

C HILDREN'S
ENVIRONMENTS

PATTERN LIBRARY

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P REFACE

The Children's Environments Pattern Library is one of two pattern libraries that were created as design methodology for the graduation project "Street Smart". The CE Pattern Library is a set of 21 interrelated patterns with a focus on creating environments that meet the needs of young people. This pattern library is based on the research conducted in the graduation project "Street Smart". In this research, multiple developmental stages were identified which were then linked to the different ways in which children of various ages experience their environment. Moreover, this experience was linked to the different needs environments must meet to adequately support children. This CE pattern library bridges the gap between theory and design by incorporating these various needs children have in different developmental stages and transforming them into design-oriented patterns. It are these patterns that provide the methodology to come to a design intervention aimed at creating environments that meet the needs of young people.

C CHILDREN'S ENVIRONMENTS

PATTERN LIBRARY

One of the most well-known methods to organize both theoretical and design-oriented information is in a "pattern". This format was developed by Alexander in his classic "A Pattern Language" (1977). In the book that describes the basis of this pattern language, Alexander (1979) described how cities and buildings will never come alive unless they are shaped and created by all the people in a society. Furthermore, he proclaimed that such a process would be impossible unless all these people shared a common language, allowing them to both shape and design these cities and buildings as well as communicate with each other. In "A Pattern Language" (1977) Alexander elaborated this idea by documenting a first pattern language. His patterns all have the same layout; they describe a problem that occurs repeatedly in our society and the core of the solution to this problem. This is described in such a way that, to quote Alexander himself "you can use this solutions a million times over, without ever doing it the same way twice" (Alexander, 1977, p.x). Moreover, Alexander created his pattern language to evolve and grow over time, as more people verified the validity of certain patterns through theoretical research or expanded upon his first work with additional patterns.

The most important feature of these patterns is the way in which they are able to structure theoretical research findings so it gives practical design guidelines and recommendations. This feature is derived, in large part, from the way in which these patterns are described. Alexander's original patterns were formatted with (1)

a picture, (2) introduction of the pattern's context, (3) core statement describing the pattern, (4) empirical background of the problem targeted through the pattern, (5) core statement describing the solutions to the problem, (6) a diagram of this solution and (7) relation of this pattern with other patterns. An important aspect of all of Alexander's patterns were that the problems were recurring, the solutions instructional, and the entire pattern was as archetypal as possible.

While adequate at meeting its goal, this original pattern format can become rather long winded and lacks the clear, concise and compact format most suited for a design tool. Furthermore, critique has been voiced on a number of premises underlying Alexander's pattern language and the way in which he described his patterns (van Dorst, 2005). Following this critique, van Dorst (2005) proposed a modified and updated format in which patterns can be described according to (1) a title, (2) a positively framed presumption or postulation, (3) a (theoretically supported) clarification (4) an application, (5) a picture and (6) references to other patterns.

Another important addition to Alexander's (1977) original patterns is the elaboration of pattern networks by Salingaros (2000). In his "The Structure of Pattern Languages" he names the connectivity of patterns as one of the key features of pattern languages, which he notes is largely overlooked by Alexander's (1977) original patterns. Salingaros (2000) states that all patterns connect to each other, and that this connection can have

different values. For instance, two patterns can be linked because one generalizes the other on a larger scale, or because they both solve the same problem in alternative, yet equally valid ways. It are these connections between the different patterns that give the language its structure, and create the system with which we can tackle complex problems. Salingaros (2000) furthermore argues that patterns "provide the necessary foundation for any design solution to connect with human beings", because it is within patterns that links can be made between social patterns and spatial patterns.

The pattern library presented in this document is an integral part of the graduation project "Street Smart". The graduation project Street Smart identified several different ways in which children of various ages experience their environments, based upon research looking into their cognitive development. The different ways in which children experience their environments was then linked to the different needs these environments must meet to adequately support children of different ages. This Children's Environments pattern library was created to bridge the gap between this theoretical research and more practical, design-oriented, recommendations aimed at addressing the needs environments must meet to accommodate children of different ages. The 21 patterns that make up this library target the spatial aspects that support children's different ages, uses and developmental needs. As such, these patterns provide input to the designer before they start designing by giving direction to the interventions.

R EADING THE LANGUAGE

In order to read a pattern language, it is important to be able to understand both the individual patterns, as well as the nature of the relationships between the different patterns. These relationships are detailed in a pattern network (p. 8). The patterns in this network are differentiated by shape, and the relationships are differentiated by line type.

The pattern network encompasses two types of patterns; meta-patterns and patterns. The meta-patterns are the higher level patterns in the pattern network, identifiable by their rectangular shape. These patterns can be directly linked back to the theoretical research conducted in the graduation project Street Smart. As such, these patterns are not only of a higher order but also more abstract. These patterns target the different age groups that can be identified, based upon children's developmental stages, and the proposed recommendations that will create an environment that meets the needs of children in age developmental stage. This recommendation is directly derived from the theoretical research, which is elaborated in the extensive scientific clarification that follows the pattern description.

Each meta-pattern is linked to several other, lower level patterns, identifiable by their round shape. These patterns address the same phenomena and recommendations but become more concrete by focusing on several distinctly different ways in which this recommendation can be addressed. Furthermore, these patterns oftentimes address more than one phenomena and recommendation

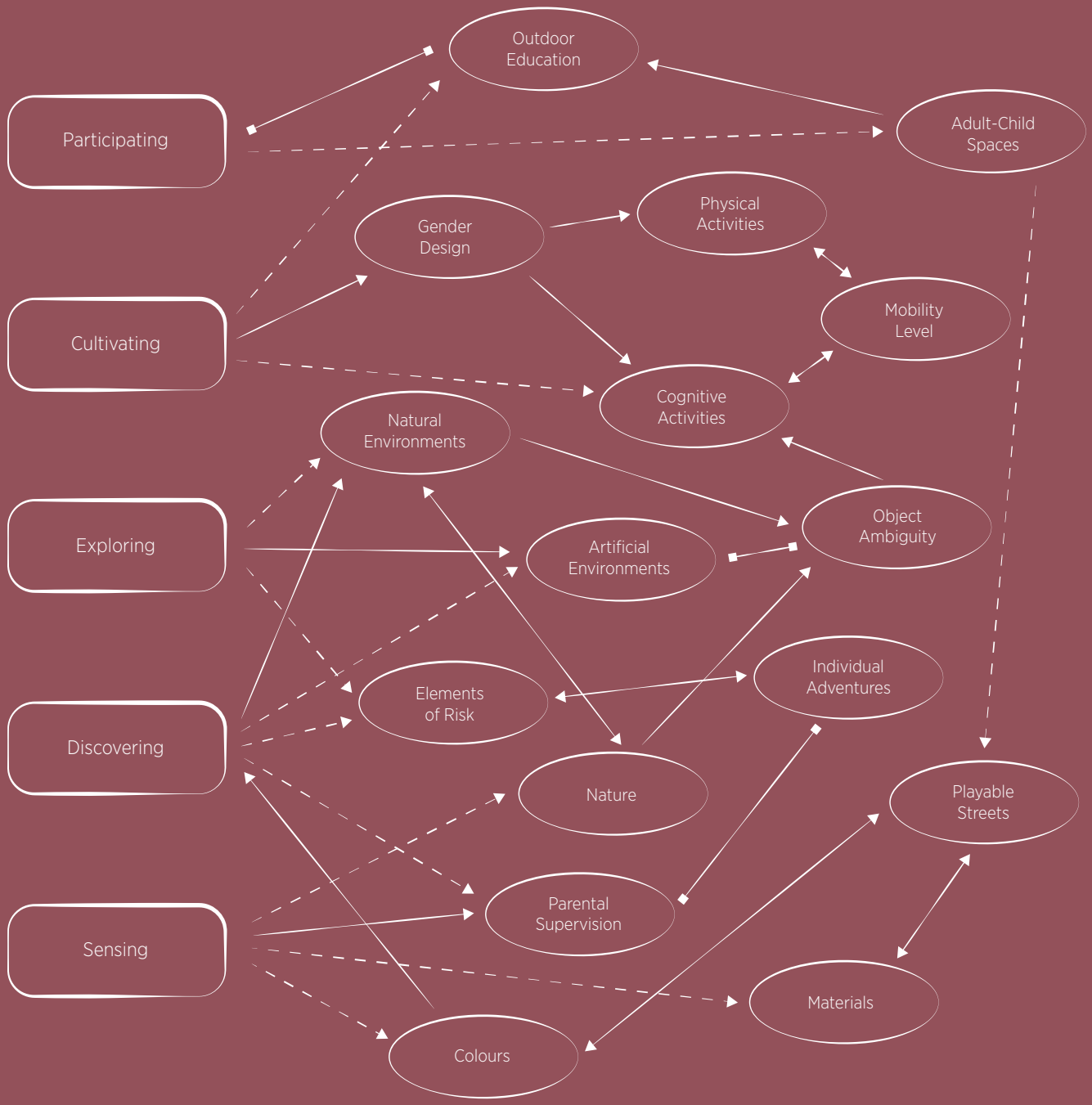
into an integrative hypothesis. These patterns share the same scientific clarification as the parent meta-pattern to which they are related. The focus of these lower level patterns, however, lies in addressing urban design knowledge that can help designers create a physical design for the pattern.

Furthermore, the network includes four different types of relationships, which are denoted with a different letter between brackets. These four relationships include the connections between higher level [H] and lower level [L] patterns. Secondly, the connections between complementary patterns, that is, pattern that strengthen each other, marked with [C]. Thirdly, it includes the connection between patterns that influence each other, with [S] for the pattern that is doing the influencing and [I] for the pattern that is being influenced. And lastly, it includes the connection between patterns that juxtapose (i.e. contradict) each other, marked with [J].

However, this pattern network is not the only way in which the patterns can be organized. Other helpful organizations include the organization by theme (p. 10), or the organization by the extent to which each pattern is either abstract or concrete (p. 12). Both of these additional pattern organization can be helpful in designing with the patterns in this pattern library.

Next to understanding the organization of and relationships between the different patterns, it is also important to understand each pattern individually. The

template that is used in this pattern library was developed on the basis of Alexander's (1977) original patterns, van Dorst's (2005) modifications and the additional description elements as detailed by Meszaros & Doble (1997). The template is designed to communicate the information of each pattern in a clear and concise manner without sacrificing its complexity. The following pages explain the different elements used to describe both the meta-patterns and the patterns.

