architecture students to become more aware of their design skills, and to gain confidence and maturity through facilitation.

The combination shows how classic relationships between "experts" can be enriched and renewed to foster mutually exclusive collaborations and learning experiences (Menconi & Grohmann, 2018). In designer-child collaboration, university students acted as a valuable "bridge" between school teachers, design practitioners, and researchers. Their role as the "translator" of children's ideas was shown to be highly effective in collaborative design processes. Albeit, in some instances, their involvement did bring additional administrative issues which required careful management, preparation, and planning (Lozanovska & Xu, 2013).

While multiple benefits of involving children in collaborative design processes were recorded across a range of themes and for a variety of stakeholders, scholarship from an assortment of geographies also exposed the presence of obstacles and barriers in engaging children in co-creation processes (M. Gallagher, 2008; Hart, 2008; Menconi & Grohmann, 2018; Million, 2017; Robbé, 2017). The subsequent sections provide a discussion of what we identified as three key challenges for research and practice going forward. Here, we focus our attention on practitioner interest, tokenistic engagement, and unequal power relations.

CRITICAL OBSTACLES AND BARRIERS IN CO-CREATION PROCESSES WITH CHILDREN PRACTITIONER INTEREST AND TRAINING

A reoccurring obstacle, present across a range of cases, was the reluctance of some practitioners to engage in co-creation processes with children. Million (2017), in her case study of collaborative design workshops conducted by Jugend Architektur Stadt (JAS) with children in Aachen, Germany, emphasized that notwithstanding the complex process of designing urban spaces and architecture, involving children in that process requires additional time, staffing, and cost. Additionally, in not corresponding with the "traditional" design process that practitioners are comfortable with or used to, collaborative design with children can seem daunting or in some instances unnecessary as actors cannot

understand the value of their input in the process. The combination was shown to dissuade practices, professionals, or decision makers from engaging with children as active stakeholders (Million, 2017).

For Menconi and Grohmann (2018) as well as Robbé (2017) resistance could be directly linked with a lack of professional training. These scholars emphasize that insecurities in how to collaborate with children may exist owing to failed past attempts to engage with these groups, keep their interest in the design process, or successfully incorporate their ideas into a design solution. Related to this, the aforementioned authors also suggest that design practitioners actually lack the proper methods and tools to deliver on these collaborative approaches (Menconi & Grohmann, 2018; Robbé, 2017). The combination suggests that better education/training of associated professionals represents a critical obstacle pertinent to the success of designer-child collaboration going forward.

TOKENISTIC ENGAGEMENT

Across the cases reviewed, the depth of the collaboration with children varied significantly. For how long and at what point children had been involved in the design process fluctuated from one project to another. A general tendency, found in 13 cases, was the involvement of children in the initial phases of a project only, to generate design ideas. In only three of the reviewed cases did children participate in the entire design process – from initial analysis, generation of design ideas to construction. Studies showed that the involvement of children in collaborative design processes can, in some cases, remain tokenistic or symbolic. As Robbé (2017, p. 180) emphasized, they may act as "a gesture to gather persuasive material to promote a project as innovative or inclusive". Similar concerns were recorded by Lozanovska and Xu (2013), O'Connor (2013), Reiersølmoen, Gianni and Divitini (2018) as well as Saridar Masri (2018), where the collaborative work and ideas developed by children and adolescents were deliberately

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omitted from the final project or design. Nevertheless, despite these discrepancies, there appeared to be a lack of consensus in academic literature on whether or not children's input being removed from the final physical design was actually problematic.

In a study of tokenistic engagement with children, Lundy (2018) highlights that the design of the built environment commonly works toward producing a physical output, yet, there are often many more aspects than what is merely visible following the implementation of the output itself. Children's involvement in the conversation around an intervention as well as the possibility to express their creativity, imagination, and inventiveness are, as argued by Lundy (2018), just as valuable as the physical manifestation of the process (Birch et al., 2017a). While no consensus on the appropriate inclusion of children in the final co-created design output could be identified, we exercise that caution should be taken to ensure that children's voices are reflected in the entire process as the line between genuine and symbolic collaboration was shown to be easily blurred.