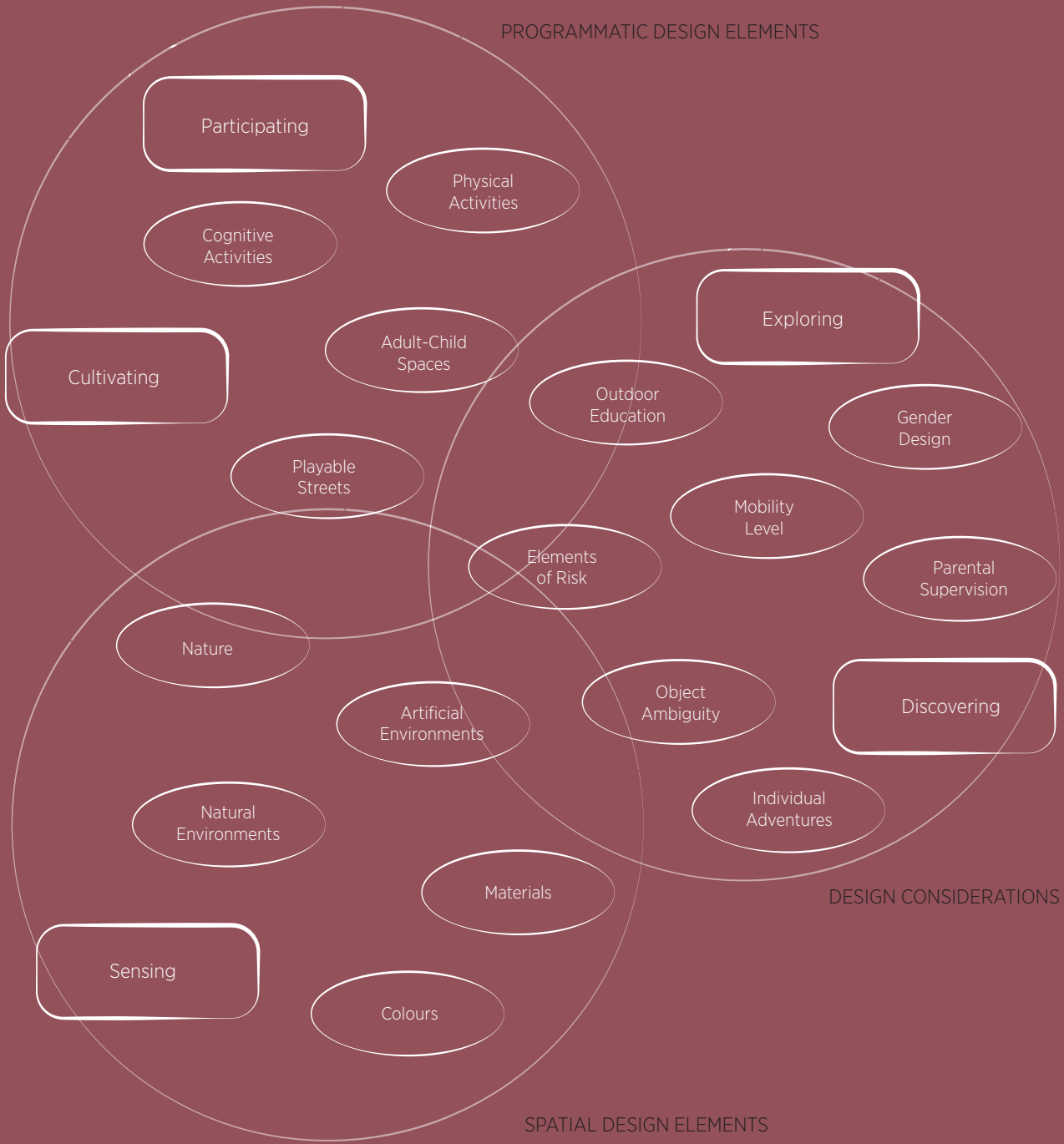


PATTERN NETWORK

[PATTERNS]

---→ [H] ↔ [L]
—→ [I] ↔ [S]
←→ [C] ↔ [C]
—■→ [J] ↔ [J]

PROGRAMMATIC DESIGN ELEMENTS



Participating

Physical Activities

Cognitive Activities

Adult-Child Spaces

Outdoor Education

Exploring

Gender Design

Cultivating

Playable Streets

Elements of Risk

Mobility Level

Parental Supervision

Nature

Artificial Environments

Object Ambiguity

Discovering

Natural Environments

Individual Adventures

Materials

Sensing

Colours

DESIGN CONSIDERATIONS

SPATIAL DESIGN ELEMENTS

O RGANIZATION
BY THEME

ABSTRACT RECOMMENDATIONS

Cultivating

Participating

Outdoor Education

Gender Design

Adult-Child Spaces

Sensing

CONCRETE RECOMMENDATIONS

Mobility Level

Playable Streets

Elements of Risk

Parental Supervision

Nature

Materials

Cognitive Activities

Individual Adventures

Colours

Natural Environments

Artificial Environments

Physical Activities

Discovering

Exploring

Object Ambiguity

O RGANIZATION
BY NATURE

R EADING THE META-PATTERNS

Pattern Title & Number

Each pattern has a title that aims to capture the core of the pattern. Furthermore, each pattern has an accompanying number. These numbers, however, do not refer to (relative) importance, but rather are there to make the patterns easier to use.

Main Statement / Hypothesis

The main statement conveys the hypothesis derived from the scientific research in one clear sentence.

Illustration / Reference

Each pattern is illustrated with an image and an icon. The image aims to show the essence of the intent behind the pattern with a captivating photograph, thus, it is not an illustration of how the design should look. Each illustration comes with a subscript that explains why this photograph was chosen. The icon furthermore explains this by symbolizing the abstract idea behind the pattern.



Context

The context describes the most important features of children's cognitive development within the age group that the pattern aims to address.



Phenomena

The phenomena describes describe how the age group the pattern aims to address experiences their environments, derived from the scientific research.

Recommendation

The recommendation describes how the context and the phenomena should be addressed. Because these patterns do not deal with problems, but rather with “facts-of-life”, this element does not describe a solution to a problem but recommendations for designers that wish to design environments for children and, as such, points to urban design literature that can help designers create a physical design for this pattern.

Related Patterns

This section describes the relationships with other patterns as detailed in the pattern network. Furthermore, it names unrelated patterns that have some overlap, for instance through a similar problem or solution. The relationships between the patterns are as follows:

- [H] Higher level patterns
- [L] Lower level patterns
- [I] Influenced by these patterns
- [S] Support these patterns
- [J] Juxtapose (contradictory) patterns
- [O] Other relevant, non-related, patterns

Scientific Clarification

Each meta-pattern is followed by a scientific clarification that describes the context, phenomena and recommendation of the pattern in-depth. While it is possible to understand the meta-pattern without reading this element, taking the time to do so will further the reader’s understanding of children’s experience of space.

03

E XPLORING (7-11 YEARS)

[META-PATTERN]



- [L] Elements of Risk
- [L] Natural Environments
- [S] Artificial Environments
- [O] Individual Adventures
- [O] Object Ambiguity
- [O] Physical Activities
- [O] Cognitive Activities
- [O] Mobility Level

Diagram illustrating the core principle behind the pattern.

Pattern number and title.

Environments for children should be aesthetically designed and include ambiguity, inviting them to explore its potential and engage their mental faculties while simultaneously offering space for group activities.

Statement describing the core principle behind the pattern.

Shows the pattern is a meta-pattern.

Related patterns.

Icon symbolizing the core idea behind the pattern.

Illustration capturing what the design could look like incorporating the pattern.



Flickr; Adriana Varela © Older children actively seek out new experiences.



actively
unders

Context - Children (ages 7-11) form perceptions of the world around them, but do not yet know or understand it fully.

Context of the phenomena.



develo
perspe
allowi

Phenomena - Children between the ages of 7 and 11 are in a transitional stage of development where they begin to adopt multiple perspectives of their environment, allowing them to engage in physical, social, and cognitive activities. Their experience of space includes this multi-dimensionality, allowing them to perceive existential space, in which they form an impression of their environment in its larger cultural context.

Phenomena that needs to be addressed.



Recommendation - The period of middle childhood is a time of powerful and memorable experiences. During these years, children gain a tremendous amount of different experiences and skills that they continue to use throughout their lives. It is therefore important to support these experiences through the design of the outdoor environments that they use. While any type of space can offer children a chance to explore and learn, especially benefit from nature (2; Tai et. al., 2006). It is not surprising that these diverse and complex environments (Acar, 2003).

Recommendations.

On the next page, the elaborate scientific clarification follows.

R EADING THE PATTERNS

Pattern Title & Number

Each pattern has a title that aims to capture the core of the pattern. Furthermore, each pattern has an accompanying number. These numbers, however, do not refer to (relative) importance, but rather are there to make the patterns easier to use.

Main Statement / Hypothesis

The main statement conveys the hypothesis derived from the scientific research in one clear sentence.

Illustration / Reference

Each pattern is illustrated with an image and an icon. The image aims to show the essence of the intent behind the pattern with a captivating photograph, thus, it is not an illustration of how the design should look. Each illustration comes with a subscript that explains why this photograph was chosen. The icon furthermore explains this by symbolizing the abstract idea behind the pattern.



Context

The force describes the recommendation made by one or multiple meta-patterns that this pattern further elaborates upon.



Force

The force follows from the context, detailing the recommendation that is conveyed in the pattern, which is an elaboration of the more general, abstract, recommendations of the meta-patterns.

**Clarification**

The clarification describes how the context and force (together a detailed recommendation for designers that wish to design environments for children) should be addressed. Its main focus lies on providing the different ways in which the recommendation can be incorporated in a design by connecting its intentions to existing urban design literature that can help designers create a physical design for this pattern.

**Related Patterns**

This section describes the relationships with other patterns as detailed in the pattern network. Furthermore, it names unrelated patterns that have some overlap, for instance through a similar problem or solution. The relationships between the patterns are as follows:

- [H] Higher level patterns
- [L] Lower level patterns
- [I] Influenced by these patterns
- [S] Support these patterns
- [J] Juxtapose (contradictory) patterns
- [O] Other relevant, non-related, patterns

ELEMENTS OF RISK



[H] Discovering
[H] Exploring

[C] Individual Adventures

[O] Parental Supervision
[O] Individual Adventures
[O] Natural Environments
[O] Artificial Environments

Diagram illustrating the core principle behind the pattern.

Pattern number and title.

It is important to incorporate elements of risk in the environments of young people, irrelevant of their age or gender and the type of space.

Statement describing the core principle behind the pattern.



Context - It is important to create an environment that allows them to discover all it has to offer, with the support of caregivers, in a way that allows them to feel accomplished about their actions.

Context of the phenomena.

Recommendations.



Forces - The opportunities that are challenging and even offer an element of risk is a vital element of children's development and, furthermore, engages them in the most active types of play, both physically and cognitively.

Related patterns.

Icon symbolizing the core idea behind the pattern.

Illustration capturing what the design could look like incorporating the pattern.



Flickr; Matthew King © Children require spaces that offer challenges and risk.

Clarification - An extensively documented theme in the literature is the mental effects of risk-taking (Gleave, 2008). Children's play is an important part of their world and is considered an essential and desirable personality traits such as creativity (Ball, 2002). Some researchers even claim that shielding children from challenge and risk is "deliberately disabling and ethically unacceptable" (Hughes, 2001, p.53).

Clarification that describes how the pattern addresses the recommendation and its design interventions, referencing more reading.

It is therefore important to incorporate elements of risk in the environments of young people, irrelevant of their age and gender or the type of space (Jones, 1997; Acar, 2003; Steampfli, 2009). This can be done through the inclusion of natural elements (Shackell et. al., 2008), which offer a greater variety of relatively safe risk-taking opportunities (climbing a tree, sliding down a hill). It should be mentioned however that it is necessary to provide a balance between opportunities for risk and keeping children reasonably safe from harm (Moorcock, 1998). This can be done by designing environments to mitigate the effects of risk-taken gone awry through, for instance, materialization (e.g. soft grass, sand, or even water beneath climbing structures).