THE PRESENCE OF POWER

Linked with genuine or symbolic engagement is the presence of power in collaborative processes (M. Gallagher, 2008). The review brought to the fore the critical need to acknowledge power imbalances in designer-child collaboration. Here, power dynamics were shown to represent a complex obstacle affecting co-creation with children (Hart, 2008). In facing up to this complexity, Hart (2008) recommends that adults see themselves as "ambassadors" in collaborative processes, conveying to those involved that initiation and decision-making are negotiated in a space of trust, where children are heard, can express themselves freely, and their ideas are met

with open minds. Ultimately, the success or failure of collaborative design processes involving children would appear to depend on the negotiation of stakeholder agendas and the acknowledgement of potential power imbalances. Discussions on expectations as well as potential conflicts of interest are a precondition for functioning collaboration.

Nevertheless, while power relations between adults and children in collaborative design were well represented, present across the literature was a tendency to ignore the complexity of involving children in actual built/development processes. Ultimately, we found that the application of co-creation processes remained detached from property and land development processes, the multiple stakeholder groups typically involved, the relations between them, and the conflicts that can ensue from differing interests, opinions, and expressions of power. "Collaborative" can imply equal involvement of stakeholders in all parts of the design process, including the construction process. In most cases within the development industry, this expectation is unrealistic, some actors will remain more powerful than others. Future work is required to more explicitly understand and evidence the navigation of the complexity of co-creating built spaces with children to highlight the potentials and pitfalls of these approaches for placemaking. Additionally, future work must also more carefully capture issues relating to power dynamics amongst stakeholders in order to more accurately conceptualize these challenges in the context of collaborative design with children in the built environment. The combination represents key barriers to the take-up of co-creation frameworks in these sectors more broadly.

...caution should be taken to ensure that children's voices are reflected in the entire process.

...the success or failure of collaborative design processes involving children would appear to depend on the negotiation of stakeholder agendas and the acknowledgement of potential power imbalances.

SUMMARY

The second phase of the study sought to explicitly exemplify practices of co-creation with children in the built environment and to develop a critical commentary on their features. The review of practice raised important insights on existing empirical scholarship in a number of areas, summarized below:

- Across 20 built environment cases, very little consistency could be identified on the practice of co-creation involving children. Ultimately, determining genuine co-creation strategies involving children in the design of the built environment is a complex procedure, relating to three key aspects: (1) the scale of child involvement, (2) the specificity of the purpose or outcome of the project as well as (3) the duration of children's active involvement in the process.
- Disciplined environments (e.g., schools or youth centers) remain the principle entry point to engagement processes with children. Half of the cases reviewed were concerned with the re-design of formal play spaces in schools or youth centers. There is therefore a need to develop more depth on the potentials and pitfalls of co-creation with children in more urban settings than can be ascertained from the review. Opportunities exist to augment these studies through further empirical research on the topic.
- It was possible to determine that designer-child collaboration in the built environment gives rise to a range of benefits as well as challenges.
- Scholars demonstrated how collaborative design with children can benefit spatial/design professionals and communities by offering a different perspective on place and space.
- Play was used as a core component of each recorded methodology. The review suggested that a mixed-method approach, combining drawing by hand/craft with digital tools, can be an effective strategy to operationalize collaborative design processes with children.
- Co-creation has the potential to provide children with new knowledge and skills. Multiple studies emphasized that children and young people acquire a range of new skills and competencies by participating in built environment design processes including, advances in spatial understanding, spatial connectivity, and spatial literacy, which in turn increased children's confidence and autonomy.
- Collaborative partnerships of one or more organizations were a feature of every case registered in the review. In reflecting on the partnerships recorded, it would appear similar approaches can be more commonly realized in academic and research environments than in professional practice. In 14 separate cases, university students acted as the "translator" of children's ideas, and these studies suggest that students in higher education have a valuable role to play in facilitating designer-child collaboration.