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C ONTENT

01

S ENSING (0-2 YEARS)

[META-PATTERN]

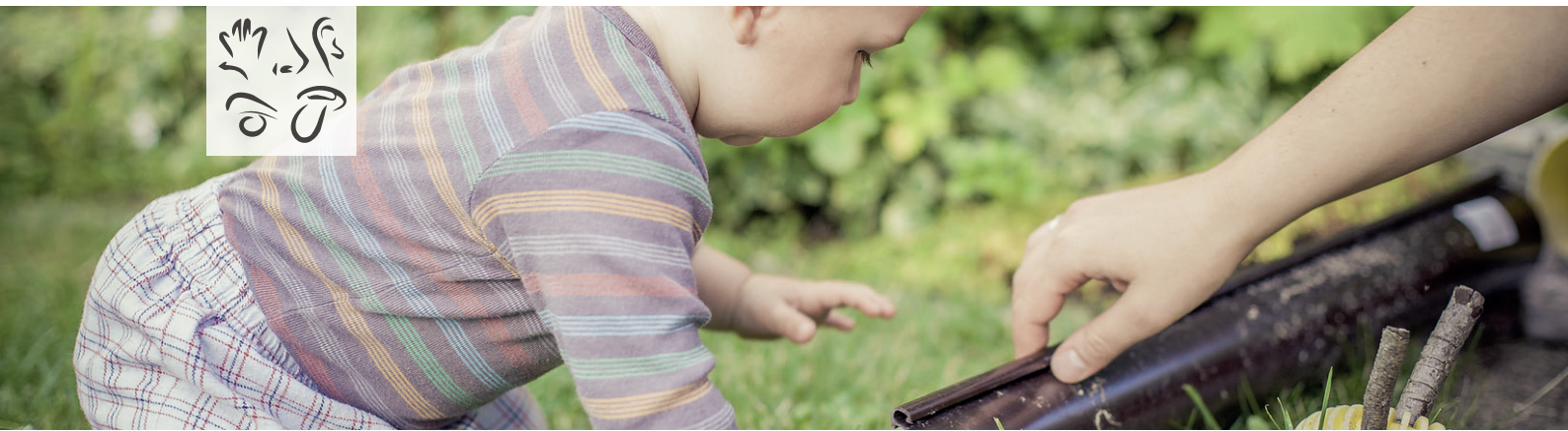


[L] Colours
[L] Materials
[L] Nature


[S] Parental Supervision


[O] Playable Streets
[O] Object Ambiguity
[O] Mobility Level
[O] Adult-Child Spaces


Spaces should be designed so they offer safe and comfortable environments that offer different sights, sounds, smells and touches that children are able to experience through their primary senses.



Flickr; 7th Element © Toddlers experience the world through their senses.

 *Context* - Infants and toddlers (ages 0-2) explore their immediate environment through their primary senses of sight, sound, smell and touch.

 *Phenomena* - Children between the ages of 0 and 2 are in the sensorimotor stage of development. In this stage, they primarily rely on sensory sensations to experience their environment, and increasingly complex motor actions to interact with it. The relationship between children and the world around them is still in its infancy, with only a basic understanding of topological concepts of space. Children are thus only capable of perceiving pragmatic space, which is the space of their sensory and motoric responses.

 *Recommendation* - By designing safe and comfortable environments that offer different sights, sounds, smells and touches, young children will be able to experience these spaces through their primary senses. Designers very rarely take sensory experiences into account, and doing so will require different design criteria (Malnar & Vodvarka, 2004), as well as different representations (Lucas & Romice, 2008). Furthermore, "sensory experiences" will have to be understood and expressed more concretely for designers to be able to create them in urban environments. Gibson's (1966) description of senses as perceptual systems instead of abstract concepts is helpful in that regard, as is Thibaud's (2011) concept of ambiances.



Scientific Clarification - Piaget (1950) describes the first stage of development as the sensorimotor stage, which starts at birth and transitions into the next stage around the age of two. In this stage, children's cognitive systems can be roughly divided into several sub-stages. These systems start out as being largely limited to children's motor reflexes. However, as they continue to develop, they build upon these reflexes to develop more sophisticated behaviours. Children begin by continuously repeating inadvertent behaviours; modifications of their initial reflexes. Following this, their actions grow more controlled and purposeful, allowing them to generalize their behaviours to a wider range of situations. They continue to develop this until they are able to create longer and more difficult chains of behaviour, in which they can manipulate both their own actions, as well as the objects they are interacting with. Towards the final sub-stage of this first developmental increment, children's development transits from being heavily dependent on sensory interactions with their environment to representational thoughts (i.e. internal mental representations of the environments that surround them).

In the first sensorimotor stage of children's development, Piaget and Inhelder (1967) thought children's experience of space in the stage of synthetic incapacity. They hypothesized that, in this stage, children's conceptualization of space start to develop following topological concepts. These concepts are the most general notions of mathematical space, describing how

collections of objects belong to the same group and how the objects within that group and the group itself relate to each other, providing them with meaning and significance. The acquisition of these topological concepts allows children to develop early "definitions" of spatial concepts such as continuity and discontinuity, connectedness and separation and convergence and divergence. Norberg-Schulz (1971) describes this much simpler with his term pragmatic space, which refers to the space of physical actions, in which people make sensory and motoric responses.

When we consider children's cognitive development and their experience of spaces in relation to each other we can see a clear link between them. One describes the sequential nature of cognitive development, the other the related development of spatial conceptualization. As their spatial conceptualization develops, children are able to experience the different layers of spaces as defined by Norberg-Schulz (1971). These differences in the perception of space greatly impacts the type of environments that is required to meet children's needs. This can be aptly explained through Maslow (1973) hierarchy of needs, who identifies basic deficiency needs, and more satisfactory growth and being needs. Children in their sensorimotor stage of development primarily require their physiological and safety needs to be met in the primitive space that they can perceive.

In this first stage of development, we can conclude that children are reliant upon sensory sensations to experience

their environment, and motor actions to interact with their environment. Both of these should be designed on a scale that is fitted to the "realm" of these young children, in other words, close to the ground. Furthermore, following the combination of children's development and Maslow's (1973) hierarchy of needs, we can hypothesize that this primitive space of the sensorimotor stage should also meet children's physiological needs (i.e. being comfortable in their environment) and safety needs (i.e. being safe, protected and feeling secure).

02

D ISCOVERING (2-7 YEARS)

[META-PATTERN]

-  [L] Parental Supervision
- [L] Elements of Risk
- [L] Artificial Environments


[C] Natural Environments


- [O] Colours
- [O] Materials
- [O] Individual Adventures
- [O] Object Ambiguity
- [O] Outdoor Education


It is important to provide children with an environment that engages and challenges them to discover all it has to offer, alone or with peers or caregivers, in a way that allows them to feel accomplished about their actions.



Flickr; Carlotta Roma © Young children are curious to discover their environment.

 *Context* - Young children (ages 2-7) perceive themselves as entities separate from their environment and through interaction with that (physical and social) environment, they start to comprehend the world around them.

 *Phenomena* - Children between 2 and 7 are in the preoperational stage of development. They are able to represent the world around them from their own point of view. This allows them to perceive the environment separate from themselves, prompting discovery. Children's experience of space expands with projective concepts of space, allowing them to perceive perceptual space, which is the space of immediate orientation based on the experience of sensory imagery.

 *Recommendation* - In allowing children to discover the world around them, the environments they find themselves in should be designed from their perspective (Elsley, 2004). By using urban elements that pique their interest, public spaces can engage them in an interactive way (Jones, 1997). For children in these ages, everything they encounter is something they perceive as a potential play object (Acar, 2003). In designing spaces for these children, we can take advantage of that fact and offer them an environment that allows them to play (Shackell, Butler, Doyle, Ball, 2008). Examples are multi-purpose objects or environments that allow them freedom in choosing which actions (e.g. to climb, crawl, jump, run or sit) to perform.

Scientific Clarification - The second stage of development is described by Piaget (195) as the preoperational stage, which starts around roughly two years of age and transits into the next stage around the age of seven. In this stage, children acquire the means that allow them to represent the world symbolically through mental imagery, drawing and, perhaps most important, language. This ability to create mental representations of the world starts with simple symbolic representations. Children will oftentimes use symbols to refer to other objects, for instance, a piece of cloth can be used to refer to a blanket or a bed. All of these symbols are personal representations that are made up by the child. As children advance through this stage, their use of symbols becomes increasingly conventional, which aids their ability to communicate with others once they acquire linguistic skills. In this second stage of development, Piaget (1950) considered children to be able to only represent and perceive the world from their own perspective. This egocentric world view results in children focusing their attention very narrowly, ignoring other important information. Moreover, in this stage of development, children are unable to represent transformations, rather, all situations are presented in a static way.

In this second preoperational stage of children's development, Piaget and Inhelder (1967) thought children's experience of space in the stage of intellectual realism. They hypothesized that, in this stage, children's conceptualization of space advances to include projective concepts of space. These concepts are primarily

constructed following children's understanding of perspective. This allows them to develop concepts such as distance and relative position. However, they are not yet able to integrate different points of view into a single representation. Norberg-Schulz (1971) describes this with his term perceptual space, which refers to the space of immediate orientation, based on the experience of sensory imagery.

When we consider children's cognitive development and their experience of spaces in relation to each other we can see a clear link between them. One describes the sequential nature of cognitive development, the other the related development of spatial conceptualization. As their spatial conceptualization develops, children are able to experience the different layers of spaces as defined by Norberg-Schulz (1971). These differences in the perception of space greatly impacts the type of environments that is required to meet children's needs. This can be aptly explained through Maslow (1973) hierarchy of needs, who identifies basic deficiency needs, and more satisfactory growth and being needs. Children in their preoperational stage of development require their physiological and safety needs to be met in the primitive space that they can perceive. As well as their belonging and love and esteem needs in the perceptual space that they can perceive. This translates to feeling comfortable in an environment made to their own scale where there is room to interact with other children, as well as with caregivers. Furthermore, the environment should challenge them to discover, prompt new actions,

and reward them for doing so in order for them to attain a feeling of prestige and accomplishment.

In this second stage of development, we can conclude that children have grown from being exclusively reliant upon sensory experiences and motor actions. Rather, they are now able to represent the world symbolically through mental imagery, language, and drawing. They perceive themselves as entities separate from their environment, yet still perceive it exclusively from their own, egocentric, perspective. This cognitive development allows them to actively discover the world around them, through meaningful interactions with their environment or with other children or caregivers in this environment. Environments for children of these ages should thus offer a design that engages these children at their own scale, offering the possibility of discovery. Furthermore, following the combination of children's development and Maslow's (1973) hierarchy of needs, we can hypothesize that on top of the requirement of primitive space these environments should also meet love and belonging (i.e. space and opportunity for interactions with peers and caregivers) and esteem needs (i.e. being challenged, feeling accomplished in their own actions).

03

E XPLORING (7-11 YEARS)

[META-PATTERN]



[L] Elements of Risk
[L] Natural Environments


[S] Artificial Environments


[O] Individual Adventures
[O] Object Ambiguity
[O] Physical Activities
[O] Cognitive Activities
[O] Mobility Level


Environments for children should be aesthetically designed and include ambiguity, inviting them to explore its potential and engage their mental faculties while simultaneously offering space for group activities.



Flickr; Adriana Varela © Older children actively seek out new experiences.

 **Context** - Children (ages 7-11) form perceptions and representations of the world around them, actively seeking out that which they do not yet know or understand.

 **Phenomena** - Children between the ages of 7 and 11 are in the concrete operational stage of development. In this stage they are able to adopt multiple perspectives in interacting with their environment, allowing for increasingly complex physical, social, and cognitive activities. Their experience of space includes this multi-dimensionality, allowing them to perceive existential space, in which they form an impression of their environment in its larger cultural context.

 **Recommendation** - The period of middle childhood is a period of exploration with a lot of powerful and memorable experiences for many children (Tai, Hague, McLellan & Knight, 2006). During these years, children gain a tremendous amount of different experiences and skills that they continue to use throughout their lives. It is therefore important to support these experiences through the design of the outdoor environments that they use. While any type of space can offer children a chance to explore, engaging their physical and mental faculties, children in middle childhood especially benefit from nature (Bixler, Floyd & Hammit, 2002; Tai et. al., 2006). It is nature that creates the most diverse and complex environments that offer diverse experiences (Acar, 2003).



Scientific Clarification - The concrete operational stage is the third stage of development described by Piaget (1950), which starts around the age of seven and transits into the next stage around the age of eleven. In this stage, children expand their cognitive abilities by being able to regard the world from different points of views than just their own. Instead of their own (egocentric) point of view, children can now take other perspectives into account, allowing them to perceive more than one representation of a single thing. Moreover, children develop the ability to represent transformations and not just static situations. This ability allows them to solve problems that include concrete objects and physically possible solutions. This problem solving is still limited however, since children are not yet able to consider all logically possible solutions, which requires advanced reasoning and understanding of abstract concepts.

In this third concrete operational stage of children's development, Piaget and Inhelder (1967) thought children's experience of space to be in the stage of visual realism. They hypothesized that, in this stage, children acquire Euclidian concepts. These concepts refer to the multi-dimensional nature of space. Children not only start to conceptualize different dimensions of space (i.e. x, y, z axes), but also start to develop the concept of temporal space. In acquiring these concepts, children develop the ability to integrate different perspective into a single whole. Norberg-Schulz (1971) describes this as existential space, which is the space that forms a person's impressions of the environment. These impressions are

mental images or imitations of the world around us. As such, they involve social constructs of reality within a larger cultural context.

When we consider children's cognitive development and their experience of spaces in relation to each other we can see a clear link between them. One describes the sequential nature of cognitive development, the other the related development of spatial conceptualization. As their spatial conceptualization develops, children are able to experience the different layers of spaces as defined by Norberg-Schulz (1971). These differences in the perception of space greatly impacts the type of environments that is required to meet children's needs. This can be aptly explained through Maslow (1973) hierarchy of needs, who identifies basic deficiency needs, and more satisfactory growth and being needs. Children in their concrete operational stage of development require their physiological and safety needs to be met in the primitive space that they can perceive. As well as their belonging and love and esteem needs in the perceptual space that they can perceive. Furthermore, they require cognitive and aesthetic needs to be met in the existential space they can perceive. This means that the environment must engage them to explore, prompt them to use their cognitive abilities, and offer up some understanding of the world when they do. Moreover, the physical appearance of the environment becomes increasingly important from this stage onwards, requiring it to be "beautiful" in terms of scale, composition, layout and furnishings.

In this third stage of development, we can conclude that children have grown from a limited, egocentric perspective to a more complex, multi-dimensional, perspective. Moreover, they have acquired the ability to represent transformations and not just static situations, which allows for more complex cognitive actions. This cognitive development prompts children to actively explore the world around them, seeking out what they do not yet know or understand, or engage in activities that challenge them to push their boundaries. Furthermore, their ability to think about different perspectives creates more complex interactions with peers, caregivers or other adults. Environments for children of these ages should thus offer them this opportunity to explore and learn, while simultaneously supporting more complex interactions between these children and/or caregivers. Furthermore, following the combination of children's development and Maslow's (1973) hierarchy of needs, we can hypothesize that, on top of the requirements of primitive and perceptual space, these environments should also meet cognitive needs (i.e. prompt them to explore and engage them in cognitive activities), as well as aesthetic needs (i.e. conform to their idea about "beauty" in terms of scale, composition, layout and furnishings).

04

C CULTIVATING (11-16 YEARS)

[META-PATTERN]

 [L] Cognitive Activities
[L] Outdoor Education


[S] Gender Design


[O] Elements of Risk
[O] Individual Adventures
[O] Object Ambiguity
[O] Physical Activities
[O] Mobility Level


Adolescents require spaces separate from adults that allow them to express themselves and their own creativity in order to realize their own potential.



Flickr; Lorenc Vercauteren © Young teens need places to cultivate their interests.

 *Context* - During puberty (ages 11-16), teenagers form a clear sense of self within a larger (cultural) context and strive to express and develop their own agency separate from parents or other adult caregivers.

 *Phenomena* - Adolescents between the ages of 11 and 16 (during puberty) are in the early formal operational stage of development. In this stage, their operational thinking develops more fully allowing them to think logically inside their own mind, allowing them to think systematically and in an infinite number of possibilities. This allows them to perceive cognitive space, which is the space that refers to the physical world and its representations.

 *Recommendation* - Older children and adolescents require spaces separate from adults, allowing them to take responsibility for themselves and behave without parental restrictions (Spencer & Blades, 2005). By being able to express themselves and their own creativity freely, these children keep developing their own potential. It is important to facilitate that development by creating and designing spaces for these children and adolescents that support their activities (Stevenson, 2007). This means providing adequate means for physical, cognitive, cultural and social development (Churchman, 2003). There are many urban environments that can support this development, from natural environments such as parks with climbing rocks to squares with skate and art facilities.



Scientific Clarification - Piaget (1950) describes the fourth stage of development as the formal operational stage, which starts around the age of eleven and continues throughout the rest of someone's life. However, a clear distinction can be made between the early stages of the formal operational stage and the later ones. Here, we consider the early formal operational stage to start around the age of eleven and to continue throughout puberty. In this stage, their operational thinking develops more fully, allowing them to easily conserve and think logically inside their minds. This enables them to systematically think about multiple variables, formulate hypotheses and consider possibilities. Moreover, adolescents begin to see the reality in which they live as only one possibility of an infinite number of imaginable realities. This realization causes them to think about alternate organizations of the world and ponder deep questions about meaning, truth, justice and morality.

In this fourth formal operational stage of development, Piaget and Inhelder (1967) hypothesized that children's experience of space is already complete following the acquisition of topological, projective, and Euclidian concepts of space. However, Norberg-Schulz (1971) describes two additional categorizations of space that roughly coincide with the early and late formal operational stage of development. In this early formal operational stage, we can deduce the understanding of what Norberg-Schulz (1971) called cognitive space. This space refers to the physical world and its representations,

relating to the relationships within this space.

When we consider children's cognitive development and their experience of spaces in relation to each other we can see a clear link between them. One describes the sequential nature of cognitive development, the other the related development of spatial conceptualization. As their spatial conceptualization develops, children are able to experience the different layers of spaces as defined by Norberg-Schulz (1971). These differences in the perception of space greatly impacts the type of environments that is required to meet children's needs. This can be aptly explained through Maslow (1973) hierarchy of needs, who identifies basic deficiency needs, and more satisfactory growth and being needs. Adolescents in this early formal operational stage of development require their physiological and safety needs to be met in the primitive space that they can perceive. As well as their belonging and love and esteem needs in the perceptual space and cognitive and aesthetic needs in the existential space. On top of that, they require self-actualization needs to be met in the cognitive space they perceive. This translated to the ability to realize their own potential, as well as the ability to discover and express themselves and their own creativity.


In this fourth stage of development, we can conclude that the predominantly activity-oriented behaviour of children have transformed into more well-round activity-, feeling-, and thought-oriented behaviours of adolescents. They are able to think logically inside their own mind, without

physical representations, and introspectively think about an infinite number of possibilities. This causes adolescents to develop a clear sense of self, which they strive to express. Environments for adolescents of this age should accommodate those activities, offering places where they can sit, think and talk, alone or with friends. Furthermore, they require environments that offer the possibility to develop their own agency separate from parents or other adult caregivers. Moreover, following the combination of children's development and Maslow's (1973) hierarchy of needs, we can hypothesize that, on top of the requirements of primitive, perceptual and existential space, these environments should also meet the self-actualization needs of cognitive space. This means that these environments should allow adolescents to realize their own potential, as well as discover and express themselves and their own creativity.

05

PARTICIPATING (16+ YEARS)

[META-PATTERN]

 [L] Adult-Child Spaces

[J] Outdoor Education

[O] Elements of Risk

[O] Individual Adventures

[O] Object Ambiguity

[O] Cognitive Activities


[O] Physical Activities


[O] Mobility Level


As adolescents become older, they increasingly require the ability to comfortably use, experience, and participate in the wide range of environments that support (young) adults in terms of amenities, leisure and (social) interaction.



Flickr; Nadia Seccareccia © Older teens participate in urban life similar to adults.

 *Context* - After puberty (ages 16+), teenagers' cognitive development (particularly their perceptual development) starts to approach that of adults, maturing their use of public spaces and making it comparable to that of young adults.

 *Phenomena* - The late formal operational stage of development starts roughly after puberty and continues throughout the rest of someone's life. In this stage, people keep expanding upon their own operational thinking though the extend to which they attain abstract thought and scientific reasoning differs. Their behaviour becomes less focused on themselves and more focused on others and their own participation in society.

 *Recommendation* - Spaces that allow all types of people from all ages to participate stimulate the social, cultural, and cognitive development of children and adolescents (Gamez & Watson, 2006). As children become older, they become increasingly interested in becoming a part of the larger society. It marks them as individuals and allows them the same freedom of choice in their lives as adults have (Spencer & Blades, 2005). However, adults do not always appreciate children and adolescents using the same public spaces that they do (Valentine, 1996). For shared spaces to work, it is necessary to design environments that children, adolescents, and adults will be able to participate in while feeling comfortable using (and sharing) it (Percy-Smith, 2006).



Scientific Clarification - Piaget (1950) describes the fourth stage of development as the formal operational stage, which starts around the age of eleven and continues throughout the rest of someone's life. However, a clear distinction can be made between the early stages of the formal operational stage and the later ones. Here, we consider the late formal operational stage to start after puberty and to continue throughout adulthood. In this stage, adolescents (and adults) continue to develop their cognitive abilities, allowing them to be increasingly able to consider abstract concepts and reflect on their own cognitive abilities. Some of the largest changes in thinking involve logical and scientific reasoning (Moshman, 1998), which is applying the most abstract way of thinking to the most challenging problems. However, Piaget (1950) noted that the extent to which this stage develops differs per individual. This means that not everyone obtains full formal operational cognitive abilities. Moreover, as a result of the aforementioned introspection, knowledge and beliefs do not remain static, but continue to change throughout someone's life.

In this fourth formal operational stage of development, Piaget and Inhelder (1967) hypothesized that children's experience of space is already complete following the acquisition of topological, projective, and Euclidian concepts of space. However, Norberg-Schulz (1971) describes two additional categorizations of space that roughly coincide with the early and late formal operational stage of development. In this late formal operational stage, we can deduce the understanding of

what Norberg-Schulz (1971) called abstract space. This space describes pure relationships, separate from any perceptual or sensory motoric skills. Norberg-Schulz (1971) theorized individuals to be able to conceptualize other concepts of, and objects in, space when perceiving this abstract space.

When we consider children's cognitive development and their experience of spaces in relation to each other we can see a clear link between them. One describes the sequential nature of cognitive development, the other the related development of spatial conceptualization. As their spatial conceptualization develops, children are able to experience the different layers of spaces as defined by Norberg-Schulz (1971). These differences in the perception of space greatly impacts the type of environments that is required to meet children's needs. This can be aptly explained through Maslow (1973) hierarchy of needs, who identifies basic deficiency needs, and more satisfactory growth and being needs. Adolescents (and adults) in their late formal operational stage of development require their physiological and safety needs to be met in the primitive space that they can perceive. As well as their belonging and love and esteem needs in the perceptual space, cognitive and aesthetic needs in the existential space, and self-actualization in the cognitive space. Furthermore, they require transcendence needs to be met, which can be explained as the need to connect to others and, sometimes, to help them find their self-fulfillment and find their own potential. It must be said however that transcendence needs are often referred

to as "spiritual" needs and do not manifest in everyone (Maslow, 1973). This is similar to the individual differences that exist in the extent to which people attain abstract thinking and reasoning abilities.