- Practitioner reluctance was present in a number of instances. In not corresponding with the "traditional" design process that practitioners are comfortable with or used to, collaborative design with children can seem daunting or in some instances unnecessary as actors cannot understand the value of their input in the process. Resistance could be directly linked with a lack of professional training. The combination suggests that better education/training of associated professionals represents a critical obstacle pertinent to the success of designer-child collaboration going forward.
- The depth of the collaboration with children varied significantly. For how long and at what point children had been involved in the design process fluctuated from one project to another. Studies showed that the involvement of children can, in some cases, remain tokenistic or symbolic. While no consensus on the appropriate inclusion of children in the final co-created design output could be identified, we exercise that caution should be taken to ensure that children's voices are reflected in the entire process as the line between genuine and symbolic collaboration was shown to be easily blurred.
- Power dynamics were shown to represent a complex obstacle affecting co-creation with children. Ultimately, the success or failure of collaborative design processes involving children would appear to depend on the negotiation of stakeholder agendas and the acknowledgement of potential power imbalances. Discussions on expectations as well as potential conflicts of interest are a precondition for functioning collaboration.
- Finally, present across the literature was a tendency to ignore the complexity of involving children in actual built/development processes. Ultimately, the application of co-creation processes remained detached from property and land development processes, the multiple stakeholder groups involved, the relations between them, and the conflicts that can ensue from differing interests and opinions. Future work is required to more explicitly understand and evidence the complexity of co-creating built spaces with children.



Future research and practice

The aim of this report was to identify the state-of-the-art on how the built environment can promote and support children's play, playful learning, and creativity through a systematic search and critical review of literature. In achieving this aim, we employed a dual-lens approach incorporating two complimentary theoretical perspectives/lenses: (1) the co-creation lens and (2) the embodied cognitive science lens. Two research objectives were set based on our dual-lens approach in an effort to gather information on:

(1) How the active involvement of children in the "co-production" and "co-design" of spaces can promote learning through play and creative skills; and

(2) How children experience and engage with the built environment, and how the design of spaces can affect and enhance their possibilities for play and learning.

Our report represents a seminal study, which for the first time, links children, play, playful learning, and creativity with the built environment, co-creation, and embodied cognitive science. The outcome of this state-of-the-art is a first step toward the generation of a sound research knowledge base on how to better design child-friendly environments and spaces that encourage children's play, learning through play, and children's holistic development. At present, this field is not yet well established, representing an emerging area of scholarship and academic interest. While existing research on the subject

holds value, connections between co-creation and embodied cognitive science in the built environment are in their infancy, thus there is a need for further testing to corroborate the outcomes of the review with additional empirical research belonging to a number of specific areas.

Six critical knowledge gaps for research and practice were defined following the outcomes of the analysis. The subsequent sections set out each limitation of the literature in combination with tailored recommendations for research and practice going forward:

INFORMAL PLAY SPACES AND THE SPECTRUM OF PLAY

Across the literature, we identified a predominant focus on "formal play spaces" (e.g., play environments within schools, childcare facilities, youth centers, playgrounds, or skate parks) and free play as the golden standard. Studies which explored, what we term "informal play spaces" such as neighborhood spaces, public spaces, or city streets/squares/plazas were less common as were projects which placed an emphasis on different types of play. We advocate that better consideration should be given to the different contexts of children's lives and where they play – including both formal and informal play spaces – and different types of play across the play spectrum (i.e., between free play, guided play, or games). Furthermore, attention should be placed on intergenerational needs, family-friendly play environments, and recognizing the positive role of adults/caregivers in children's play and enhancing opportunities for playful learning in the built environment.

AFFORDANCE FOR PLAY IN THE BUILT ENVIRONMENT

According to our literature review, the existing research examining child-environment relationships through play provides a solid background to understand the built environment as a landscape of affordances for play. However, despite the prominence of the affordance-based approach to play in built spaces, there is a need to better understand how and why particular affordances in a play environment invite or solicit playful activities for a particular child. Similarly, while there is an established consensus on children as agents and active explorers in the built environment, more research is required to uncover how children recognize and actualize play affordances in built settings, especially when they are not designed for play as is often the case with informal play spaces. Furthermore, we identified a scarcity of evidence on how children with different bodily and cognitive abilities (e.g., different age groups, gender effects, or cognitive/physical impairments) engage with same play affordances. We, therefore, recommend that more knowledge be generated on how to design for neurodiversity and accessibility in play spaces. Likewise, due to the complexity of play and its different variations, a one-solution-fits-all approach may not work in that one space may not equally support all types of play. Nevertheless, opportunities exist for stronger cross-disciplinary research on children's play and playful learning in the built environment to obtain a more systematic and empirically supported understanding of affordances for play in both formal and informal play spaces.