In the later stages of the fourth stage of development, we can conclude that the behaviour of adolescents (and adults) is still a mix of activity-, feeling-, and thought-oriented behaviours. While some people may obtain the ability to think in increasingly abstract concepts, this is not true for everyone. However, what does apply to everyone is the fact that knowledge and beliefs do not remain static, but keep changing. Whereas the need to express themselves and their own creativity becomes less overt after puberty, adolescents (and adults) still require those opportunities for introspection, social interactions and leisure activities. These activities do however become increasingly less self-centered and start involving other people such as (younger) siblings and friends, and, eventually, maybe even children of their own. Furthermore, following the combination of children's development and Maslow's (1973) hierarchy of needs, we can hypothesize that, on top of the requirements of primitive, perceptual, existential and cognitive space, these environments should also meet the transcendence needs of abstract space. This can be explained as the need to connect to others and, sometimes, to help them find their self-fulfillment and find their own potential. This requires mixed-use environments, focused on participation, that integrate different types of people and different types of activities into one.

06

C OLOURS



[H] Sensing

[C] Playable Streets

[O] Materials

[O] Nature

[O] Artificial Environments

[O] Natural Environments

[O] Gender Design

[O] Adult-Child Spaces

In designing spaces for children, it is important to think of colour as an integral part of the design, both in its artificial and its natural form.




Context - Spaces should be designed so they offer safe and comfortable environments that offer different sights, sounds, smells and touches that children are able to experience through their primary senses.



Forces - Colour influences children's preferences for outdoor (and indoor) spaces in terms of attractivity.



Flickr; Patrick © Colours can make the environment more attractive for children.

 *Clarification* - Colour and its effects have been extensively studied from a psychological point of view. One of the early researchers, Birren (1961) attributed different behaviours, moods and emotions to different colours. Building in large part upon his work, Mahnke & Mahnke (1987) voiced the importance of colour and light (as the carrier for colour) in man-made environments. While the field of “colour psychology” has seen a lot of study throughout the past decades, much of the research on the psychology of colour is inconsistent and inconclusive. However, in spite of this, colour still remains an important aspect of the urban environment that can elicit attention and motivate people to either slow down or speed up (Nasar, 1997).

In recent years, the use of colour in architecture and urban design has been approached not from a psychological but from an aesthetical point of view. Colourists underline the importance of colour in clarifying and defining space, form and structure (Minah, 2008). Furthermore, methods have been created that can help designers use colour as another aspect of a design from concept to development (Linton, 2002). While the effects and use of colours in child environments have not seen extensive studying, colour does appear to be an important factor in children’s preferences for outdoor spaces in terms of attractivity (Acar, 2003). Furthermore, colour can support educational children’s environments (Francis, 1997), as well as assist them with wayfinding in larger areas (Read, 2003).

07

MATERIALS



[H] Sensing

[C] Playable Streets

[O] Colours

[O] Nature

[O] Parental Supervision

[O] Artificial Environments

[O] Natural Environments

[O] Adult-Child Spaces

Materialization is an important factor in designing children's environment through its different properties; colour, texture, hardness, diversity, complexity and richness.



Context - Spaces should be designed so they offer safe and comfortable environments that offer different sights, sounds, smells and touches that children are able to experience through their primary senses.



Forces - Different materials influence children's preferences for outdoor (and indoor) spaces in terms of attractivity. Furthermore, through their properties, materials can promote either safety or risk, as well as diversity, complexity and richness.



Flickr; AJ Brusteijn © Varied materialization offers diversity in design and use.

□ *Clarification* - Materialization is one of the dimension of urban design that is an important aspect of its visual integration (Carmen, Tiesdell, Heath & Oc, 2003). Next to providing colour and texture, materials also affect weathering, detailing and visual interest. Different materialization can be used to make the differences between various parts of the built environment bigger or smaller and thereby define the relationship between these different parts (Carmen et. al., 2003).

When we consider children's environments, materials are similar to colours, in the sense that they influence children's preferences for outdoor spaces (Acar,

2003). Materialization also plays an important factor in determining the safety or risk in urban spaces as a result of their properties, that is, by their softness or hardness (Jones, 1997). Furthermore, materials also influence the complexity, diversity and richness found in an environment. Natural materials offer more complexity, diversity and richness than artificial materials, since they can be evaluated in different ways and thus promote children's creativity (Acar, 2003). It is therefore unsurprising that children appear to prefer recycled, low-cost materials with natural and green component in their environments (Francis & Lorenzo, 2008) that they can manipulate and use to fabricate other things (Shackell et. al., 2008).

08

NATURE



[H] Sensing

[S] Object Ambiguity

[C] Natural Environments

[O] Colours

[O] Materials

[O] Physical Activities

[O] Cognitive Activities

[O] Adult-Child Spaces

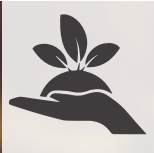
Incorporating nature, and natural elements, in children's environments will offer them a rich variety of sensory experiences, as well as diverse and rich possibilities for interactions.




Context - Spaces should be designed so they offer safe and comfortable environments that offer different sights, sounds, smells and touches that children are able to experience through their primary senses.



Forces - Children require interaction with nature and access to natural environments for a healthy cognitive and affective development. Furthermore, nature supports diverse and complex environments that enable many types of activities while simultaneously offering a large variety of sensory experiences.



Flickr; Adriana Varela © Nature is always changing and offers sensory diversity.

 *Clarification* - The use and integration of nature in urban design has been extensively reviewed and discussed in recent decades (Kaplan, 1983, 1984; Jackson, 2003; Beatley, 2011) following research supporting that natural environments have a positive effect on health and general well-being by improving blood pressure and self-esteem (Pretty et al, 2005), decreasing symptoms of attention deficits disorder (Kuo & Taylor, 2004), improve community resilience (Moore, Townsend, Pryor, Brown & St. Leger. 2006), restore cognitive attention (Kaplan & Kaplan, 2002), support environmentally conscious behaviours (Hartig, Kaiser & Bowler, 2011) and stimulating stress recovery (Ulrich, Simons, Losito, Fiorito, Miles & Zelson, 1991). Moreover, for children, nature and natural

play areas play an important role in the development of their cognitive and affective systems (Pyle, 2002; Derr & Midbier, 2008).

Children's need for nature have been aptly described by Louv in his popular "Last Child in the Woods" (2008). In this book, he argues that modern children (as well as adults) suffer from a nature deficit disorder, which impedes their healthy development. It is therefore unsurprising that, in designing for children, a large emphasis is placed on designing with nature and natural materials, which furthermore offers diverse and complex environments and a variety of sensory experiences (Acar, 2003; Shackell et. al., 2008)

09

PARENTAL SUPERVISION



[H] Discovering

[I] Sensing

[J] Individual Adventures

[O] Playable Streets

[O] Physical Activities

[O] Gender Design

[O] Adult-Child Spaces

In designing spaces for children, it is important to support parental supervision by ensuring that they can easily see and hear their children from a comfortable position, as well as consider parents concerns about safe spaces.




Context - Spaces should be designed so they offer safe and comfortable environments that offer different sights, sounds, smells and touches that children are able to experience through their primary senses. Moreover, it is important to provide children with an environment that engages and challenges them to discover all it has to offers, alone or with peers or caregivers, in a way that allows them to feel accomplished about their actions.



Forces - Parents concerns about the safety of different public spaces, as well as their ideas about the competence of their child, influences where children are allowed to go and whether this is alone or supervised.



Flickr; Vegan Butterfly © Adults require places from where to supervise children.

 *Clarification* - There are multiple ways in which parents supervise and regulate the activities of their children. Infants, toddlers and young children are continuously supervised and regulated in their activities by their parents as a natural extension of their inability to navigate the world alone (Muñoz, 2009). As children become older, they are increasingly able to move and play independently from their parents. However, parental concerns heavily influence the extent and the range of this independence. Parents' ideas about neighbourhood safety (Molnar, Gortmaker, Bull & Buka, 2004), social dangers (Blakely, 1994) and their own child's competence (Valentine, 2002) affect where children are allowed to go either alone or supervised.

In designing spaces that will be used by children, it is thus paramount that we consider these parental concerns. Children are more likely to visit public spaces such as parks and playgrounds (either alone or supervised) that parents consider to be safe, both physically and socially (Veitch, Bagley, Ball & Salmon, 2006). This means that they offer physical environments that offer soft surfaces, good visibility and are well maintained. Moreover, parents value social factors such as public facilities, connections to the surrounding urban fabric and the presence of other users. Furthermore, in designing these places, it is important to include opportunities for parents to sit comfortably in a location from where they can easily see and hear their children (Acar, 2003).

P LAYABLE STREETS



[H] Adult-Child Spaces

[C] Colours

[C] Materials

[O] Parental Supervision

[O] Object Ambiguity

[O] Physical Activities

[O] Cognitive Activities

Streets should be made safe and accessible for children so that they can comfortably use them for (play) activities.



Context - Spaces should be designed so they offer safe and comfortable environments that offer different sights, sounds, smells and touches that children are able to experience through their primary senses. Moreover, it is important to provide children with an environment that engages and challenges them to discover all it has to offer, alone or with peers or caregivers, in a way that allows them to feel accomplished about their actions.



Forces - Children enjoy spaces that offer spontaneous play opportunities even though they may not be designed for them, such as streets, street corners and abandoned buildings or construction sites.



Flickr; Di's Free Range Photos © Streets should be designed for children to play.

□ *Clarification* - It is a fact that children oftentimes create places for themselves that are not, by adults' standards, spaces for children (Rasmussen, 2004). Children's creativity and resourcefulness allows them to draw stimulation from all surroundings, which, combined with their drive for play, often places them in child unfriendly places such as streets, street corners, abandoned lots or construction sites (Bartlett, 1999). Moreover, it appears that children tend to even prefer these spaces that offer spontaneous play opportunities over more structured play environments (Bartlett, 1999). However, most of these places are not designed for children, making them unsafe for their use (Appleyard, 2005) and restricted by parents (Steampfly, 2009).

Therefore, it is important to make streets accessible for children to play in without removing the opportunities for spontaneous play that they seek out. In doing so, not only will streets become safer, but they will furthermore support a more holistic view of their community (Appleyard, 2005). In designing these spaces several factors are important, namely, the presence, frequency and speed of motorized traffic, the visibility and lighting and the opportunities for safe crossings (Timperio, Ball, Salmon, Roberts, Giles-Corti, Simmons, Baur & Crawford, 2006). In making streets more liveable for children, it is important to provide adequate sitting, walking and bicycling facilities that allow them to explore, connect and socialize (Appleyard, 2005).

ELEMENTS OF RISK



[H] Discovering
[H] Exploring

[C] Individual Adventures

[O] Parental Supervision
[O] Individual Adventures
[O] Natural Environments
[O] Artificial Environments

It is important to incorporate elements of risk in the environments of young people, irrelevant of their age or gender and the type of space.




Context - It is important to provide children with an environment that engages and challenges them to discover all it has to offers, alone or with peers or caregivers, in a way that allows them to feel accomplished about their actions.