THE EMOTIONAL ASPECT OF PLAY FOR LEARNING AND SOCIAL DEVELOPMENT

Recent developments in neuroscience show that emotional processes involving the body are central to cognitive processes such as learning, memory, decision making, and creativity. Studies of adults with brain damage acquired during early childhood to cortical areas (those areas involved in emotional regulation in the brain) revealed that the patients' overall understanding of social rules

and moral behavior was compromised. Consequently, it has been hypothesized that play may have an important role in the brain development and emotional intelligence of children, with implications for individuals' social behavior in later life – and in extension, for the culture of a society more broadly. However, our review showed that the emotional aspect of play in the built environment is a topic which was largely overlooked. Further theoretical understanding and empirical testing are needed in this area to explore the relationship between emotional processes, children's development, and play affordances in the built environment.

DEFINING THE CO-CREATION STRATEGY

Our research identified very little conceptual consistency on the practice of co-creation involving children. We put forward that defining the co-creation strategy is of vital importance to research and practice going forward. Here, careful consideration should be given to what we determine to be three key and related aspects: (1) the scale of child involvement, (2) the specificity of the purpose or outcomes of the project as well as (3) the duration of children's active involvement in the process. Common across the literature was an over-extension of the degree to which children have been involved in the process. Stronger consensus on the definition and practice of co-creation is needed. We suggest that the framework presented above be tested empirically in a bid to move toward a more robust and rigorous appreciation of the concept and its constituent parts.

CONSIDERATION OF BUILT ENVIRONMENT REALITIES

Present across the literature was an ignorance of the complex regulatory reality of construction/development processes. Ultimately, the application of co-creation processes in the built environment remained detached from property and land development processes; the multiple stakeholder groups typically involved; the relations between them; and the conflicts that can ensue from differing interests, opinions, and expressions of power. These represent critical subjects for

practice and research going forward. Moreover, the “collaborative” component of the word can imply an equal involvement of all stakeholders in all parts of the design process, including the construction process. In most cases within the development industry, this is unrealistic as some actors remain more powerful than others. Future work is required to more explicitly understand and evidence the navigation of the complexity of co-creating built spaces with children to highlight the potentials and pitfalls of these approaches for placemaking. Additionally, future work must also more carefully capture issues relating to power dynamics amongst stakeholders in order to more accurately conceptualize these challenges in the context of collaborative design with children.

CROSS-DISCIPLINARY, CROSS-SECTORAL PARTNERSHIPS

The authors also identified the absence of proper methods and tools for design-oriented practitioners to engage in co-creation processes with children as well as a lack of education/training in how to facilitate and engage in such processes. Similarly, a finer-grain understanding of play, playful learning, and child development is required if built environment researchers and practitioners are to be more attentive to the different types of play being addressed through

a particular design. We advocate a focus on developing cross-disciplinary, cross-sectoral perspectives that integrate and support collaborative design thinking/research with knowledge on play and playful learning; linking specialists in play with specialists in spatial design as a way to assess the strengths and weaknesses of different strategies and outcomes of the collaborative design process.

In conclusion, this research adds additional support to the notion children can – and should – be considered as co-producers of spaces and places through play in the built environment. It advocates that designer-child collaboration – if executed with due care and consideration – can act as the bridge and translation process to ensure that this environment is designed collectively and a rich landscape of affordances for play provided. Through a series of research and practical gaps in tandem with their corresponding recommendations, the authors highlight that opportunities are available to develop stronger theoretical and empirical research on how different spaces afford and invite children’s play across the play spectrum as well as how designer-child collaboration can potentially influence and enable place makers to arrive at more child-friendly design approaches in cities.

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ABOUT THE AUTHORS

This state-of-the-art research project "Children in the built environment: Promoting play, playful learning, and creativity. What can we learn from co-creation and embodied cognitive science?" was conducted and conceptualized by a team of six architectural and urban design researchers from Aalborg University, Department of Architecture, Design and Media Technology. The project was supported and funded by CoC Playful Minds. The authors would like to thank the team from CoC Playful Minds for the support and insightful discussions in the development of this project, and Sine Bjerg Ernschhof for her assistance with the review of practice and associated visual materials.

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