Forces - The opportunity to engage in activities that are challenging and even offer an element of risk is a vital element of children's development and, furthermore, engages them in the most active types of play, both physically and cognitively.



Flickr; Matthew King © Children require spaces that offer challenges and risk.

 *Clarification* - An extensively documented theme in the literature on the developmental effects of children's play is the benefit of risk and risk-taking (Gleave, 2008). The ability to engage in challenging and risk-taking play is reasoned to provide children with important abilities to cope with the unpredictable nature of our world in adulthood (Gill, 2007). Furthermore, risk-taking is considered to benefit the development of confidence and an "I can do"-attitude (Dweck, 2000), as well as other desirable personality traits such as creativity (Ball, 2002). Some researchers even claim that shielding children from challenge and risk is "deliberately disabling and ethically unacceptable" (Hughes, 2001, p.53).

It is therefore important to incorporate elements of risk in the environments of young people, irrelevant of their age and gender or the type of space (Jones, 1997; Acar, 2003; Steampfli, 2009). This can be done through the inclusion of natural elements (Shackell et. al., 2008), which offer a greater variety of relatively safe risk-taking opportunities (e.g. climbing a tree, sliding down a hill). It should be mentioned however that it is necessary to provide a balance between opportunities for risk and keeping children reasonably safe from harm (Moorcock, 1998). This can be done by designing environments to mitigate the effects of risk-taken gone awry through, for instance, materialization (e.g. soft grass, sand, or even water beneath climbing structures).

INDIVIDUAL ADVENTURES



[C] Elements of Risk

[J] Individual Adventures

[O] Exploring

[O] Nature

[O] Natural Environments

[O] Physical Activities

Young people benefit from being able to distance themselves from parents and other adult caregivers, allowing them to take responsibility for themselves.




Context - It is important to provide children with an environment that engages and challenges them to discover all it has to offer, alone or with peers or caregivers, in a way that allows them to feel accomplished about their actions. Moreover, adolescents require spaces separate from adults that allow them to express themselves and their own creativity in order to realize their own potential.



Forces - Granting children autonomy in outdoor environments is a great way for children to develop their own independence by allowing them to take responsibility for themselves.



Flickr; John White © Children require safe environments separate from adults.

 *Clarification* - The development of independence and being able to take care of one's self is an important part of growing up (Bowlby, 1956). Establishing independence starts around the age of two, once toddler's start to realize that they are their own person (Hughes, 2010). For them, autonomy revolves around being able to do things themselves, such as putting on a jacket or climbing up a playground structure. As children become older, the level of autonomy they require becomes increasingly larger. It is therefore important to provide children with opportunities that allow them to experience autonomy and independence in outdoor environments (Stevenson, 2007).

For younger children, this can simply be safe (play) environments that they are able to navigate themselves, without the need for parents (Shackel et. al, 2007). Examples are objects that allow them to temporarily distance themselves from parents, such as hollow objects they can crawl through or structures they can climb on or hide behind. Older children require environments that are increasingly separate from parents where they can meet friends (Acar, 2003). Research shows that parents are more likely to grant their children this autonomy when they live in green areas, have a strong sense of community and more neighbourhood relations (Prezza, Alparone, Cristallo & Luigi, 2005).

OBJECT AMBIGUITY

[S] Cognitive Activities

[I] Natural Environments

[J] Artificial Environments


[O] Discovering


[O] Nature

[O] Physical Activities

[O] Adult-Child Spaces


Children benefit from different types of objects; ones that offer singular interactions and ones that offer a wide variety of different interactions.

 *Context* - It is important to provide children with an environment that engages and challenges them to discover all it has to offer, alone or with peers or caregivers, in a way that allows them to feel accomplished about their actions. Furthermore, environments for children should be aesthetically designed and include ambiguity, inviting them to explore its potential and engage their mental and physical faculties.

 *Forces* - Different types of objects offer different interactions. Open objects support a wide range of diverse interactions. In contrast, closed objects support only singular interactions. The higher the ambiguity of an object, the more it stimulates cognitive activities.



Flickr; Becky Frances © Ambiguous objects allow them to be used idifferently.

 *Clarification* - Objects in children's environments can either be described as open objects or as closed objects (Moore, 1987). Open objects are objects that support a wide range of diverse interactions (e.g. a small stone ledge can be used for sitting, jumping, walking, hiding, balancing). Closed objects, on the other hand, support only singular interactions (e.g. a swing can only be used to swing, or to sit on). Open objects support open-ended play, which allows children to express themselves by stimulating free and creative play (Frost, Brown, Sutterby & Thornton, 2004). Open objects and open-play therefore stimulate more cognitive activities than closed objects do.

Children benefit from having access to both open and closed objects. Closed objects create a more simple environment, whereas open objects create a more complex environment (Jones, 1997). As children become older, they require increasingly complex environments as stimulation. However, this does not mean that they need open objects exclusively. Swinging, for instance, is an extremely well-liked physical activity for both boys and girls of all ages (Acar, 2003). Therefore, in creating children's environments, it is important to include objects of varying ambiguity (Shackell et. al., 2008). This can be done in accordance with the context of the environments; ambiguous objects are easier to blend into mixed spaces that attract people from all ages.

A ARTIFICIAL ENVIRONMENTS

[H] Discovering

[I] Exploring

[J] Object Ambiguity

[O] Colours


[O] Materials


[O] Parental Supervision

[O] Playable Streets

[O] Gender Design

In creating artificial environments for children and adolescents, it is important to consider its affordances and design spaces that support physical and/or cognitive activities that are challenging and stimulating.

 *Context* - It is important to provide children with an environment that engages and challenges them to discover all it has to offers, alone or with peers or caregivers, in a way that allows them to feel accomplished about their actions. Furthermore, environments for children should be aesthetically designed and include ambiguity, inviting them to explore its potential and engage their mental and physical faculties.

 *Forces* - Environments that are created artificially can offer a wide variety of stimuli for children and adolescents and, furthermore, can support very specific activities.



Flickr; WeyQing © Artificial environments should be engaging and stimulating.

□ *Clarification* - Most environments in today's urban environment are artificial environments. While there is nothing wrong with artificial environments, research into children's use and experience of these places suggests that they lack stimulation (Steampfly, 2009). Environments created by adults over-use closed objects that focus on safety first, whereas children benefit from a diverse, stimulating, environment (Shackell et. A., 2008). There is a large body of literature advocating the use of more natural environments that reintroduce a sense of adventure into children's outdoor environments (Acar, 2003).

However, it may not always be possible or desirable to

create natural environments. Therefore, it is important to understand the positive properties of natural environments so we can translate them into elements that can be integrated into artificial environments. A good way of approaching the issue is through the concept of affordances (Heft, 1988). By judging the types of activities an environment affords, we can start designing new environments and evaluating old ones. To make artificial environments as beneficial for children as natural environments, they need to afford physical and cognitive activities that are challenging and stimulating (Shackel et. al., 2008). This can be achieved in numerous ways, for example through use of ambiguous objects, natural elements and colour.

NATURAL ENVIRONMENTS

[H] Exploring

[I] Discovering

[S] Object Ambiguity


[C] Nature


[O] Physical Activities

[O] Cognitive Activities

[O] Gender Design

It is important for children and adolescents to have access to natural environments since they increase their physical and psychological well-being while offering a diverse range of both physical and cognitive activities.

 *Context* - It is important to provide children with an environment that engages and challenges them to discover all it has to offer, alone or with peers or caregivers, in a way that allows them to feel accomplished about their actions. Furthermore, environments for children should be aesthetically designed and include ambiguity, inviting them to explore its potential and engage their mental and physical faculties.

 *Forces* - Natural environments promote health, are considered exciting and offer a diverse range of both highly physical, as well as cognitive activities.



Flickr; Travis Swan © Natural environments promote health and offer varied uses.

□ *Clarification* - Natural environments have a positive effect on health and general well-being by improving blood pressure and self-esteem (Pretty et. al., 2005), decreasing symptoms of attention deficits disorder (Kuo & Taylor, 2004), improving community resilience (Moore et. al., 2006), restoring cognitive attention (Kaplan & Kaplan, 2002), supporting environmentally conscious behaviour (Hartig, Kaiser & Bowler, 2011) and stimulating stress recovery (Ulrich, et. al., 1991). Louv (2008) argues that modern children (as well as adults) in our urban environment suffer from a nature deficit disorder, which impedes their healthy development.

It is therefore unsurprising that, in designing for

children, a large emphasis is placed on designing natural environments (Acar, 2003; Shackell et. al., 2008; Steampfli, 2009). Natural environments offer adventures outdoor play, which offers highly physical play that enhances children's motor functions (Fjørtoft, 2004). Natural environments are also highly ambiguous, which support free and creative play and thus stimulates cognitive activities (Acar, 2003). Furthermore, these environments offer a lot of elements that can be modified by children themselves, such as branches to make a hut or flowers to string together. Lastly, natural environment offer a lot of opportunities for "safe risk-taking", for instance through tree climbing, sliding down a hill, or crossing a stream (Shackell, et. al., 2008).

P HYSICAL ACTIVITIES

[I] Gender Design

[C] Mobility Level


[O] Playable Streets


[O] Elements of Risk

[O] Artificial Environments

[O] Natural Environments

It is important to support and facilitate physical activities in spaces for young people of all ages.

 *Context* - It is important to provide children with an environment that engages and challenges them to discover all it has to offer, alone or with peers or caregivers, in a way that allows them to feel accomplished about their actions. Furthermore, environments for children should be aesthetically designed and include ambiguity, inviting them to explore its potential and engage their mental and physical faculties.

 *Forces* - Physical activity promotes the development of motor skills and provides different ways of interacting with the environment. Moreover, physical activities in outdoor environments have both physical and psychological health benefits.



Flickr; Adriana Varela © Children require space for physical activities.

Clarification - Physical activities are those that require the child to perform a physical action and promote the development of motor skills (Williams, Pfeiffer, O'Neill, Bowda, McIver, Brown & Pate, 2008). Physical activities can also be used to promote interaction with the environment or with other youth or adults (Frank, Engelke & Schmid, 2003). Moreover, physical activities have a positive influence on young people's health (e.g. in reducing obesity, cardiovascular disease and skeletal health; Biddle, Gorely, Stensel, 2004), and physical activities in outdoor environments have additional psychological benefits (e.g. increased feeling of well-being, reduced stress levels and reduced sleep and gastro-intestinal problems; Biddle, Gorely & Stensel, 2004).

Aspects of the physical environment play a crucial role in promoting physical activity (Jackson, 2003). In designing environments for children, it is important to focus on designing recreational infrastructure (Davidson, 2006). That means creating physical and visual access to open public spaces such as parks and playgrounds. These physical connections should extend into the rest of the neighbourhood through the design of sidewalks and bicycle lanes (Badland & Schofield, 2005; Faulkner, Buliung, Flora & Fusco, 2009), as well as opportunities for children to move independently in a safe neighbourhood (Carver, Timperio & Crawford, 2008). Furthermore, (play) objects that engage children to use a motor action can further stimulate physical activities (Shackell et al., 2008).

C

OGNITIVE ACTIVITIES

[H] Cultivating

[I] Object Ambiguity

[I] Gender Design


[C] Mobility Level


[O] Nature

[O] Natural Environments

[O] Outdoor Education


In designing environments for young people it is important to offer cognitive challenges for different age groups (e.g. naming objects, creating puzzles and free, creative, play).

 *Context* - It is important to provide children with an environment that engages and challenges them to discover all it has to offers, alone or with peers or caregivers, in a way that allows them to feel accomplished about their actions. Furthermore, environments for children should be aesthetically designed and include ambiguity, inviting them to explore its potential and engage their mental and physical faculties.

 *Forces* - Young people require different types of activities throughout their development. Cognitive activities promote the development of mental abilities and promote different ways of interacting with the environment.



Flickr; Moaan © Children need spaces that offer opportunities for cognitive play.

 *Clarification* - Cognitive activities are activities that engage children's and youth's mental faculties and are crucial throughout their entire development. The physical context of cognitive activities has mainly been a focus of studies in child care centers (Moore, 1987) or schoolgrounds (Malone & Tranter, 2003). However, in spite of the fact that cognitive activities are mainly associated with such "learning environments", there are ways in which the design of the urban environment can support cognitive activities. This is mainly achieved through play, which is an essential part of cognitive development (Acar, 2003; Shackell et. al., 2008). However, simply including children and youth in adult design will also promote their cognitive development (Gamez & Watson, 2006).


Jones (1997) classified nine specific design elements that are essential in creating outdoor environments for children that support their intellectual, social, cognitive and physical development. Of these nine elements, we can identify four that have a pronounced cognitive component, namely; active-passive, natural-people/built, permanence-change, simple-complex. Changing urban designs which offer complex environments that actively engage children and youth provide the most cognitive stimulation. While both natural and people/built environments can provide cognitive activities, research indicates that natural environments offer more cognitive stimulation and development (Pyle, 2002; Derr & Midbier, 2007).


M OBILITY LEVEL

[C] Physical Activities
[C] Cognitive Activities

[O] Playable Streets
[O] Object Ambiguity
[O] Artificial Environments
[O] Natural Environments
[O] Gender Design


Environments for young people should support different levels of mobility, with places for more active, high mobility activities, as well as spaces for more passive, low mobility activities.

 *Context* - It is important to provide children with an environment that engages and challenges them to discover all it has to offer, alone or with peers or caregivers, in a way that allows them to feel accomplished about their actions. Furthermore, environments for children should be aesthetically designed and include ambiguity, inviting them to explore its potential and engage their mental and physical faculties.

 *Forces* - Spaces that are designed to support different mobility levels are associated with different types of physical and cognitive activities.



Flickr; Luizzitos © Spaces need to be able to offer activities of varied mobility.

 *Clarification* - Different environments invite young people to use them in different ways. Traditional public spaces designed for children are overrepresented by schoolyards, playgrounds, sports field and parks (Steampfli, 2009). All of these spaces support mainly high mobility levels; inviting young people to play, run around and make up games, thereby supporting interactions for young people that exclusively focuses on high mobility activities. While these environments are a necessity in child development, it is just as important to support low mobility activities. These are activities such as creative play (Tai, et. al., 2006), playing with elements of the outdoor space that the child can control such as building a hut from branches or playing in the sand (Churchman, 2003),

or simply places for children to retreat from adults, get together and “chill” (Tai et. al., 2003).

In supporting activities of a varied mobility, public spaces must also offer places for children to sit, relax, and interact with each other without running around. This does not just include features that allow children to sit, but also allows them the space they need to engage in stationary play activities (e.g. colouring or playing with toys; Shackel et. al., 2008). These spaces should be separate from each other so that the young people using the high mobility environments do not hinder young people who make use of the low mobility environments (Jones, 1997).

GENDER DESIGN

[I] Cultivating

[S] Physical Activities

[S] Cognitive Activities


[O] Parental Supervision


[O] Artificial Environments

[O] Natural Environments

[O] Mobility Level

It is important to take the differences in activities girls and boys choose to participate in into account when designing environments for children.

 *Context* - It is important to provide children with an environment that engages and challenges them to discover all it has to offer, alone or with peers or caregivers, in a way that allows them to feel accomplished about their actions. Furthermore, environments for children should be aesthetically designed and include ambiguity, inviting them to explore its potential and engage their mental and physical faculties.

 *Forces* - There are both similarities and differences in the outdoor activities girls and boys choose to participate in. This difference is most notable in constructed playground, in natural playground boys and girls often choose the same types of activities.



Flickr; Slavik Tereboc © Boys and girls often choose different outdoor activities.

🗨️ *Clarification* - While we mostly speak of design for gender a-specific “young people”, there are some notable differences in the activities boys and girls choose to participate in (Kinzie & Joseph, 2008). This difference is most pronounced in constructed playgrounds or environments (e.g. schoolyards), in nature playground or natural environments (e.g. parks), boys and girls chose to participate in similar types of activities (Nabhan & Trimble, 1994; Änggård, 2011). In constructed playground or environments, however, girls are more likely to choose socially-driven activities such as games or make-believe scenario, or play equipment that promotes social interaction (Nabhan & Trimble, 1994). Moreover, they are more likely to choose sedentary activities such as playing

in the sandbox or games played on a plaid in the grass (Holmes & Procaccino, 2009). Boys, on the other hand, are more likely to participate in competitive activities on asphalt surfaces (Nabahn & Trimble, 2009). They also tend to sustain their active play for a longer period of time than girls do (Holmes & Procaccino, 2009).

When we design spaces for young people, it is thus important to take these differences into account. If we want to create spaces that are attractive to both boys and girls, it is important to support a diverse range of surfaces and urban design elements that support gender neutral, as well as gender-specific activities.

O UTDOOR EDUCATION

[H] Cultivating

[I] Adult-Child Spaces

[J] Participating


[O] Nature


[O] Parental Supervision

[O] Elements of Risk

[O] Natural Environments

Outdoor environments can provide meaningful educational experiences for children of all ages when they are designed to support intuitive learning.

 *Context* - Environments for children should be aesthetically designed and include ambiguity, inviting them to explore its potential and engage their mental and physical faculties. Furthermore, adolescents require spaces separate from adults that allow them to express themselves and their own creativity in order to realize their own potential.

 *Forces* - Outdoor learning has also been linked to social and educational benefits such as improved interpersonal skills and practical problem solving, as well as a better understanding of the relationship between people and their environment.



Flickr; Sally Anscombe © Outdoor environments can offer intuitive learning.

Clarification - In recent years, there has been a renewed focus on outdoor spaces as educational environments (Muñoz, 2009). Most of this research has focused on how to create more outdoor and nature-oriented learning in the school curriculum (Sobel, 2008), which has been confirmed to benefit learning through increasing attention, retention and problem solving (Spencer & Blades, 2005). However, intuitive learning experiences in outdoor spaces through their everyday use or play activities can also provide meaningful educational experiences (Spencer & Blades, 2005). Of these educational experiences, the development of environmentally conscious behaviour and attitudes is the most well documented (Simmons, 1994; White, 2004).

However, there are multiple other ways in which we can support outdoor education through urban design. By creating more natural spaces with pronounced landscape features, we can not only support environmental awareness (Moore & Cosco, 2000). Rather, dependent on the design, such environments can also teach children something about biology (through trees, plants, flowers and animals; Herrington & Studtmann, 1998) or nurturing (by taking care of animals or fruit or vegetable plants; Acar, 2003). Furthermore, by providing children with urban elements that they can manipulate, urban environments can also facilitate traits such as creativity and self-expression (Suransky, 1982).

A

DULT-CHILD SPACES

[H] Participating

[L] Playable Streets


[S] Outdoor Education


[O] Materials

[O] Parental Supervision

[O] Object Ambiguity


An effort should be made to design adult-child spaces that are able to support the activities of young people, as well as the activities of adults.

 *Context* - As adolescents become older, they increasingly require to be able to comfortably use, experience, and participate in the wide range of environments that are support (young) adults in terms of amenities, leisure and (social) interaction.

 *Forces* - Young people appreciate being a part of the larger socio-cultural context in their environment. Adults, on the other hand, tend to negatively evaluate environments that include these young people.



Flickr; Marthinus Duckitt © Combining adult and child spaces creates diversity.

 *Clarification* - As children become older, they are increasingly interested in participating in society; going to and using the places adults do and thereby having the same freedom of choice as adults (Spencer & Blades, 2005). Younger children also benefit from sharing spaces with adults and older children as it stimulated their social, cultural and cognitive development (Gamez & Watson, 2006). The problem with shared adult-child spaces however, is that adults tend to negatively evaluate environments that include children and adolescents because of issues like being too loud, or using the space inappropriately (Valentine, 1996). Yet successful urban spaces for children do appear to be the ones that support mixed-uses and are close to other adult facilities

(Churchman, 2003; Veitch et. al., 2008).

The challenge in designing urban spaces that meet the requirements of both adults and children lies in being able to offer a widely diverse space in which people of all ages feel like they can participate (Percy-Smith, 2006). Separating different uses and user-groups is one way in which potential negative effects of the shared use can be negated (Acar, 2003). Furthermore, for shared adult-child spaces to become successful, it will primarily be important to focus on allowing children and adolescents to participate while showing adults that this participation does not necessarily have to interfere with their use of the space (Elsley, 2004).

R EFERENCES

- Acar, H. (2003). Landscape Design for Children and Their Environments in Urban Context. In M. Özyavuz, M. (Ed.). *Advances in Landscape Architecture* (pp. 291-324). Vienna: InTech.
- Alexander, C., Ishikawa, S. & Silverstein, M. (1977). *A Pattern Language*. New York: Oxford University Press.
- Änggård, E. (2011). Children's Gendered and Non-Gendered Play in Natural Spaces. *Children, Youth, Environments*, 21, 5-33.
- Appleyard, B. S. (2005). *Liveable Streets for Schoolchildren*. Retrieved from http://www.activeliving.org/files/Livable_streets_for_schoolchildren.pdf
- Badland, H. & Schofield, G. (2005). Transport, Urban Design, and Physical Activity. *Transport and Environment*, 10, 177-196.
- Ball, D. (2002). *Playgrounds: Risks, Benefits and Choices*. London: HSE Books.
- Bartlett, S. (1999). Children's Experience of the Physical Environment in Poor Urban Settlements and the Implications for Policy, Planning and Practise. *Environment and Urbanization*, 11, 63-74.
- Beatley, T. (2011). *Biophilic Cities: Integrating Nature Into Urban Design and Planning*. Washington, DC: Island Press.
- Bell, S. (2008). Scale in Children's Experience With the Environment. In C. Spencer & M. Blades. (Eds.). *Children and Their Environments*. Cambridge: Cambridge University Press.
- Biddle, J. H., Gorely, T. & Stensel, D. J. (2004). Health-Enhancing Physical Activity and Sedentary Behaviour in Children and Adolescents. *Journal of Sports Sciences*, 22, 679-701.
- Birren, F. (1961). *Color Psychology and Color Therapy*. New York: University Books, Inc.
- Bixler, R. D., Floyd, M. F. & Hammit, W. E. (2002). Environmental Socialization: Quantitative Tests of the Childhood Play Hypothesis. *Environment and*

- Behavior*, 34, 795-818.
- Blakely, K. S. (1994). Parents' Conceptions of Social Dangers to Children in the Urban Environment. *Children's Environments*, 11, 20-35.
- Bowlby, J. (1956). The Growth of Independence In the Young Child. *Royal Society of Health Journal*, 76, 587-591.
- Carmona, M., Tiesdell, S., Heath, T. & Oc, T. (2003). *Public Places – Urban Spaces*. Oxford: Routledge.
- Carver, A., Timperio, A. & Crawford, D. (2008). Playing It Safe: The Influence of Neighbourhood Safety on Children's Physical Activity. *Health & Place*, 14, 217-227.
- Churchman, A. (2003). Is There A Place For Children In the City? *Journal of Urban Design*, 8, 99-111.
- Davidson, K. K. (2006). *Do Attributes in the Physical Environment Influence Children's Physical Activity?* Retrieved from <http://www.ijbnpa.org/content/3/1/19>
- Derr, C. & Midbier, A. (2007). *Environment and Children: Passive Lessons From the Everyday Environment*. Oxford: Architectural Press.
- Dorst van, M. J. (2005). *Een duurzaam leefbare woonomgeving*. Unpublished doctoral dissertation, Technische Universiteit Delft, Delft.
- Dweck, C. S. (2000). *Self-Theories: Their Role in Motivation, Personality and Development*. Philadelphia: Psychology Press.
- Elsley, S. (2004). Children's Experience of Public Space. *Children & Society*, 18, 155-164.
- Faulkner, G. E. J., Buliung, R. N., Flora, P. K. & Fusco, C. (2009). Active School Transport, Physical Activity Levels and Body Weight of Children and Youth. *Preventive Medicine*, 48, 3-8.
- Fjørtoft, I. (2004). Landscape As Playscape. *Children, Youth, Environments*, 14, 21-44.
- Francis, C. (1997). Particular Places: School Environments Over Time. In S. Styne (Ed.). *Landscapes for Learning*. New York: John Wiley & Sons, Inc.
- Francis, C. & Lorenzo, R. (2008). Seven Realms of Children's Participation. *Journal of Environmental Psychology*, 22, 157-169.
- Frank, L. D., Engelke, P. O. & Schmid, T. L. (2003). *Health and Community Design*. Washington, DC: Island Press.
- Frost, J. L., Brown, P. S., Sutterby, J. A. & Thornton, C. D. (2004). *The Developmental Benefits of Playgrounds*. Olney: Association for Childhood Education International.
- Gamez, C. G. & Watson, G. B. (2006). *Urban Design Approaches to Fostering the Participation of Children and Teenagers in their Everyday Environments*. Retrieved from http://eso.cnrs.fr/TELECHARGEMENTS/colloques/rennes_11_06/GOMEZGAMEZ.pdf
- Gibson, J. J. (1966). *The Senses Considered as Perceptual Systems*. Westport, Connecticut: Greenwood Press.
- Gill, T. (2007). *No Fear: Growing Up In a Risk Averse Society*. London: Calouste Gulbenkian Foundation.
- Gleave, J. (2008). *Risk and Play: A Literature Review*. Retrieved from http://www.springzaad.nl/litdocs/risk_and_play-a_literature_review.pdf
- Hartig, T., Kaiser, F. G. & Bowler, P. A. (2011). Psychological Restoration in Nature As a Positive Motivation for Ecological Behavior. *Environment and Behavior*, 33, 590-607.
- Heft, H. (1988). Affordances of Children's Environments. *Children's Environments Quarterly*, 5, 29-37.
- Herrington, S. & Studtmann, K. (1998). Landscape Interventions: New Directions for the Design of Children's Outdoor Play Environments. *Landscape and Urban Planning*, 42, 191-205.
- Holmes, R. M. & Procaccino, J. K. (2009). Preschool Children's Outdoor Play Area Preferences. *Early Child Development and Care*, 179, 1103-1112.
- Hughes, B. (2001). *Evolutionary Playwork and Reflective Analytic Practice*. London: Routledge.

- Hughes, F. P. (2010). *Children, Play, and Development*. Thousand Oaks: SAGE Publications, Inc.
- Jackson, L. E. (2003). The Relationship of Urban Design to Human Health and Condition. *Landscape and Urban Planning, 64*, 191-200.
- Jones, E. (1997). Basics. In S. Styne (Ed.). *Landscapes for Learning*. New York: John Wiley & Sons, Inc.
- Kaplan, R. (1983). The Role of Nature in the Urban Context. *Human Behavior and Environment, 6*, 127-161.
- Kaplan, R. (1984). Impact of Urban Nature. *Urban Ecology, 8*, 189-197.
- Kaplan, R. & Kaplan, R. (2002). *Experience of Nature: A Psychological Perspective*. Ann Arbor: Ulrich's.
- Kinzie, M. B. & Joseph, D. R. D. (2008). Gender Differences in Game Activity. *Educational Technology Research and Development, 56*, 643-663.
- Kuo, F. E. & Taylor, A. F. (2004). The Potential Natural Treatment for Attention Deficit/Hyperactivity Disorder. *American Journal of Public Health, 94*, 1580-1586.
- Linton, H. (2002). *Color in Architecture*. London: The McGraw-Hill Companies.
- Louv, R. (2008). *Last Child in the Woods*. New York: Workman Publishing.
- Lucas, R. & Romice, O. (2008). Representing Sensory Experience in Urban Design. *Design Principles and Practises, 2*, 83-94.
- Mahnke, F. H. & Mahnke, R. H. (1987). *Color and Light in Man-Made Environments*. New York: Van Nostrand Reinhold Company.
- Malnar, J. M. & Vodvarka, F. (2004). *Sensory Design*. Minneapolis: University of Minnesota Press.
- Malone, K. & Tranter, P. (2003). Children's Environmental Learning and the Use, Design, and Management of Schoolgrounds. *Children, Youth and Environments, 13*, 87-137.
- Maslow, A. H. (1971). *Farther Reaches of Human Nature*. New

- York: Penguin Arkana.
- Meszaros, G. & Doble, J. (1997). A Pattern Language for Pattern Writing. In R. C. Martin, D. Riehle, F. Buschmann. (Eds.). *Pattern Language of Program Design*. Reading: Addison, Wesley.
- Minah, G. (2008) Colour as Idea: The Conceptual Basis for Using Colour in Architecture and Urban Design. *Colour: Design & Creativity*, 3, 1-9.
- Molnar, B. E., Gortmaker, S. L., Bull, F. C. & Buka, S. L. (2004) Unsafe to Play? Neighborhood Disorder and Lack of Safety Predict Reduced Physical Activity Among Urban Children and Adolescents. *American Journal of Health Promotion*, 18, 378-386.
- Moorcock, K. (1998). *Swings and Roundabouts: The Danger of Safety in Outdoor Play Environments*. Sheffield: Sheffield Hallam University Press.
- Moore, G. T. (1987). The Physical Environment and Cognitive Development in Child-Care Centers. In C. S. Weinstein & T. G. David. *Spaces for Children* (pp. 41-72). New York: Springer.
- Moore, R. C. & Cosco, N. G. (2000). *Developing an Earth-Bound Culture Through Design of Childhood Habitats*. Paper for presentation at the International Conference on People, Land and Sustainability, Nottingham, UK.
- Moore, M., Townsend, M., Pryor, A., Brown, P. & St. Leger, L. (2006). Linking Human and Ecosystem Health. *EcoHealth Journal*, 3, 255-261.
- Moshman, D. (1998). Cognitive Development Beyond Childhood. In D. Kuhn & R. S. Siegler (Eds.). *Handbook of Child Psychology: Vol. 2 Cognition, Perception & Language*. New York: Wiley.
- Muñoz, S. A. (2009). *Children in the Outdoors*. Forres: Sustainable Development Research Centre.
- Nabhan, G. P. & Trimble, S. (1994). *The Geography of Childhood: Why Children Need Wild Places*. Boston: Beacon Press.
- Nasar, J. L. (1997). New Developments in Aesthetics for Urban Design. In G. T., Moore & R. W. Marans (Eds.). *Toward the Integration of Theory, Methods, Research and Utilization* (pp. 149-193). New York: Springer.
- Norberg-Schulz, C. (1971). *Existence, Space and Architecture*. London: Praeger Publishers.
- Percy-Smith, B. (2006). From Consultation to Social Learning in Community Participation with Young People. *Children, Youth and Environments*, 16, 153-179.
- Piaget, J. (1950). *The Principles of Genetic Epistemology*. New York: Basic Book.
- Piaget, J. & Inhelder, B. (1967). *The Child's Conceptualization of Space*. New York: WW Norton & Co.
- Pretty, J., Peacock, J., Sellens, M. & Griffin, M. (2005). The Mental and Physical Health Outcomes of Green Exercise. *International Journal of Environmental Health Research*, 15, 319-337.
- Prezza, M., Alparone, F. R., Cristallo, C. & Luigi, S. (2005). Parental Perception of Social Risk and of Positive Potentiality of Outdoor Autonomy for Children. *Journal of Environmental Psychology*, 25, 437-453.
- Pyle, R. M. (2002). Eden in a Vacant Lot: Special Places, Species and Kids in the Neighbourhood of Life. In P. H. Kahn & S. R. Kellert (Eds.). *Children and Nature* (pp. 305-327). London: The MIT Press.
- Rasmussen, K. (2004). Places for Children – Children's Places. *Childhood*, 11, 155-173.
- Read, M. A. (2003). Use of Color in Child Care Environments. *Early Childhood Education*, 30, 233-239.
- Shackell, A., Butler, N., Doyle, P. & Ball, D. (2008). *Design for Play*. Nottingham: DCSF Publications.
- Simmons, D. A. (1994). Urban Children's Preferences for Nature: Lessons for Environmental Education. *Children's Environments*, 11, 194-203.
- Sobel, D. (2008). *Place-Based Education: Connecting Classroom and Community*. Retrieved from <http://>

- www.antiochne.edu/wp-content/uploads/2012/08/pbexcerpt.pdf
- Spencer, C. & Blades, M. (2005). *Children and their Environments*. Cambridge: Cambridge University Press.
- Steampfli, M. B. (2009). Reintroducing Adventure Into Children's Outdoor Play Environments. *Environment and Behavior, 41*, 268-280.
- Stevenson, A. (2007). *What We Know About How Urban Design Affects Children and Young People*. Retrieved from <http://cph.co.nz/Files/Children-and-Urban-Design.pdf>
- Suransky, V. R. (1982). *The Erosion of Childhood*. Chicago: Chicago University Press.
- Tai, L., Hague, M. T., McLellan, G. K. & Knight, E. J. (2006). *Designing Outdoor Environments For Children*. London: The McGraw-Hill Companies.
- Thibaud, J. P. (2011). The Sensory Fabric of Urban Ambiances. *Senses and Society, 6*, 203-215.
- Timperio, A., Ball, K., Salmon, J., Roberts, R., Giles-Corti, B., Simmons, D., Baur, L. A. & Crawford, D. (2006). Personal, Family, Social and Environmental Correlates of Active Commuting to School. *American Journal of Preventive Medicine, 30*, 45-51.
- Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A. & Zelson, M. (1991). Stress Recovery During Exposure to Natural and Urban Environments. *Journal of Environmental Psychology, 11*, 201-230.
- Valentine, G. (2002). Children and Parents' Understandings of Kids' Competence to Negotiate Public Space Safely. *Antipode, 29*, 65-89.
- Veitch, J., Bagley, S., Ball, K. & Salmon, J. (2006). Where Do Children Play? *Health & Place, 12*, 383-393.
- White, R. (2004). *Young Children's Relationship with Nature*. Retrieved from <http://www.childnatureandyou.org/Young%20Children's%20Relationship%20with%20>

Nature-%20White.pdf

Williams, H. G., Pfeiffer, K. A., O'Neill, J. R., Dowda, M., McIver, K. L., Brown, W. H. & Pate, R. R. (2008). Motor Skill Performance and Physical Activity in Preschool Children. *Obesity*, 16, 1421-1426.